Universal Carbon Registry

PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: 13.6 MW Bundled Wind Power Project by Interocean

Version 1.1

Date 25/09/2023

First CoU Issuance Period: 10 years

Date: 01/01/2013 to 31/12/2022

Project Concept Note (PCN)
CARBON OFFSET UNIT (CoU) PROJECT

BASIC INFORMATION	
Title of the project activity	13.6 MW Bundled Wind Power Project by Interocean
Scale of the project activity	Small Scale
Completion date of the PCN	25/09/2023
Project participants	Interocean Shipping India Pvt Ltd
Host Party	India
Applied methodologies and standardized baselines	AMS-I.D. “Grid connected renewable electricity generation”, v18.0 Standardized Baseline: Not Applicable
Sectoral scopes	01 Energy industries (Renewable/Non-Renewable Sources)
Estimated amount of total GHG emission reductions	288,210 CoUs or 288,210 tCO_{2eq}

SECTION A. Description of project activity

A.1. Purpose and general description of Carbon offset Unit (CoU) project activity >>

The proposed project activity, "13.6 MW Bundled Wind Power Project by Interocean" is a bundled project involving operation of 10 Wind Turbine Generators (WTGs) in different states of India. The WTGs in the project activity are operational with continuous generation and supply of electricity using renewable source of energy, that is, wind and thus contributing to greenhouse gas emission reduction.

Purpose of the project activity:

The proposed activity has 10 WTGs in of different capacities in Tamil Nadu, Gujarat, Maharashtra and Rajasthan states of India which are operational and use wind to generate electricity. The purpose of the proposed project activity is to generate electricity with the help of clean and renewable source of energy, i.e., wind. The details of the WTGs in the proposed project activity are as follows:

WTG No.	Capacity (MW)	Location	Project Owners	Date of Commissioning
1	1.65	Tamil Nadu	Jubilee Sea Trade Pvt Ltd	11/01/2005
2	0.95	Tamil Nadu	Jubilee Sea Trade Pvt Ltd	26/03/2005
3	1.65	Tamil Nadu	Scent Trans	29/04/2005
4	1.65	Maharashtra	Interocean Shipping India Pvt Ltd	31/12/2006
5	1.65	Tamil Nadu	Scent Trans	31/12/2007
6	1.25	Rajasthan	Interocean Shipping India Pvt Ltd	28/09/2008
7	1.5	Tamil Nadu	Ganapati Marine	13/02/2009
8	1.65	Tamil Nadu	Ganapati Marine	27/03/2010
9	0.8	Gujarat	Interocean Shipping Company	27/09/2010
10	0.85	Gujarat	Interocean Shipping Company	30/09/2011
Total	13.60 MW			

The project activity helps in Greenhouse gas (GHG) emission reduction by utilizing renewable resource (wind) for generating power which otherwise would have been generated using grid mix power plants, which is dominated by fossil fuel based thermal power plants. In the pre-project scenario, the equivalent amount of electricity would have been generated from the Indian grid, which is dominated by fossil fuel based thermal power plants. The project activity will thus reduce the anthropogenic emissions of Green House Gases (GHGs) in to the atmosphere associated with the equivalent amount of electricity generation from the fossil fuel-based grid connected power plant. Since the project activity will generate electricity through wind energy, a clean renewable energy source it will not cause any negative impact on the environment and thereby contributes to climate change mitigation efforts as well as sustainable development.

The estimated annual average CO_2e emission reduction by the project activity is expected to be 28,821 tCO_2e.

A.2 Do no harm or Impact test of the project activity>>

The facilities do not produce any pollution in process of power generation as it utilises renewable energy source, i.e., wind energy. Hence there is positive impact on the environment. Due to implementation this small-scale project activity of reducing the pollution caused by fossil fuels used in mix power plants in grid.

The project has obtained all the relevant and required clearances from the nodal agencies. It has also been declared by the "Central Pollution Control Board" that such project activity comes under white category industry[1] and won't require any environmental clearance.
Ministry of Environment, Forests and Climate Change of Government of India[2], has stipulated economic, social, environment and technological well-being as the four indicators of sustainable development. The project contributes to sustainable development using the following ways

- **Social Well-Being**

  The project would help in generating employment opportunities during the construction and operation phases. The employment opportunities created will contribute towards alleviation of poverty in the surrounding area throughout the lifetime of the project activity.

- **Economic Well-Being:**

  The project is implementation of clean technology investment in the region. As the project activity generates employment opportunities in the local area. Hence, the project contributes to the economic sustainability, which is promotion of decentralization of economic power.

- **Environmental Well-Being:**

  The project utilizes wind energy for generating electricity which otherwise would have been generated through alternate fossil fuel based power plants; thus the project activity contributes in reduction GHG emissions. Being a renewable resource, using wind energy to generate electricity contributes to resource conservation of natural resources besides avoiding emissions of harmful effluents. Thus, the project causes no negative impact on the surrounding environment contributing to environmental well-being.

- **Technological well-being:**

  The project makes use of efficient environmentally safe technology for power generation. Successful operation of project activity would lead to promotion of wind power generation would encourage many other entrepreneurs to participate in similar projects. The generation of electricity from the project also leads to strengthening of the grid, increasing the energy availability thereby meeting the energy demand to a certain extent leading to technological well-being.

A.3. Location of project activity >>

The WTGs in the bundle are located in Tamil Nadu, Maharashtra, Gujarat and Rajasthan states of India. The sites are well connected by roads to the nearest town.

[1] https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9MYXRlc3RfMTE4X0ZpbmFsX0RpcmVjdGlvbnMucGRm

[2] https://ncdmaindia.gov.in/approval_process.aspx

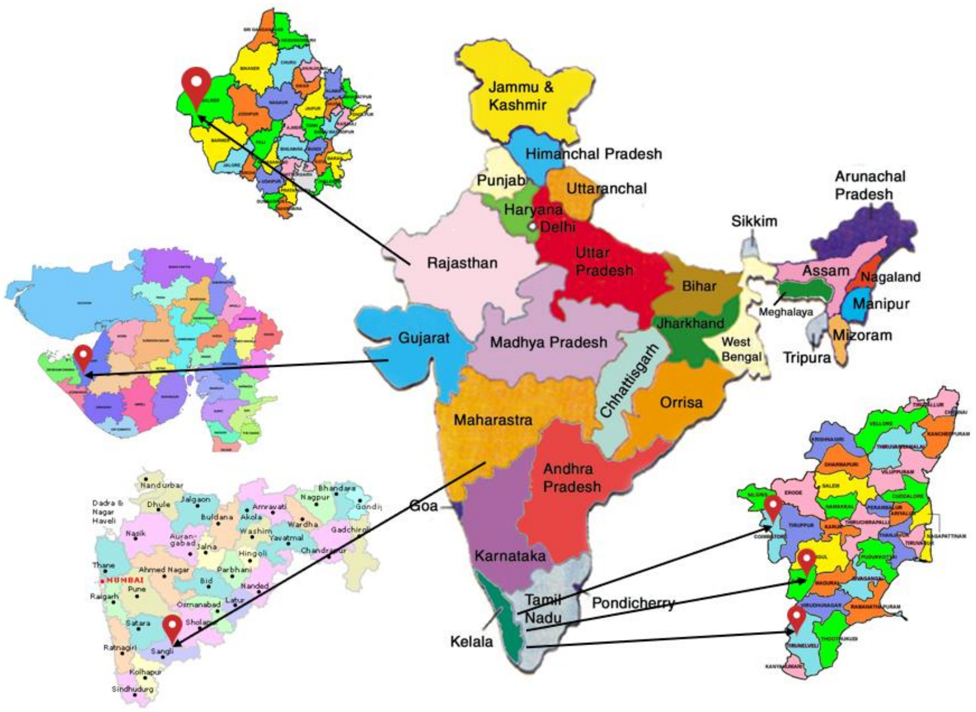


Fig. Project Location

The physical address and geocoordinates of the project site is as per below:

S No. NO.	HTSC NO.	Capacity (in MW)	Physical Address	Latitude	Longitude
1	602	1.65	SF No 118 & 119, Village Anthiyur, Udumalpet Taluqa, Coimbatore, Tamil Nadu, India	10° 36’ 14.32” N	77° 11’ 5.58 E
2	689	0.95	SF No 120/D2, Village Panaikinar, Udumalpet Taluqa, Coimbatore, Tamil Nadu, India	10° 39’ 27.09” N	77° 9’ 55.53” E
3	787	1.65	SF No 81/202, Village Gomangalampudur, Taluqa Pollachi, Coimbatore, Tamil Nadu	10° 36’ 54.27” N	77° 10’ 12.60” E
4	GP10	1.65	Survey No 149,150,151, Villagwe Bharewadi, Tal Shirala, Distt Sangli, Maharashtra	17° 07’ 30.00” N	73° 59’ 7.8” E
5	2503	1.65	SF No 913/5A, Samugarengapuram, Taluqa Radhapuram, Tirunelvelli, Tamil Nadu	08° 19’ 26.40” N	77° 40’ 8.47” E
6	R42	1.25	Khasra 16/P, Vill Satta, The & Distt Jaiselmer, Rajasthan	26° 46’31.8” N	70° 47’ 08.0” E

7	2748	1.5	SF No 113(P), Village Kasthurirengapuram, Taluqa Radhapuram, Tirunelvelli, Tamil Nadu	08° 16’ 48.44” N	77° 47’ 8.78” E
8	T-72	1.65	SF No 118/1P, 118/2P, 118/3P & 118/4P, Village G Usilampatti, Taluqa Andipetty, Theni, Tamil Nadu	9 55‟ 48.07” N	77 33‟ 30.1” E
9	1853	0.8	226/1, Vill. Chiroda Mulji, Tal. Jamjodhpur, Distt. Jamnagar, Gujarat	21° 59’ 49.1‟ N	70° 05’55.7‟ E
10	GMG/850/11-12/2354	0.85	Survey No. 106, Village Chandvad, Taluka Bhanvad, Distt. Jamnagar, Gujarat.	22° 03' 11.87" N	69°44'7.87" E

A.4. Technologies/measures >>

The proposed project activity operates Wind Turbine generators in Tamil Nadu, Maharashtra, Gujarat and Rajasthan states of India. The process involves utilization of wind energy which is a renewable source of energy to produce electricity which is exported through the Indian grid to the end user via a Power purchase agreement. The average lifetime of the WTGs installed in the project activity is 25 years. In the absence of the project activity the equivalent amount of electricity would have been generated by grid connected power plants, which is predominantly based on fossil fuels.

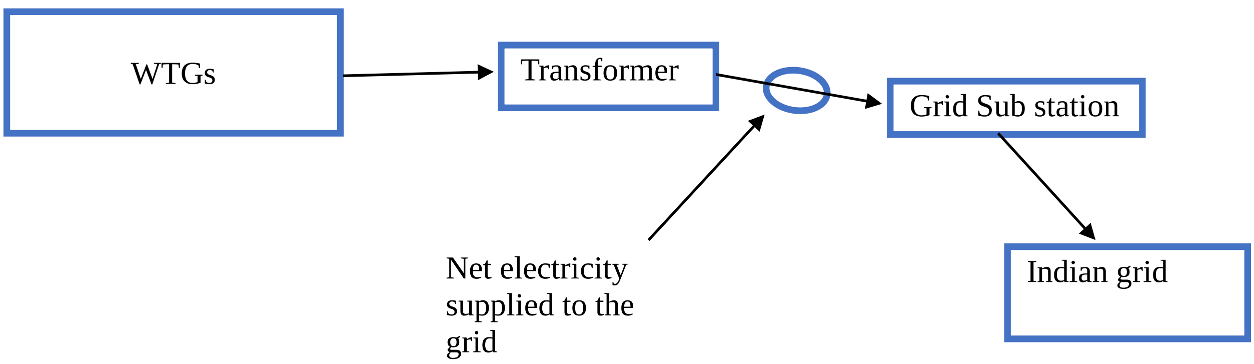


Fig: Schematic arrangements of systems and monitoring equipment

The technical specifications of the WTGs installed at different locations are described in Appendix 1 of this report.

A.5. Parties and project participants >>

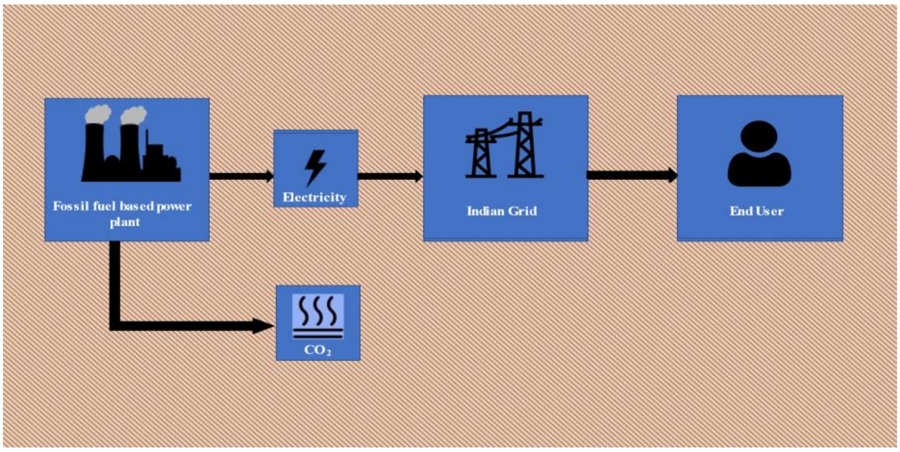
Party (Host)	Participants
India	**Project Owner:** Interocean Shipping India Pvt Ltd

A.6. Baseline Emissions>>

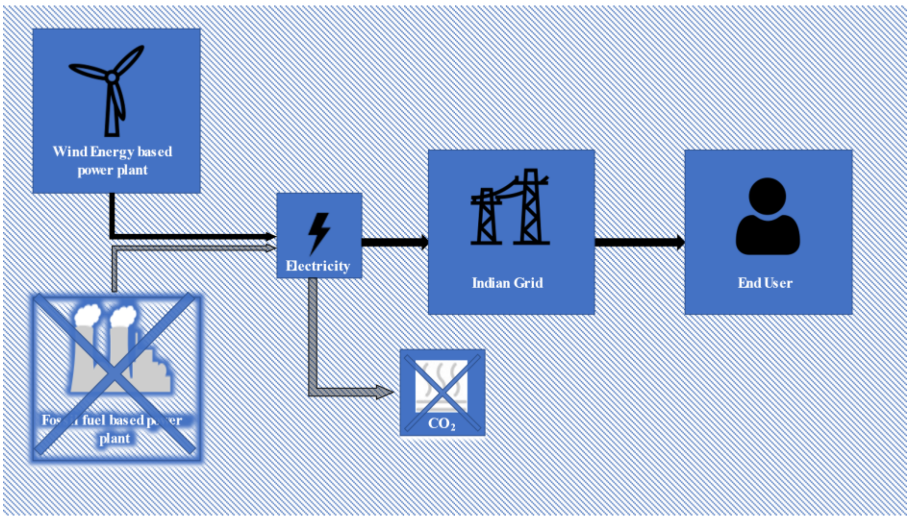
As per paragraph 19 of the approved methodology AMS-I.D., v18.0, for a greenfield project activity, *"The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid."*
In the absence of the project activity, equivalent amount of electricity would be produced from operation of power plants that are connected to the Indian grid which is predominantly produces electricity from thermal power plants. Hence, baseline scenario of the project activity is the grid-based electricity system, which is also the pre-project scenario.

Below is the illustration of baseline and project scenario for the project activity

BASELINE SENARIO
Electricity supplied from operation of grid connected power plants predominantly based on fossil fuel.



PROJECT SCENARIO
Electricity generated using renewable energy technology and supplied via Indian grid.



A.7. Debundling>>

The project is not a de-bundled component of a larger project activity. Although some of the WTGs in the proposed project activity were registered under CDM/VCS for a fixed period of time, but to avoid any double counting, these WTGs will only be claiming CoUs for the period after the end of the recent crediting period of the WTGs in CDM. Some WTGs in the project were also listed in GS.

However the same will not be registered and will not claim credits from the same. Please see section B.6 for more details.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines >>

SECTORAL SCOPE –
01 Energy industries (Renewable/Non-renewable sources)

TYPE
I - Renewable Energy Projects

CATEGORY-
AMS. I.D. ,"Grid connected renewable electricity generation", v18.0

B.2. Applicability of methodologies and standardized baselines >>

The project activity meets the applicability conditions of the approved consolidated baseline and monitoring methodology AMS-I.D., v18.0, Sectoral Scope 1 as described below:

Applicability Conditions	Position of the project activity vis-à-vis applicability conditions
Condition para 4: 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).	The project activity is a greenfield project involves installation and operation of 13.6MW wind energy-based power generation. The generated power is supplied to grid. **Hence, the criterion is satisfied.**
Condition para 5: Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: (a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; (b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2; (c) The project activity results in new reservoirs and the power density of the power plant, as per	The project activity is **NOT** a hydro power project. **Hence, the condition does not apply.**

definitions given in the project emissions section, is greater than 4 W/m2.	
Condition para 6: If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project activity is a 13.6 MW Wind Power based renewable electricity generation project. It does not include any non-renewable unit and co-firing system. **Applicability criterion is therefore not relevant.**
Condition para 7: Combined heat and power (co-generation) systems are not eligible under this category.	The project activity does not involve combined heat and power generation system as it involves Wind energy-based power project. **Applicability criterion is therefore not relevant**
Condition para 8: In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The proposed project activity is a Greenfield project and not the extension of an existing renewable energy facility. **Applicability criterion is therefore not relevant**
Condition para 9: In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	The proposed project activity is not the retrofitting or replacement of an existing facility for renewable energy generation. **Hence this criterion in not applicable.**
Condition para 10: In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.	The proposed project activity is a wind-based power project. **Hence criterion not applicable.**
Condition para 11: In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	The proposed project activity is a wind-based power project. **Hence criterion not applicable.**

Standardized baseline: Not applicable

B.3. Applicability of double counting emission reductions >>

The emission reductions from the bundled project activity will not be double counted as:

- The projects are readily identifiable on its geo-coordinates.
- The WTGs have dedicated commissioning certificates and metering points.
- Energy meters are in place for monitoring of both export and import accurately.

It is being informed that some of the WTGs in the project activity were earlier registered under CDM. It is assured that there will not be double issuance of credits. Credits issued under CDM will not be issued under UCR. Please refer section B.6. for more details.

B.4. Project boundary, sources and greenhouse gases (GHGs)>>

As per applied approved methodology, the spatial extent of the project boundary includes the project power plant/unit and all power plants/units connected physically to the electricity system that the project power plant is connected to.

Hence, the project boundary includes the project site where the power plant has been installed, associated power evacuation infrastructure, energy metering points, switch yards and other civil constructs and the connected grid of India.

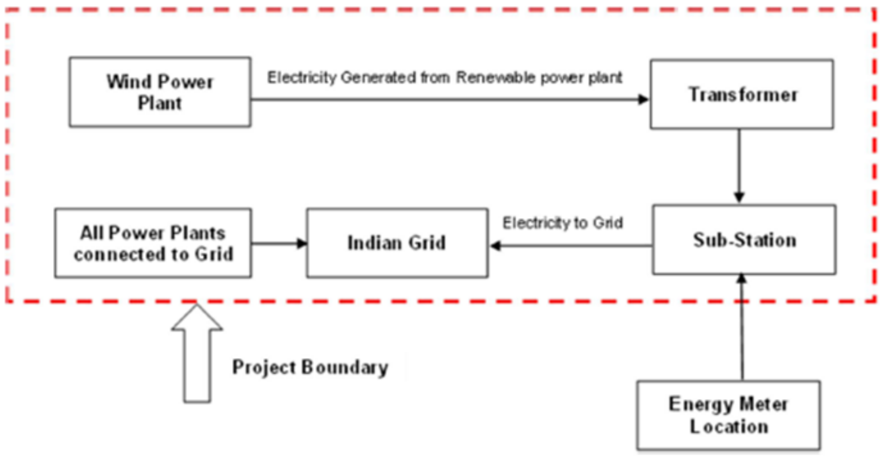


Fig. Project Boundary

The table below provides an overview of the emissions sources included or excluded from the project boundary for determination of baseline and project emissions.

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	Included	Main emission source
		CH_4	Excluded	Minor emission source
		N_2O	Excluded	Minor emission source
Project	Wind energy project (Project activity)	CO_2	Excluded	No emission associated with project activity
		CH_4	Excluded	
		N_2O	Excluded	

B.5. Establishment and description of baseline scenario (AMS-I.D. – v18.0) >>

The project activity involves operation of 10 Wind based power generation in different states of India. The generated power will be injected through the Indian grid which finally could be utilized by the end user, which otherwise would have been generated by grid connected power plants, which possesses a mix of generation types with fossil fuel fired power plants.

As per para 19 of AMS-I.D., v18.0, "The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid." Project activity delivers electricity to Indian grid. In the absence of the project activity same amount electricity would have been generated in which the electricity is generated by the fossil fuel intensive power plant.

Para 22 of AMS-I.D., v18.0 calculates baseline emissions as:

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

Where,

BE_y = Baseline Emissions in year y; t CO_2

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

$EF_{grid,.y}$ = 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)

Accordingly, the emission factor of the grid will be used to estimate emission reductions. As per para 23 of AMS-I.D., v18.0, PP has chosen option (a) and used the combined margin (CM) approach to calculate emission factor, as official data is available for operating margin (OM) and build margin (BM) values, whereas no such data exists in the public domain to support choice of option (b). Hence,

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

Data:

Parameters	**Description**	**Source**
$EF_{,OM,y}$	Operating margin CO_2 emission factor for the project electricity system in year *y*	**Calculated as per "*Tool to calculate the emission factor for an electricity system (v7.0)*" using data from Central Electricity Authority of India's (CEA) "*Baseline Carbon Dioxide Emission Database, v18.0*"** [3]
$EF_{,BM,y}$	Build margin CO_2 emission factor for the project electricity system in year *y*	
$EF_{CM,y}$	Combined margin CO_2 emission factor for the project electricity system in year *y*	
$EG_{PJ,y}$	Quantity of net electricity supplied by the candidate project activity to the grid in year *y*	Estimated generation based on rated capacity of the project activity and the applicable PLF. During the crediting

[3] http://cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

		period, records of actual net electricity supply to the grid will be used.

This data is published by Central Electricity Authority (CEA) (a statutory body constituted under Electricity Act and having its office attached to Ministry of Power, Government of India) on their website (www.cea.nic.in). "Baseline Carbon Dioxide Emission Database, v18.0" is the latest available data and is, therefore, being used in calculation of the baseline emissions.

The baseline emission is calculated in line with para 22 of 'AMS-I.D.- Grid connected renewable electricity generation', v18.0, using equation below

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

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 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)

The methodology provides following approaches for emission factor calculations:
(a) Combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology "Tool to calculate the emission factor for an electricity system". OR
(b) The weighted average emissions (in tCO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option (a) has been considered to calculate the grid emission factor as per the 'Tool to calculate the emission factor for an electricity system' since data is available from an official source.
CO_2 Baseline Database for the Indian Power Sector, v18.0, December 2022, published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

As per the "Tool to calculate the emission factor for an electricity system" v7.0, EB 100, Annex 4, the following steps have been 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) emission factor.

STEP 1: Identify the relevant electricity power systems
The tool defines that "for determining the electricity emission factors, identify the relevant electricity system. Similarly, identify any connected electricity systems". It also states that, "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". Keeping this into consideration, the Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into five regional grids viz. Northern, Eastern, Western, North-eastern and Southern.

However, since August 2006, however, all regional grids except the Southern Grid had been integrated and were operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids were treated as a single grid named as Indian grid from FY 2007-08 onwards for the purpose of this CO_2 Baseline Database. As of 31 December 2013, the Southern grid has also been synchronised with the Indian grid, hence forming one unified **Indian Grid**. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

Indian Grid				
Northern	**Eastern**	**Western**	**North-Eastern**	**Southern**
Chandigarh Delhi Haryana Himachal Pradesh Jammu & Kashmir Punjab Rajasthan Uttar Pradesh Uttarakhand	Bihar Jharkhand Orissa West Bengal Sikkim Andaman-Nicobar	Chhattisgarh Gujarat Daman & Diu Dadar & Nagar Haveli Madhya Pradesh Maharashtra Goa	Arunachal Pradesh Assam Manipur Meghalaya Mizoram Nagaland Tripura	Andhra Pradesh Karnataka Kerala Tamil Nadu Pondicherry Lakshadweep

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

Project participants have the option of choosing 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 Project Participant has chosen only grid power plants in the calculation.

STEP 3: Select a method to determine the operating margin (OM) method
The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

PP has chosen Option (a) i.e. simple OM, to determine the operating margin. Other available options in the tool were ruled out considering the fact that data required to calculate simple adjusted

OM or dispatch data analysis is not available publicly. As per the tool, low cost/must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Data for the same, as published by Central Electricity Authority, has been presented below which illustrates that low cost/must run resources constitute less than 50% of total Indian grid generation, hence, the average OM method could not have been used.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
India	14.6%	14.3%	14.5%	17.0%	16.5%	15.8%

Data Source: Central Electricity Authority (CEA) database, v18.0

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of three most recent years) for the INDIAN grid is less than 50 % of the total generation. Thus, the average emission rate method cannot be applied, as low cost/must run resources constitute less than 50% of total grid generation.

The "Simple operating margin" has been calculated as per the weighted average emissions (in tCO_2/MWh) of all generating sources serving the system, excluding hydro, geo-thermal, wind, low-cost biomass, nuclear and solar generation;

As per tool to calculate emission factor for an electricity system (v7.0), The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. Since the low cost/must run resources constitute less than 50% of total grid generation as seen from the average of five most recent years, the Simple OM method can be used to calculate the Operating Margin Emission factor.

PP has chosen ex ante option, thus, no monitoring and recalculation of the emissions factor during the crediting period is required. PP has considered a data vintage of 3-year generation-weighted average, based on the most recent data available at the time of submission of the PSF to the DOE for validation.

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

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

The Central Electricity Authority, Ministry of Power, Government of India has published a database of Carbon Dioxide Emission from the power sector in India based on detailed authenticated information obtained from all operating power stations in the country. This database i.e. The CO_2 Baseline Database provides information about the Combined Margin Emission Factors of all the regional electricity grids in India. The Combined Margin in the CEA database is calculated ex ante using the guidelines provided by the UNFCCC in the "Tool to calculate the emission factor for an electricity system, v7.0". We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

As per „Tool to calculate the emission factor for an electricity system", Option A ("Based on the net electricity generation and a CO_2 emission factor of each power unit") is used to calculate simple OM emission factor. Where Option A is used, the simple OM emission factor is calculated based on the electricity generation of each power unit and an emission factor for each power unit, as follows:

$$\mathbf{EF_{grid,OMsimple,y} = \Sigma \left(EG_{m,y} * EF_{EL,m,y}\right) / \Sigma EG_{m,y}}$$

Where:

$EF_{grid,OMsimple,y}$ Simple operating 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 All power units serving the grid in year y except low-cost / must-run power units y the relevant year as per the data vintage chosen in STEP 3

The CO_2 emission factor ($EF_{EL,m,y}$) data for simple OM, available under the CEA database (v17.0) for the last three years is as follows.

	2019-20	**2020-21**	**2021-22**
Simple OM, tCO_2/MWh (incl. Imports)	0.9540798	0.9401733	0.9604593
Net Generation, GWh	965,009.197	958,218.269	1,035,671.791
Weighted Average Simple OM, tCO_2/MWh	**0.9518**		

Step 5: Calculate the build margin (BM) emission factor, $EF_{grid,BM,y}$

The project participants have chosen Option I, i.e. fixing 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 PSF submission to the DOE for validation.

The build margin emissions factor is the generation-weighted average emission factor of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$\mathbf{EF, grid_{BM,y} = \Sigma\left(EG_{m,y} * EF_{EL,m,y}\right) / \Sigma EG_{m,y}}$$

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (t CO_2 e/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* (t CO_2 e/MWh)
m = Power units included in the build margin

y = Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the procedures given in step 4 (a) for the simple OM, using options A1B1 using for y the most recent historical year for which power generation data is available, and using form the power units included in the build margin.

CEA's "CO_2 Baseline Database for the Indian Power Sector" v18.0,

Build Margin (tCO_2/MWh) (not adjusted for imports)	
	2021-22
Indian Grid	0.8687

Step 6: Calculate the combined margin (CM) emissions factor
The combined margin is the weighted average of the simple operating Margin and the build margin. In particular, for intermittent and non-dispatchable generation types such as WTGs, the 'Tool to calculate the emission factor for an electricity system (v5.0)', allows to weigh the operating margin and Build margin at 75% and 25%, respectively

$$\mathbf{EF_{grid,y}} = \left(\mathbf{EF_{Om,y}} * \mathbf{W_{OM}}\right) + \left(\mathbf{EF_{BM,y}} * \mathbf{W_{BM}}\right)$$
$$\mathbf{EF_{grid,y}} = \left(\mathbf{EF_{OM,y}} * \mathbf{75\%}\right) + \left(\mathbf{EF_{BM,y}} * \mathbf{25\%}\right)$$

Electronic spreadsheet showing calculation of all these parameters is being submitted separately and the final values are presented below:

Parameter		**Value**	**Units**
Operating Margin :	$EF_{OM,y}$	0.9518	tCO_2e/MWh
Build Margin :	$EF_{BM,y}$	0.8687	
Combined Margin :	$EF_{grid,y}$	0.9310	

The grid emission factor for the project activity thus calculated for the project activity is 0.9310 tCO_2e/MW. However, UCR recommends an emission factor of 0.9 tCO_2/MWh for the 2013-2020 years as a fairly conservative estimate for Indian projects. Thus **0.9 tCO2e/MWh** is chosen as the grid emission for the project which is appropriate.

Emission reduction (ER_y):
The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plant by renewable electricity. The emission reduction ER_y by the project activity during a given year y is the difference between Baseline emission and Project emission & Leakage emission.

The emission reduction is calculated in line with para 43 of 'AMS-I.D.- Grid connected renewable electricity generation', v18.0, using equation below

$$\boldsymbol{ER_y = BE_y - PE_y - LE_y}$$

Where,
ER_y = Emission Reduction in tCO_2/year

BE_y = Baseline emission in tCO_2/year
PE_y = Project emissions in tCO_2/year
LE_y = Leakage Emissions in tCO_2/year

Baseline emission:
As per equation 1 of the the applied methodology AMS-I.D., v18.0,
Baseline emissions from electricity generation in power plants that are displaced due to the project activity are calculated as:

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

Where,

BE_y = Baseline emissions in year y (t CO_2)

$EG_{PJ,y}$ = 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)

$EF_{grid,y}$ = Combined margin CO2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Since the project is a greenfield project activity, as per para 26 of the applied methodology,

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

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)
$EG_{PJ,facility,y}$	= Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)

Here,

$$EG_{PJ,y} = EG_{PJ,\text{Maharashtra},y} + EG_{PJ,\text{Tamil Nadu},y} + EG_{PJ,\text{Gujarat},y} + EG_{PJ,\text{Rajasthan},y}$$

$EG_{PJ,\text{Maharashtra},y}$ = 1.65 MW*25.29%*365 days*24 hours
$EG_{PJ,\text{Maharashtra},y}$ = 3,655.42 MWh

$EG_{PJ,\text{Gujarat},y}$ = [(0.80 MW*22.13%) + (0.85 MW*24.49%)]*365days*24hours
$EG_{PJ,\text{Gujarat},y}$ = 3,374.40 MWh

$EG_{PJ,\text{Rajasthan},y}$ = 1.25 MW*17.39%*365 days*24 hours
$EG_{PJ,\text{Rajasthan},y}$ = 1,904.21 MWh

$EG_{PJ,\text{Tamil Nadu},y}$ = [(1.65 MW*31.56%) + (0.95 MW*23.22%) + (1.65 MW*34.16%) + (1.65 MW*27.49%) + (1.50 MW*23.28%) + (1.65 MW*32.04%)]*365days*24hours
$EG_{PJ,\text{Tamil Nadu},y}$ = 23,095 MWh

Thus,

$$BE_y = (EG_{PJ,\text{Maharashtra},y} + EG_{PJ,\text{Tamil Nadu},y} + EG_{PJ,\text{Gujarat},y} + EG_{PJ,\text{Rajasthan},y}) * EF_{grid,y}$$

BE_y = (3,655.42 + 23,095.00 + 3,374.40 + 1,904.21) * 0.9
BE_y = 32,029.01 * 0.9 tCO_2e

BE_y = 28,821 tCO_2e (Rounded Down)

Project Emissions:
As per applied methodology only emission associated with the fossil fuel combustion, emission from operation of geo-thermal power plants due to release of non-condensable gases, emission from water reservoir of Hydro should be accounted for the project emission. Since the project activity is a wind power project, hence PE_y= 0.

Leakage Emissions:
As per applied methodology no source of leakage emissions identified under proposed project activity.
Hence, LE_y= 0

Emission reduction (ER_y):
The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plant by renewable electricity. The emission reduction ER_y by the project activity during a given year y is the difference between Baseline emission and Project emission & Leakage emission.

The emission reduction is calculated in line with para 43 of 'AMS-I.D.- Grid connected renewable electricity generation', v18.0, using equation below

$$\boldsymbol{ER_y = BE_y - PE_y - LE_y}$$

Where,
ER_y = Emission Reduction in tCO_2/year
BE_y = Baseline emission in tCO_2/year
PE_y = Project emissions in tCO_2/year
LE_y = Leakage Emissions in tCO_2/year

Thus,
ER_y = 28,821 – 0 – 0
ER_y = 28,821 tCO_2e

B.6. Prior History>>

Some of the WTGs in the project activity were registered under CDM/VCS for a fixed crediting period. The Credits issued under CDM/VCS will not be issued under UCR as CoUs. The details of the same are as per below.

WEG No	CDM Ref No.	Crediting Period under CDM till	CERs issued till in CDM
01	1015	23/06/2016	07/03/2013
02	1015	23/06/2016	07/03/2013
04	3815	19/11/2020	12/08/2014
06	3815	19/11/2020	12/08/2014

- WTG 04,05,06&07 were registered under VCS with VCS ID 321 for pre CDM VCUs. The project activity has issued VCUs till 01/08/2009. The project was also listed under GS (GSID: 4443) for availing GS claims. However, the project was not registered and no credits were issued under GS.

- WTG 05 & 07 were registered under CDM under Project Ref No. 3815. However, the same were removed from the project activity and has claimed CERs till 12/08/2014.

B.7. Changes to start date of crediting period >>

There is no change in the start date of crediting period.

B.8. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

There are no permanent changes from registered PCN monitoring plan and applied methodology

B.9. Monitoring period number and duration>>

First CoU Issuance period: 10 years 04 months
Date: 01/01/2013 to 30/04/2023[4]

B.8. Monitoring plan>>

Data and Parameters available ex-ante.

Data/Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2e/MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year y
Source of data	CEA's "Baseline Carbon Dioxide Emission Database, v18.0" https://cea.nic.in/cdm-co2-baseline-database/?lang=en
Value(s) applied	0.9518
Measurement methods and procedures	This value is calculated
Purpose of data	Calculation of combined margin emission factor.

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2e/MWh
Description	Build margin CO_2 emission factor for the project electricity system in year y
Source of data	CEA's "Baseline Carbon Dioxide Emission Database, v18.0" https://cea.nic.in/cdm-co2-baseline-database/?lang=en
Value(s) applied	0.8687
Measurement methods and procedures	This value is calculated
Purpose of data	Calculation of combined margin emission factor.

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year y
Source of data	Combined Margin Emission Factor has been calculated by the

[4] As some of the projects in the bundle were registered under CDM, to avoid double counting, only those period will be monitored which are not issued under CDM.

	Central Electricity Authority in accordance with “Tool to calculate the emission factor for an electricity system”, v7.0
Value(s) applied	0.9310
Measurement methods and procedures	This value is calculated
Purpose of data	Calculation of baseline emission.

Data and Parameters to be monitored (ex-post).

Data/Parameter	$EG_{PJ, Maharashtra, y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plants to the grid in Maharashtra in year y
Source of data	Monthly Joint Meter Readings (JMRs)
Measurement procedures	The net electricity exported will be ascertained by Maharashtra DISCOM on the basis of energy meter readings. The net electricity exported will be calculated on monthly basis. The energy supplied by WTGs are continuously monitored and recorded once in a month.
Value(s) applied	3,655.42
Monitoring frequency	Continuous monitoring, monthly recording
QA/QC procedures	The energy meters will be calibrated as per standard practice adopted by the state nodal agency. The meters at the substation is of accuracy 0.5s or as stipulated by utility and will be calibrated at least once in 3 years which is the standard practice. The net electricity exported can also be checked from the monthly bills raised by PP.
Any Comment	All the data will be archived till a period of two years from the end of the crediting period.

Data/Parameter	$EG_{PJ, Rajasthan, y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plants to the grid in Rajasthan in year y
Source of data	Monthly Joint Meter Readings (JMRs)
Measurement procedures	The net electricity exported will be ascertained by Rajasthan DISCOM on the basis of energy meter readings. The net electricity exported will be calculated on monthly basis. The energy supplied by WTGs are continuously monitored and recorded once in a month.
Value(s) applied	1,904.21
Monitoring frequency	Continuous monitoring, monthly recording
QA/QC procedures	The energy meters will be calibrated as per standard practice adopted by the state nodal agency. The meters at the substation

	are of accuracy 0.5s or as stipulated by utility and will be calibrated at least once in 3 years which is the standard practice. The net electricity exported can also be checked from the monthly bills raised by PP.
Any Comment	All the data will be archived till a period of two years from the end of the crediting period.

Data/Parameter	$EG_{PJ, Gujarat, y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plants to the grid in Gujarat in year y
Source of data	Monthly Joint Meter Readings (JMRs)
Measurement procedures	The net electricity exported will be ascertained by Gujarat DISCOM on the basis of energy meter readings. The net electricity exported will be calculated on monthly basis. The energy supplied by WTGs are continuously monitored and recorded once in a month.
Value(s) applied	3,374.40
Monitoring frequency	Continuous monitoring, monthly recording
QA/QC procedures	The energy meters will be calibrated as per standard practice adopted by the state nodal agency. The meters at the substation are of accuracy 0.5s or as stipulated by utility and will be calibrated at least once in 3 years which is the standard practice. The net electricity exported can also be checked from the monthly bills raised by PP.
Any Comment	All the data will be archived till a period of two years from the end of the crediting period.

Data/Parameter	$EG_{PJ, Tamil Nadu, y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plants to the grid in Tamil Nadu in year y
Source of data	Monthly Joint Meter Readings (JMRs)
Measurement procedures	The net electricity exported will be ascertained by Tamil Nadu DISCOM on the basis of energy meter readings. The net electricity exported will be calculated on monthly basis. The energy supplied by WTGs are continuously monitored and recorded once in a month.
Value(s) applied	23,095.00
Monitoring frequency	Continuous monitoring, monthly recording
QA/QC procedures	The energy meters will be calibrated as per standard practice adopted by the state nodal agency. The meters at the substation are of accuracy 0.5s or as stipulated by utility and will be calibrated at least once in 3 years which is the standard practice. The net electricity exported can also be checked from the monthly bills raised by PP.
Any Comment	All the data will be archived till a period of two years from the

	end of the crediting period.

Appendix 1

Technical Specification for the NEG Micon, Vestas, Suzlon, Enercon & Gamesa WTGS

Technical specification for NEG Micon 1.65 MW WTG in Tamil Nadu

Parameter	
Make	NEG Micon
Model	NM82/1650
Operational	
Normal output	1650 kW
Cut-in speed	3.5 m/s
Cut-out speed	24 m/s
Rotor	
Diameter	82 m
Swept Area	5281 m2
Number of Blades	3 Nos
Brake System	
Blade tip Air Brake	Full Blade Pitch
Disc Brake	Hydraulic Disc Brake
Drive Train	
Gear type	Planetary/Helical gears
Ratio	1:70.2 - 50Hz
Main Shaft	High quality forged shaft
Main Bearing	Self aligning roller bearing
Cooling	Closed circuit liquid cooling
Generator	
Type	Asynchronous
Nominal Voltage	690 V
Nominal Frequency	50 Hz
Name Plate Rating	1650/900 kW
Cooling	Closed circuit liquid cooling

Yaw	
Type	Ball bearing slewing ring with gearing and yaw breaks
Drive Mechanism	6 active electric yaw drives
Tower	
Type	Tubular, Steel, PU Painted

Technical specification for NEG Micon 0.95 MW WTG in Tamil Nadu

Parameter	
Make	NEG Micon
Model	NM54/950
Operational	
Normal output	950 kW
Cut-in speed	3.5 m/s
Cut-out speed	25 m/s
Rotor	
Diameter	54.5 m
Swept Area	2333 m2
Number of Blades	3 Nos
Brake System	
Blade tip Air Brake	Hydraulic, fail safe
Disc Brake	1 Pcs. Hydraulic fail safe
Drive Train	
Gear type	Planetary - Parallel axle
Ratio	1:67.5 - 50 Hz
Main Shaft	Forged shaft and flange
Main Bearing	Spherical roller bearing
Cooling	Heat exchanger with pump
Generator	
Type	Asynchronous
Nominal Voltage	690 V
Nominal Frequency	50 Hz
Name Plate Rating	950/200 kW
Cooling	Liquid cooled with pump
Yaw	
Type	Sliding Bearing
Drive Mechanism	3 electrical planetary gears
Tower	
Type	Conical, Steel, Painted

Technical specification for NEG Micon 1.65 MW WTGs in Tamil Nadu

Parameter	
Make	NEG Micon
Model	NM82/1650

Operational Condition	
Cut in wind speed	3.5 m/s
Cut out wind speed	20 m/s (10 min. Average)
Maximum rotational speed	14.4 rpm
Main Specification	
Rotar diameter	82 m
Number of blades	3
Power control	Active Stall®
Rotational speed (Synchronous)	14.4 rpm
Rotor position	Upwind
Nominal power	1650 kW
Hub height	78 m
Rotor	
Rotor Diameter	82 m
Tilt angles	5º
Swept area	5281 m^2
Blade	
Material	Carbon Fibre/ Epoxy/Wood
Blade length	40 m
Blade profile	FFA - W3, NACA 63.4
Air Brake	Full Blade
Hub	
Type	Spherical
Material	EN-GJS-400-18U-LT
Main Shaft	
Type	Forged shaft and flange
Material	34 CrNiMo6

Technical specification for Vestas 2*1.65 MW WTGs in Maharashtra and Tamil Nadu

Parameter	
Make	Vestas
Model	NM82/V82
Operational Condition	
Cut in wind speed	3.5 m/s
Cut out wind speed	20 m/s (10 min. Average)
Maximum rotational speed	14.4 rpm
Main Specification	
Rotar diameter	82 m
Number of blades	3
Power control	Active Stall
Rotational speed (Synchronous)	14.4 rpm
Rotor position	Upwind
Nominal power	1650 kW
Hub height	78 m
Rotor	

Rotor Diameter	82 m
Tilt angles	5º
Swept area	5281 m^2
Blade	
Material	Carbon Fibre/ Epoxy/Wood
Blade length	40 m
Blade profile	FFA - W3, NACA 63.4
Air Brake	Full Blade
Hub	
Type	Spherical
Material	EN-GJS-400-18U-LT
Main Shaft	
Type	Forged shaft and flange
Material	34 CrNiMo6
Main Bearing	
Front Bearing	Spherical roller bearing
Main Gearbox	
Gear Ratio	1:70.2
Mechanical Power	1800 kW
Couplings	
Gearbox/Generator	Flexible
Generator	
Nominal Power	1650 kW
Rotational speed (Synchronous)	1012 rpm at rated power
Insulation class	F/B
Protection class (IEC529)	IP54
Machine Frame	
Type	Casted front end
Material	EN-GJS-400-18U-LT
Yawing System	
Yaw bearing type	Ball bearing, internal gearing
Yaw motor	6 Nos.
Yaw gear	6pcs
Gearing ratio	1:1666
Yaw brake	Hydraulic disc brake, 6 pcs
Mechanical Brake	
Type	Fail safe - Hydraulic
Position	Mounted on high speed shaft
Number of calipers	1 pc
Tower	
Type	Conical tubular
Height	75.5 m
Corrosion protection	Acc. To ISO 12944 : C5 I
Control System	
Manufacture	NEGM Control systems

Type	Microprocessor based

Technical specification for Suzlon 1.25 MW WTG in Rajasthan

Parameter	
Make	Suzlon
Model	S66
Rotor	
Rotor Diameter	66 m
Hub Height	74 m
Swept Area	3421.19 m²
Rotational Speed	13.9 / 20.8 rpm
Rotor material	GRP
Regulation	Pitch-regulated
Operational Data	
Cut in wind speed	3 m/s
Rated wind speed	14 m/s
Cut- out wind speed	25 m/s
Survival wind speed	65 m/s
Generator	
Type	Asynchronous generator 4/6 pole
Rated output	250/1250 kW
Rotational speed	1010/1515 rpm
Operating voltage	690 V
Frequency	50 Hz
Protection	IP 56
Insulation class	"H"
Cooling system	Air Cooled
Gear Box	
Type	Integrated 3 stage gearbox
	1 planetary & 2 helical
Gear ratio	1:74.917
Nominal load	1390 kW
Type of cooling	Oil cooling system
Yaw Drive	
Yaw drive system	4 active electrical yaw motors
Yaw bearing	Polyamide slide bearing

Technical specification for Suzlon 1.5 MW WTG in Tamil Nadu

Parameter	
Make	Suzlon
Model	S82
Rotor	
Rotor Diameter	82 m
Number of Rotor blades	3

Orientation	Upwind/Horizontal axis
Rotational direction	Clockwise
Rotor blade material	GRP
Hub Height	78.5m
Swept Area	5821 m²
Regulation	Pitch-regulated
Operational Data	
Cut in wind speed	4 m/s
Rated wind speed	14 m/s
Cut- out wind speed	20 m/s
Generator	
Type	Asynchronous 4 pole
Rated output	1500 kW
Rotational speed	1511 rpm
Operating voltage	690 V
Frequency	50 Hz
Protection	IP 56
Insulation class	“H”
Cooling system	Air Cooled
Slip control	Macro slip providing sip upto 16.7%
Gear Box	
Type	Integrated 3 stage 1 Planetary & 2 helical
Gear ratio	1:95.09
Nominal load	1650 kW
Manufacturer	Winergy/Hansen
Yaw Drive	
Yaw drive system	Active electrical yaw motors
Yaw bearing	Polyamide slide
Operating Brakes	
Aerodynamic brakes	3 independent systems with blade pitching

Technical specification for Vestas 1.65 MW WTG in Tamil Nadu

Parameter	
Model	V 82
Make	Vestas
Particulars	**Specifications**
Main Specifications	
Rotor diameter	82 m
Number of blades	3
Power Control	Active Stall
Rotational Speed (Synchronous)	14.4 rpm
Rotor position	Upwind
Nominal Power	1650 kW
Hub height	78 m

Rotor	
Rotor Diameter	82 m
Tilt angle	5°
Swept area	5281 m²
Blade	
Material	Fibre/Epoxy/Wood
Blade Length	40 m
Blade Profile	FFA – W3, NACA 63.4
Air Brake	Full Blade
Hub	
Type	Spherical
Material	EN-GJS-400-18U-LT
Main Shaft	
Type	Forged shaft and flange
Material	34 CrNiMo6
Main Bearings	
Front Bearing	Spherical roller bearings
Main Gearbox	
Gear Ratio	1:70.2
Mechanical Power	1800 kW
Couplings	
Gearbox/Generator	Flexible
Generator	
Nominal Power	1650 kW
Rotational Speed (Synchronous)	1012 rpm at rated power
Insulation class	F/B
Protection class (IEC529)	IP54
Machine Frame	
Type	Casted front end
Material	EN-GJS-400-18U-LT
Yawning System	
Yaw bearing	Ball bearing, internal gearing
Yaw Motor	6 Nos.
Yaw gear	6 pcs
Gearing ratio	1:1666
Yaw brake	Hydraulic disc brakes, 6 pcs.
Mechanical Brake	
Type	Fail Safe – Hydraulic release
Position	Mounted on high speed shaft
Number of calipers	1 pc.
Tower	
Type	Conical tubular
Height	75.5 m
Corrosion protection	Acc. To ISO 12944:C5 I
Control System	

Manufacturer	Vestas Control systems
Type	Microprocessor based

Technical specification for Enercon 0.8 MW WTG in Gujarat

Parameter	
Turbine	Enercon
Rated Power	800 kW
No. of Blades	3
Tower	Tubular
Turbine Type	Gearless horizontal
Power regulation	Independent electro-mechanical pitch system for each blade
Cut in wind speed	3 m/s
Rated wind speed	12 m/s
Cut-out wind speed	28 – 34 m/s
Extreme wind speed	59.5 m/s
Rated rotational speed	31.5 rpm
Operating range rot. Speed	16 – 31.5 rpm
Orientation	Upwind
No. of blades	3
Blade Material	Glass Fiber Reinforced Epoxy
Gear box type	Gear less
Generator type	Synchronous generator
Braking	Aerodynamics
Output voltage	400 V
Yaw system	Active yawing with 4 electric yaw drives with brake motor and friction bearing
Tower	Tubular

Technical specification for Gamesa 0.85 MW WTG in Gujarat

Parameter	
GAMESA–0.85 MW[2]	
ROTOR	
Diameter	58 m
Swept area	2,642 m²
Rotational speed	19.4-30.8 rpm
BLADES	
Number of blades	3
Length	28.3 m
Material	Fiberglass pre-impregnated with epoxy resin
TOWER	
Type	Modular

Height	74 m
GEAR BOX	
Type	2 Parallel Stages
Ratio	1:74.5 (60Hz)
GENERATOR	
Type	Doubly-fed machine
Rated power	850KW
Voltage	690V
AC Frequency	50 Hz
Protection class	IP 54
Power factor	IP 54, Power factor 0.95 CAP - 0.95 IND at partial loads and 1 at nominal power