



**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	Vaayu India Wind Power Project in Tamilnadu.
Scale of the project activity	<input checked="" type="checkbox"/> Large-scale <input type="checkbox"/> Small-scale
Version number of the PDD	10
Completion date of the PDD	03/10/2018
Project participants	Vaayu (India) Power Corporation Private Limited ACT Financial Solutions B.V.(Netherlands) First Climate Markets A.G.(Germany)
Host Party	India
Applied methodologies and standardized baselines	<p>Methodology Title: Consolidated baseline methodology for grid-connected electricity generation from renewable sources, Version 12.1.0, EB 58</p> <p>Reference: ACM0002</p> <p>Standardized Baseline: Not applicable.</p>
Sectoral scopes linked to the applied methodologies	<p>Sectoral Scope: 01 (Energy Industry Renewable/Non Renewable Sources)</p> <p>TYPE I: Renewable Energy Projects</p>
Estimated amount of annual average GHG emission reductions	103,612

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Vaayu (India) Power Corporation Private Limited (VIPCPL) has developed 50.4 MW wind farm in the state of Tamilnadu in India. The project activity involves supply, erection, commissioning and operation of 63 machines of rated capacity 800 kW each. The machines are Enercon E-53 make. The project will generate 109.625 GWh of electricity per year which is supplied to the state electricity utility thereby contributing to reducing the energy demand supply gap in the state of Tamilnadu. The project activity will assist the sustainable growth of the region by providing clean and green electricity to the state electricity grid. The project activity was registered on 19 July 2011 and all the machines were under the Power Purchase Agreement with state utility for supply of electricity to the southern regional grid. However, during post registration phase (i.e. during Feb 2016), the ownership of 19 machines has been transferred to its subsidiary company "Vaayu Renewable Energy (Godavari) Private Limited (VREGPL)"¹.

Further, the power purchase agreement for the 19 machines under VREGPL has been restructured and electricity is being supplied to JK Tyre & Industries Limited through two different third party sale agreements (as per TANGEDCO statements). As per the present arrangement, the electricity generated by these 19 machines is being pooled through Tamil Nadu state distribution & transmission network first (part of southern grid which is now integrated with Indian Grid) and then further supplied to JK Tyre & Industries Limited. However, the remaining 44 machines under the ownership of VIPCPL continue to supply electricity to the state grid as per the existing arrangements without any change.

Purpose of the project activity:

The purpose of the project activity is to utilize renewable wind energy for generation of electricity. The project activity replaces anthropogenic emissions of greenhouse gases (GHG's) into the atmosphere, which is estimated to be approximately 103,612 tCO_{2e} per year, by displacing the equivalent amount of electricity generation through the operation of existing fuel mix in the grid comprising mainly fossil fuel based power plants and future capacity expansions connected to the grid.

In the absence of the project activity the equivalent amount of electricity would have been generated from the connected/ new power plants in the Southern grid, which are/ will be predominantly based on fossil fuels². Whereas the electricity generation from operation of Wind Energy Convertors (WEC's) is emission free. As per the applicable methodology the baseline scenario for the project activity is the grid based electricity system, which is also the pre-project scenario.

Nature of Project

The Project harnesses renewable resources in the region, thereby displacing non-renewable natural resources and leading to sustainable economic and environmental benefits. Wind World (India) Limited ("WWIL") (formerly Enercon (India) Limited) will be the equipment supplier and the operations and maintenance contractor for the Project. The Project is owned by VIPCPL. The generated electricity will be supplied to Tamilnadu Electricity Board (TNEB) under a long-term power purchase agreement (PPA).

¹Earlier entire 63 machines were under the ownership of VIPCPL; however in the year 2016, 19 machines were transferred to VREGPL. VREGPL is a subsidiary entity of VIPCPL. The list of WEGs (with their respective HTSC nos.) own by the two project participant has been included under the Annex 1 of the report. Also, the details of the WEG transfer, new PPA execution etc. are provided under Annex 1. The generation statement for the monthly cycle starting from 12/02/2016 has been considered as the phase of ownership change for the 19 machines.

²http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver5.pdf

Contribution to Sustainable Development

The National CDM Authority (NCDMA) which is the Designated National Authority (DNA) for the Government of India (GoI) in the Ministry of Environment and Forests (MoEF) has stipulated four indicators for sustainable development in the interim approval guidelines for Clean Development Mechanism (CDM) projects from India³. The contributions of this project activity towards these indicators are provided below:

Social well being:

- The project activity will lead to the development of supporting infrastructure such as road network etc., in the wind park location, the access to which is also provided to the local population.
- The project activity will lead to alleviation of poverty by establishing direct and indirect benefits through employment generation and improved economic activities by strengthening of local grid of the state electricity utility.
- Use of a renewable source of energy reduces the dependence on imported fossil fuels and associated price variation thereby leading to increased energy security.

Environmental well being:

- The project activity employs renewable energy source for electricity generation instead of fossil fuel based electricity generation which would have emitted gaseous, liquid and/or solid effluents/wastes.
- Being a renewable resource, using wind energy to generate electricity contributes to resource conservation. Thus the project causes no negative impact on the surrounding environment and contributes to environmental well-being.

Economic well being:

- The project activity requires temporary and permanent, skilled and semi-skilled manpower at the wind park; this will create additional employment opportunities in the region
- The generated electricity will be fed into the Southern grid through local grid, thereby improving the grid frequency and availability of electricity to the local consumers (villagers & sub-urban habitants) which will provide new opportunities for industries and economic activities to be setup in the area thereby resulting in greater local employment, ultimately leading to overall development.

Technological well being:

- Increased interest in wind energy projects will further push R&D efforts by technology providers to develop more efficient and better machinery in future.

In addition to this, the project proponent will contribute 2% of the CDM revenue realized from the candidate CDM project for sustainable development including society / community development. PP is aware about the Indian DNA guideline on commitment of 2% of the CDM revenues towards sustainable development and a formal undertaking is being submitted separately

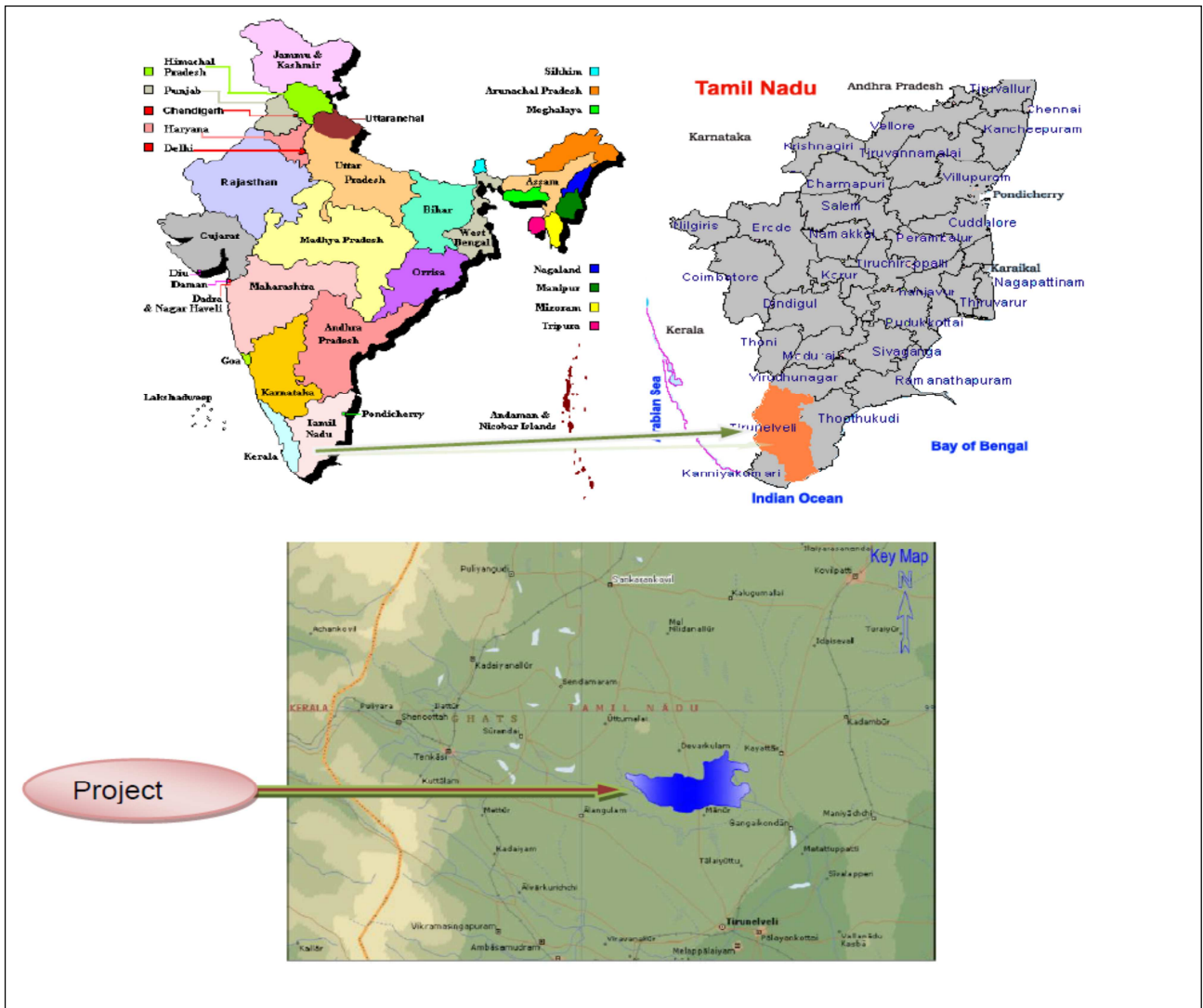
³http://ncdmaindia.gov.in/approval_process.aspx

A.2. Location of project activity

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 India, Southern Region/Tamilnadu State.

The project is spread across Vagaikulam, Kuruchikulam, Ettankulam, Kalakudi, Muthammalpuram, Ukkirankottai villages in Tirunelveli district in Indian State of Tamilnadu.

The project area extends between latitude 8° 52' 12.368" and 8° 56' 6.770" North and longitude 77° 35' 0.824" and 77° 37' 9.822" East. Tirunelveli railway station is about 25 kms away from the site. Nearest airport is at Tuticorin about 70 kms from the site. The longitude and latitude details are given in Annex 1.



A.3. Technologies/measures

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 The project activity involves 63-wind energy converters (WECs) of Wind World India (earlier known as Enercon) make (800 kW E-53) with internal electrical lines connecting the project activity with local evacuation facility. The WECs generates 3-phase power at 400V, which is stepped up to 33 KV. The project activity can operate in the frequency range of 47.5–51.5 Hz and in the voltage range of 400 V ± 12.5%. The average life time of the WEC is around 20 years as per the industry standards; however the project activity is yet to be commissioned. The other salient features of the state-of-art-technology are:

E 53 Specifications

Turbine model	E- 53 (Supplied by Wind World (India) Ltd.)
Rated power	800 KW
Rotor diameter	53 m
Hub height	75m
Turbine Type	Gearless horizontal axis wind turbine with variable rotor speed
Power regulation	Independent electromechanical pitch system for each blade.
Cut in wind speed	2.5 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	32 rpm
Operating range rot. speed	12-29 rpm
Orientation	Upwind
No of Blades	3
Blade Material	Fibre Glass Epoxy reinforced with integral lightning protection
Gear box type	Gear less
Generator type	Synchronous generator
Braking	Aerodynamic
Output Voltage	400 V
Yaw System	Active yawing with 4 electric yaw drives with brake motor and friction bearing
Tower	74 m concrete

WWIL has secured and facilitated the technology transfer for wind based renewable energy generation from Enercon GmbH, has established a manufacturing plant at Daman in India, where along with other components the "Synchronous Generators" using "Vacuum Impregnation" technology are manufactured.

In the absence of the project activity the equivalent amount of electricity would have been generated from the connected/ new power plants in the Southern grid, which are/ will be predominantly based on fossil fuels⁴, hence baseline scenario of the project activity is the grid based electricity system, which is also the pre-project scenario. Since the project activity involves power generation from wind, it does not involve any GHG emissions for generating electricity.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host)	Vaayu (India) Power Corporation Private Limited ⁵ ...	No
Netherlands	ACT Financial Solutions B.V.	No
Germany	First Climate Markets A.G.	No

A.5. Public funding of project activity

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⁴http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver5.pdf

⁵CDM project activity is being represented by VIPCPL only; hence VIPCPL remains as the project participant and focal point of communication with the board.

There is no public funding from Annex 1 countries and no diversion of Official Development Assistance (ODA) involved in the project activity.

A.6. History of project activity

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The project activity is a green-field project and only registered with CDM as 'Project Activity', hence it is confirmed that:

- i) This 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);
- ii) This project activity is not a project activity that has been deregistered.

Both these conditions can be verified from the UNFCCC database.

Also, it is declared that:

- i) This project activity was never a CPA that has been excluded from a registered CDM PoA;
- ii) This project activity is not 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.

A.7. Debundling

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Not Applicable.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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Title: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”

Reference: Approved consolidated baseline methodology ACM0002 (Version 12.1.0, EB 58)

ACM0002 draws upon the following tools which have been used in the PDD:

- Tool to calculate the emission factor for an electricity system – Version 02
- Tool for the demonstration and assessment of additionality – Version 5.2

Further information with regards to the methodology / tools can be obtained at <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

B.2. Applicability of methodologies and standardized baselines

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The project activity is wind based renewable energy source, zero GHG emission power project connected to the Tamilnadu state grid which in turn forms part of the Southern grid. The project activity will displace fossil fuel based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel based power plants in Southern grid.

The approved consolidated baseline and monitoring methodology ACM0002 Version 12.1.0 is the relevant baseline and monitoring methodology and it is applicable because:

Para No	Applicability Conditions as per ACM0002	Applicability to this project activity
1	The project activity is the installation capacity addition, retrofit or replacement of a power plant/unit of one of the following types: <ul style="list-style-type: none"> ➤ Hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir) ➤ Wind power plant/unit, ➤ Geothermal power plant/unit, ➤ Solar power plant/unit, ➤ Wave power plant/unit ➤ Tidal power plant/unit. 	The project activity is grid connected renewable power generation from wind.
2.	In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition project which use option 2: on the page 10 to calculate the parameter $EG_{PJ, y}$) : the existing plant 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 or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;	This condition is not relevant, as the project activity does not involve capacity additions, retrofits or replacements.
3.	In case of hydro power plants: <ul style="list-style-type: none"> ➤ The project activity is implemented in an existing reservoir, with no change in the volume of reservoir. 	This condition is not relevant, as the project activity is not the installation of a hydro power plant.

	<ul style="list-style-type: none"> ➤ 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. ➤ The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m². 	
4.	<p>The methodology is not applicable to the following:</p> <ul style="list-style-type: none"> ➤ Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; ➤ Biomass fired power plants; ➤ Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m². 	The project activity does not involve any of the given criteria hence methodology is applicable for the project activity.
5.	<p>In the case of retrofits, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is “the continuation of the current situation, i.e. to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance”.</p>	The project activity is a new wind power plant. Also no replacement, modification and retrofit measures are implemented here. Hence, this criterion is also not relevant to the project activity.

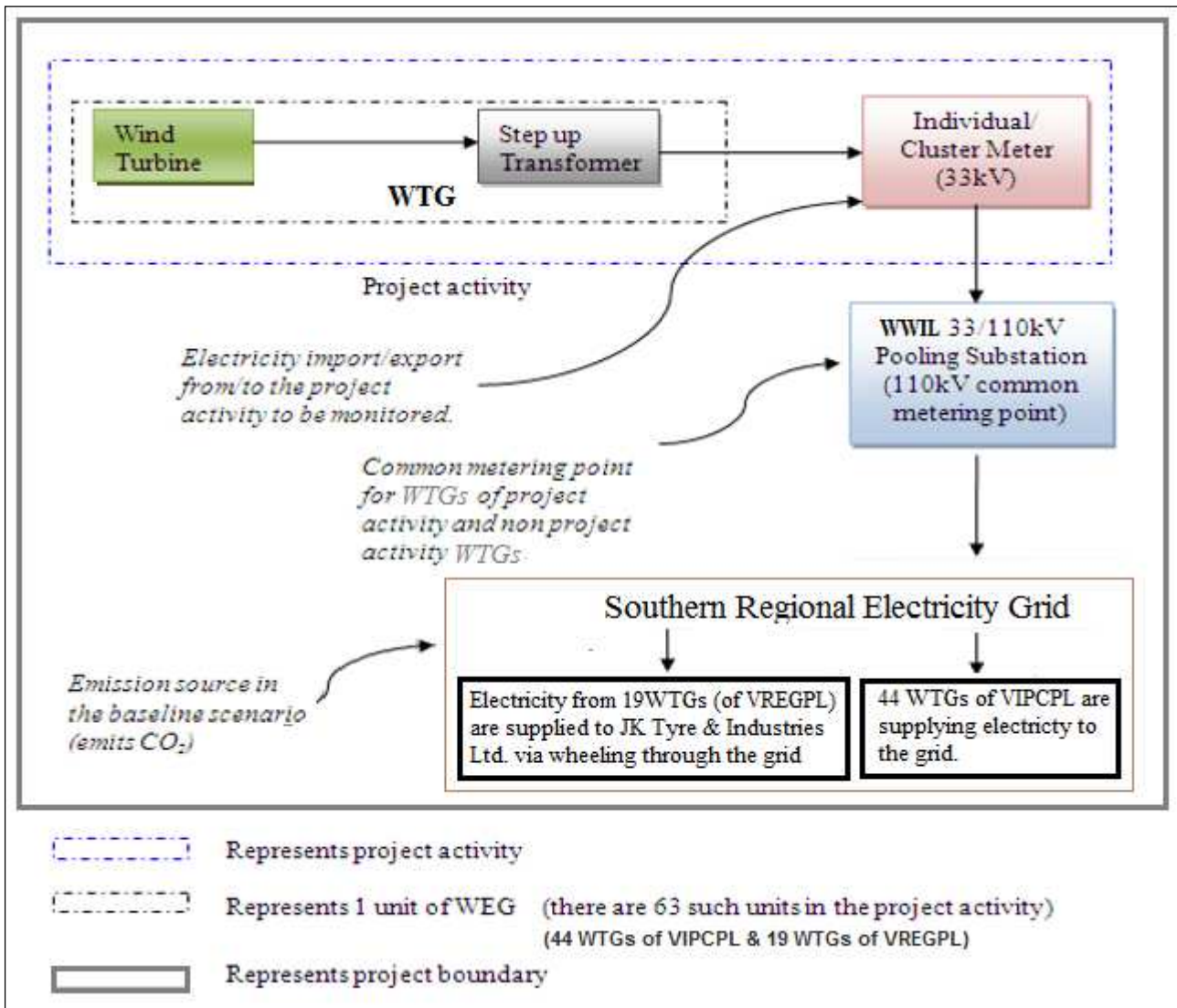
The description provided in the table above shows that the project activity satisfies the applicable conditions of the methodology, ACM0002.

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

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According to the applicable methodology, spatial extent of this project activity includes the project site and all the power plants connected physically to the electricity system that the CDM power project is connected to. The project activity is connected to the network of state transmission utility which falls in Southern grid. Thus the project boundary includes all the power plants physically connected to the Southern grid. Project activity is connected to 110kV Pillayarkulam sub-station developed by WWIL (formerly Enercon (India) Limited). However, after the ownership change of 19 WEGs from VIPCPL to VREGPL the third party power purchaser (i.e. has also been included under the project boundary. Therefore, the flow diagram of the project boundary has been revised accordingly.

Flow diagram of the project boundary:



The baseline study of Southern grid shows that the main sources of GHG emissions in the baseline are CO₂ emissions from the conventional power generating systems, the other emissions are that of CH₄ and N₂O but both emissions were conservative and are excluded for simplification of the project. The project activity is GHG emission free electricity generation from renewable sources.

Following table indicates the sources and gases included in the project boundary:

Source		GHG	Included?	Justification/Explanation
Baseline	Grid-connected electricity generation	CO ₂	Yes	In the baseline scenario the electricity would have been sourced from the Southern grid which in turn would be connected to fossil fuel fired power plants which emit CO ₂ .
		CH ₄	No	No methane generation is expected to be emitted
		N ₂ O	No	No nitrous oxide generation is expected to be emitted.
Project activity	Greenfield wind energy conversion system	CO ₂	No	The project activity does not emit any emissions.
		CH ₄	No	No methane generation is expected to be emitted.
		N ₂ O	No	No nitrous oxide generation is expected to be emitted.

B.4. Establishment and description of baseline scenario

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According to ACM0002, for project activities that do not modify or retrofit an existing electricity generation facility, the baseline scenario is the following:

Electricity delivered to the grid by the project 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 below.

As the Project does not modify or retrofit an existing generation facility, the baseline scenario is the emissions generated by the operation of grid-connected power plants and by the addition of new generation sources. This is estimated by multiplying the Combined Margin with electricity delivered to the grid.

The details of Indian grid⁶ system is described in the table below:

S.No.	Electricity Regional Grid	Electricity (Earlier)	Grid	Geographical Areas covered
1.	NEWNE	Northern		Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand
		Western		Chhattisgarh, Gujarat, Daman & Diu, Dadar & Nagar Haveli, Madhya Pradesh, Maharashtra, Goa
		Eastern		Bihar, Jharkhand, Orissa, West Bengal, Sikkim, Andaman-Nicobar
		North-Eastern		Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripu
2.	Southern Grid	Southern		Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Pondicherry, Lakshadweep

Tamilnadu state falls under Southern grid which is now the part of unified Indian Grid. The power sector in India including the Southern region largely comprises thermal power stations⁷; as can be seen from the table below⁸:

⁶As per CEA database version 11 (released in April 2016), in previous years the Indian electricity system was divided into two grids, the NEWNE and Southern Grid as described above. These are now integrated as a single Indian Grid covering all the states. Thus, the project activity earlier was considered under Southern Grid which is now referred as Indian Grid.

⁷<http://www.cea.nic.in/>

⁸http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver5.pdf

Sector	Hydro	Thermal				Nuclear	Renewable	Total
		Coal	Gas	Diesel	Total			
State	27055.76	42537.5	3672.12	602.61	46812.23	0.0	2247.68	76115.67
Central	8592.00	29620.00	6638.99	0.00	36258.99	4120.0	0.00	48970.99
Private	1230.00	5491.38	4565.50	597.14	10654.02	0.0	10994.73	22878.75
All India	36877.76	77648.88	14876.61	1199.75	93725.24	4120.0	13242.41	147965.41

It is evident from the above table that the installed capacity in India is predominantly thermal power plants; thermal power generation is GHG intensive and is a major source of CO₂ emissions. In the absence of the project activity equivalent amount of electricity would have been generated from the existing grid connected power plants and planned capacity additions which are also largely fossil fuel based. Thus generation from the project displaces the electricity generated from existing and planned power plant capacities in the southern grid whose emission intensities are represented by the Combined Margin Emission Factor of the Southern Grid.

The baseline emissions and emission reductions from the project activity are estimated by multiplying the amount of electricity exported by the project activity to the Southern grid with the emission factor of the Southern grid calculated as the combined margin (CM) of the operating margin (OM) and build margin (BM) emission factors.

Variable	Data Source
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)	Records maintained by project proponents
EF _{grid,OM,y} = Operating Margin Emission Factor (tCO ₂ /MWh)	CEA Database for CO ₂ emission factor, version 5
EF _{grid,BM,y} = Build Margin Emission Factor (tCO ₂ /MWh)	CEA Database for CO ₂ emission factor, version 5
EF _{grid,CM,y} = Grid Emission Factor	Calculated as the weighted average of the operating margin and build margin

B.5. Demonstration of additionality

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The project activity has been conceived as a CDM project since its inception. The project start date is 05 December 2009 and the PP has intimated UNFCCC and DNA about the project activity initiative within six months of the start date. The acknowledgement from UNFCCC and email to Indian DNA shall be provided to the DoE for verification.

The latest Additionality tool i.e. Tool for the demonstration and assessment of Additionality version 5.2 approved by CDM Executive Board is used to demonstrate project Additionality.

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

Define realistic and credible alternatives³ to the project activity(s) through the following Sub-steps:

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

As per ACM0002, the baseline alternative for the project activity is generation of equivalent amount of electricity by operation of grid-connected power plants and by addition of new generation sources. Accordingly, the realistic and credible alternatives to the project activity are:

- (a) The Project is undertaken without registering it as a CDM activity.

(b) Equivalent amount of electricity being generated through operation of grid-connected power plants and addition of new generation sources

Outcome of Step 1a: Alternatives (a) and (b) above have been identified as realistic and credible alternative scenario(s) to the project activity

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

There are no legal and regulatory requirements that prevent Alternatives (a) and (b) from occurring.

Outcome of Step 1b: Identified realistic and credible alternative scenario(s) to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis). (Project participants may also select to complete both steps 2 and 3.)

Step 2: Investment Analysis

The project activity generates revenue from the sale of electricity to the grid and third party via wheeling through grid, thus simple cost analysis (option I) cannot be applied to the proposed CDM project activity.

The alternative to the project activity is continuation of current situation, i.e. no project activity and equivalent amount of energy would have been produced by the grid electricity system. This alternative will not require capital investment; hence investment comparison analysis (option II) cannot be applied.

In this case the benchmark analysis (option III) is most appropriate. The guidance to investment analysis issued in EB 51, Annex 58 (paragraph 12) states that in cases where a benchmark approach is used, the applied benchmark shall be appropriate to the type of IRR calculated. Weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity (Cost of Equity) are appropriate benchmarks for equity IRR.

The tool for demonstration and assessment of additionality [para-5, sub step 2(b)] states that in cases where the project has more than one potential developer, the benchmark shall be based on parameters that are standard in the market, considering the specific characteristics of the project type. Accordingly, the cost of Equity applicable to the project type has been considered as the benchmark to be compared against equity IRR.

The benchmark Cost of equity for the project is calculated as **16.84%**. Further details of the benchmark Cost of equity considered are presented in Annex -2 and beta snapshots have been added in Annex 3.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

Key assumptions used for calculating post-tax Equity IRR are set out below (it also includes the change in parameters after the ownership change, considered as post registration change):

Assumptions for Financial Model			
Capacity of Machines	kW	800	WWIL Offer
No. of Machines for VIPCPL	Nos.	44	WWILOffer& current status
No. of Machines for VREGPL	Nos.	19	Post registration change
Project Capacity (total)	MW	50.40	WWILOffer
Capacity of VIPCPL	MW	35.2	Current status

Capacity of VREGPL	MW	15.2	Current status
Expected Project Commissioning Date	Date	01/04/2011	WWILOffer
Project Cost per MW	(INR. In Millions)	59.34	Calculated
Operations			
Plant Load Factor Base Case	%	24.83	C-WET Report
Transformation loss and Transmission Loss up to metering point	%	0	
Effective PLF	%	24.83	Calculated
Insurance Charges @ % of capital cost	%	0.12	Normative
Operation & Maintenance Cost base year @ % of capital cost	%	1.30	WWILOffer
% of escalation per annum on O & M Charges	%	6.0	WWILOffer
Tariff			
Base year Tariff for 20 years - INR./kWh (for VIPCPL)	INR/kWh	3.39	TNERC Order
Generation Based Tariff- INR./Kwh		0.50	Generation based incentive are applicable to wind power projects at the rate of INR. 0.50 per kWh with cap of INR. 6.2 Million per MW (web link: http://www.mnre.gov.in/gbi-scheme.htm)
Tariff for WEGs under VREGPL (INR/kWh)	INR/kWh	5.25	Revised fixed tariff as per Third Party sale agreement.
Project Cost		INR Million	
Land and Infrastructure, Generator & Electrical Equipments, Mechanical Equipments, Civil Works, Instrumentation & Control, Other Project Cost, Pre operative Expenses, etc.			
Total Project Cost		2,990.61	WWILOffer
Means of Finance		INR Million	
Own Source	30%	897.18	Debt Equity Ratio for the power generation projects in India.
Term Loan	70%	2,093.43	Debt Equity Ratio for the power generation projects in India.
Total Source		2,990.61	
Terms of Loan			
Interest Rate	11.50%		PLR rate published by RBI dated 30 October 2009;
Tenure	Years	10	Normative for power

			generation Sector India
Income Tax Depreciation Rate (Written Down Value basis)			
On Wind Energy Generators	%	80	Income Tax Act www.fastfacts.co.in/resources/DepIncomeTax.rtf
Book Depreciation Rate (Straight Line Method basis)			
On all assets	%	4.50	Straight line method
Book Depreciation up to (% of asset value)	%	90	
Income Tax			
Income Tax Rate	%	33.99	Income Tax Act
Minimum Alternate Tax	%	17.00	Income Tax Act
Working Capital			
Receivables	Days	30	Billing Cycle
O & M expenses	Days	90	WWILOffer

Note: during the Post Registration Change (PRC – change of ownership of 19 WEGs from VIPCPL to VREGPL), the project additionality has been re-assessed with the revised tariff applicable for VREGPL. The project IRR has been demonstrated in a separate set of IRR sheets, one for 19 WEGs owned by VREGPL and other one for 44 WEGs owned by VIPCPL. As the entire 63 WEGs in the project activity are operational with no technical and physical changes even after the ownership change; thus the other parameters assumed at the time of investment analysis remain unchanged.

Debt Equity Ratio: This is the first investment by Vaayu (India) Power Corporation Private Limited and there are no existing debts in the company. Hence the debt equity ratio of 70:30 envisaged for the project activity as per detailed project report has been considered. In addition a sensitivity analysis on the debt equity ratio has been carried out to strengthen the investment analysis.

Interest rate: This is the first investment by Vaayu (India) Power Corporation Private Limited and there are no existing debts in the company. Therefore we have taken the Prime lending rate as interest rate for investment analysis from the data published by Reserve bank of India that is publically available.

Plant Load Factor: As per EB 48, annex 11, Plant load factor validated by independent third party source can be used for investment analysis. Plant load factor for the project activity is taken from Center for Wind Energy Testing (a Government of India Agency). The plant load factor for the project site as determined by CWET is 24.83%.

Salvage Value: The project is depreciated up to 90% of the project cost (except for land that is non depreciable item); therefore we have considered land cost and 10% of the remaining value as salvage in the cash flow for computing equity IRR.

The post tax equity IRR for the Project without CDM revenues are as follows:

For VIPCPL (pertaining to the 44 WEGs) : 6.69%
 For VREGPL (pertaining to the 19 WEGs) : 11.48%

Thus, the respective IRRs are below the benchmark which ensures the project is additional.

Sub-step 2d: Sensitivity analysis (only applicable to Options II and III):

Sensitivity Analysis

The investment in wind power project shall be tested based on the following parameters:

- Capital Cost
- Tariff
- Plant Load Factor
- Debt Equity Ratio
- O&M cost

Capital Cost

In accordance with the investment guidance, the additionality for the project activity is demonstrated at the time of decision making. The project proponent has considered it appropriate to conduct the sensitivity at the variation of +/- 10% of the project cost.

	10% decrease in Capital Cost	Base Capital Cost	10% Increase In Capital Cost
Post tax Equity IRR (w.r.t. 44 WEGs of VIPCPL)	9.29%	6.69%	4.55%
Post tax Equity IRR (w.r.t. 19 WEGs of VREGPL)	13.95%	11.48%	9.32%

The equity IRR crosses the benchmark at negative capital cost variation of 30.5% and 20% respectively for the two sets of WEGs; which is not realistic.

Tariff

Tamilnadu state electricity commission has fixed the tariff for the period of 20 years (Lifetime) for the wind power projects. The control period for the tariff order dated 20 Mar 2009 is specified as two years and hence the applicable order will extend to 30 Mar 2011. The tariff for the entire life of the project activity is fixed a INR 3.39 per kWh as per current tariff order in force and all the projects that are commissioned up to 30 Mar 2011 will be provided the tariff approved by the commission in its order dated 30 Mar 2009. Therefore it is not appropriate to conduct sensitivity on tariff.

The equity IRR (assessed at the time of registration) crosses the benchmark at the tariff of INR 5.15 per kWh that is at 52% increase in base tariff of INR 3.39 per kWh which is not a reasonable assumption.

However, during the change of ownership for 19 WEGs, a new third party power sale agreement has been executed for the 19 machines at a tariff of INR 5.25 per kWh⁹. Therefore, at post registration change phase the applicable tariff for these 19 machines are changed, hence the revised IRR assessment is conducted with this new tariff for the 19 WEGs. Whereas original tariff of INR 3.39 remains applicable for the 44 WEGs owned by VIPCPL.

Conservativeness:

The new tariff for the 19 WEGs has been clearly defined for a period of 10 years (as tariff is fixed during the PPA tenure of 10 years), but the same is not clear from the 11thYear onwards (i.e. from the 15th year in the IRR sheet).

Therefore, PP has analyzed three possible scenarios to calculate applicable tariff after the completion of term (10years) of third party sale agreement:-

1. Fixed tariff as determined by TNERC (20.3.2009) in its order prevailing at the time of project initiation i.e. 3.39 INR/kWh.

This is the most likely scenario since TNERC fixed the tariff for 20 years and while going for renewal of PPA with state authority, the applicable tariff would be determined based on the date of commissioning of project activity. Since the project commissioning date falls under the regime of tariff order dated 20.03.2009, applicable tariff after completion of ten years would be 3.39 INR/kWh

2. Renewal of current PPA at tariff as mentioned in third party sale agreement i.e. @ 5.25 INR/kWh.

3. Further as per ‘cost + return on equity (16.84%, pre-tax)’ approach¹⁰ as mentioned in TNERC tariff order based on which commission calculates tariff and using assumptions that are valid to the project activity.

As per this approach, average tariff post end of third party sale agreement comes out to be 3.59 INR/kWh.

Thus, out of all the options the tariff rate of 5.25 INR/kWh is found to be most conservative. Hence, the tariff rate of 5.25 INR/kWh has been applied from 11th year onward also.

Sensitivity:

Now, as per revised sensitivity analysis the IRR pertaining to the 44 WEGs of VIPCPL crosses the benchmark at the tariff of INR 5.09 (i.e. at an increase in base tariff of 50%), which is practically not possible as the existing tariff for 44 WEGs is fixed for 20 years.

Whereas, for the 19 WEGs the IRR crosses the benchmark only at a tariff above INR 6.56 (i.e. at an increase in tariff of 25%), which is again not practically possible as the third party sale agreement is already executed and tariff is fixed for first 10 years and beyond that also tariff is not likely to get increased as understood from the “cost plus return on equity” approach.

	10% Decrease in tariff	Base Case	10% Increase in tariff
Post tax Equity IRR (w.r.t. 44 WEGs of VIPCPL)	4.53%	6.69%	8.82%

⁹Evident from the third party power purchased agreement and the monthly invoices.

¹⁰The calculation of tariff based on “Cost+RoE approach” has been included in the IRR sheet 2 (i.e. IRR for 19 WEGs), version 2, dated 07/07/2018.

Post tax Equity IRR (w.r.t. 19 WEGs of VREGPL)	9.11%	11.48%	13.70%
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Plant Load Factor

Plant Load Factor is the key variable encompassing variation in wind profile, variation in off-take (including grid availability) including machine downtime.

CWET Data: The PLF estimated by CWET (Center for Wind Energy Testing-Third party independent source for PLF) is 24.83%. We have conducted sensitivity at a variation of 10% over the base case.

	PLF @ 22.35% (10% Decrease over PLF estimated by CWET)	PLF 24.83% (PLF by CWET)	PLF @ 27.31% (10% Increase over PLF estimated by CWET)
Post tax Equity IRR (w.r.t. 44 WEGs of VIPCPL)	4.49%	6.69%	8.88%
Post tax Equity IRR (w.r.t. 19 WEGs of VREGPL)	9.11%	11.48%	13.70%

As it is seen, there is no impact on additionality with the standard variation in PLF. The respective IRR values shall cross the benchmark only at an increase in PLF of 48% and 25% respectively, which is not practical as project is operational and as perhistorical trend there is no such variation in PLF witnessed.

It may also be noted that at 100% equity, the Equity IRR is 6.57% for 44 WEGs of VIPCPL and 11.95% for 19 WEGs of VREGPL.

O&M Cost

The Sensitivity in O&M cost is conducted after taking to consideration +/-10% decrease in O&M Cost.

	10% decrease in O&M cost	Base O&M Cost	10% Increase In O&M cost
Post tax Equity IRR (w.r.t. 44 WEGs of VIPCPL)	7.05%	6.69%	6.32%
Post tax Equity IRR (w.r.t. 19 WEGs of VREGPL)	11.74%	11.48%	11.21%

The project IRR (for both the set of WEGs) does not cross the benchmark even at 100% variation in O&M cost.

Loan Tenure

At the time of investment decision the loan repayment period was assumed as 10 years for the project activity. The loan repayment period of 10 years is accepted norm for power sector projects and is envisaged by Central Electricity Regulatory Commission and State Electricity Regulatory Commission. However, in actual the PP was able to secure loan from IDFC for period of 12 years. To capture the deviation, the sensitivity analysis at loan tenure of 12 years has been done; the equity IRR for 12 years loan tenure is 6.41% for the set of 44 WEGs by VIPCPL and 11.57% for the set of 19 WEGs by VREGPL; where both are less than the benchmark.

Outcome of Step 2: As can be seen, the equity IRR of the project activity remains well below the benchmark even under the sensitivity analysis. Therefore it can be concluded that the proposed CDM project activity is unlikely to be the most financially/economically attractive.

Step 3: Barrier analysis:

Not Opted for.

Step 4: Common practice analysis:**Sub-step 4a: Analyze other activities similar to the proposed project activity:**

Analysis of similar projects within comparable regulatory regime and investment climate. Over the years there have been two different regulatory / investment regimes in the state of Tamil Nadu for wind power projects.

Regime 1 – Central regime (MNES policy)

- Projects installed prior to September 2001
- Wind power projects were governed by MNES policy with tariff set at INR. 2.25 per unit for the base year 1994-95 with a 5% annual escalation, wheeling and banking charges of 2%, etc.

Regime 2 – State regime (TNEB and TNERC policies / orders)

Projects installed after September 2001

Wind power projects were governed by (a) TNEB order of 2001 with fixed tariff of INR. 2.70 per unit, wheeling and banking charged of 5%, etc. (b) TNERC order of 2006 with fixed tariff of INR. 2.9 per unit, etc.

The different tariffs under regime 1 and regime 2 are presented below:

Electricity tariff (INR/kWh)	2006 - 07	2007 - 08	2008 - 09	2009 - 10	2010 - 11	2011 - 12	2012 - 13	2013 - 14	2014 - 15	2015 - 16	Average
REGIME 1 MNES Policy ¹¹	3.60	3.72	3.83	3.94	4.05	4.17	4.28	4.39	4.50	4.62	4.11
TNEB order 2001 ¹²	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
TNERC Order 2006 ¹³	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90

Wind projects prior to September 2001 were governed by the MNES policy. However this regime was superseded by the state policy and post September 2001 all project fell into the state regime (regime 2). As can be seen above, Regime 1 projects are of a different regulatory and investment environment and hence cannot be compared to the proposed project activity which falls under the Regime 2.

The candidate CDM project activity is a large scale project and hence an analysis of all private wind farm owners with an installed capacity of 15 MW or above, in the state of Tamil Nadu, under the Regime 2 i.e. after September 2001, has been presented below (Details of all the investors for the common practice analysis have been sourced from the Indian Wind Power Directory 9th edition published in year 2009.)

Name of Investor ¹⁴	Total Capacity MW in the	CDM ¹⁶	Web-links and Explanation

¹¹INR.2.25 for 1994-95 and 5% annual escalation thereafter

¹²INR.2.70 for 2001 fixed for next 10 years

¹³INR. 2.90 for 2006, fixed for next 10 years

¹⁴The data on private wind farm owners with greater than 15 MW installed capacity has been taken from http://www.windpowerindia.com/index.php?option=com_content&view=article&id=21&Itemid=26.

	Regime 2 ¹⁵		
Madras Cement Ltd.	142.350	Yes	Installations under the 3 CDM PDDs titled 1) "41.6 MW grid connected electricity generation project by Madras Cements Limited in Tamil Nadu." http://cdm.unfccc.int/Projects/Validation/DB/AOLO0C51SE7IUL19FP3B27HORLRSK0/view.html 2) 46.2 MW wind energy project in Tamilnadu, India. http://cdm.unfccc.int/Projects/Validation/DB/OB98HGOB9W6DUNN60IUBED9VHZRTUQ/view.html 3) 74 MW wind energy project in Tamilnadu, India. http://cdm.unfccc.int/Projects/Validation/DB/BHX0TQO6T2FMQNF1A59AGMX7X5E4DD/view.html
Simran wind power project	51.600	Yes	Installations under 2 PDDs 1) Grid connected wind energy project in Tamil Nadu by Simran Wind Project Private Ltd. http://cdm.unfccc.int/Projects/Validation/DB/IVRFOXG4PHX66FTOIH9AHHP55OHR4L/view.html 2) 33.9 MW bundled wind power project in states of Karnataka and Tamil Nadu. This is a VCS project.
Super wind power project	36.000	Yes	PDD titled "Grid connected wind energy project in Tamil Nadu by Super Wind project private ltd" http://cdm.unfccc.int/Projects/DB/DNV-CUK1280379317.22/view
DLF Home developers	34.500	Yes	PDD titled "Wind Power based electricity generation project in India by DLF Home Developers Limited" http://cdm.unfccc.int/Projects/DB/BVQI1270985563.08/view
Soundararaja Mills Ltd.	33.850	Yes	Installations are under the CDM PDDs titled 1) 10.005 MW captive grid connected wind power project by the members of IWPA at Coimbatore. http://cdm.unfccc.int/Projects/Validation/DB/LO3RUNJBVPC94GWP0N3IPQZM866Y0/view.html 2) 40.68 MW grid connected electricity generation project by Indian Wind Power Association at Tirunelveli in Tamil Nadu. http://cdm.unfccc.int/Projects/Validation/DB/1VD4I971NMFAB70C0LGFR01GV4RI4H/view.html 3) Bundled Wind power project in Tamil Nadu, India, coordinated by Tamil Nadu Spinning Mills Association (TASMA-II) http://cdm.unfccc.int/Projects/Validation/DB/4R4NBZ8HU31NRZMNQAMH37GJN07926/view.html 4) 21.00 MW grid connected electricity generation project by

¹⁶The CDM status of the projects has been taken from the CDM pipeline, in <http://cdm.unfccc.int>, MoEF site and other publicly available sources.

¹⁵The capacity of installations under the Regime 2, i.e. commissioned after September 2001 and before the project start date, in the state of Tamil Nadu, has been sourced from the Directory of Indian Windpower 2009.

CDM-PDD-FORM

			Indian Wind Power Association at Tirunelveli in Tamil Nadu. http://cdm.unfccc.int/Projects/Validation/DB/471EKHW7NC9S7MHCK3H8Y9DLP08GYA/view.html
KPR Mill Pvt. Ltd.	32.250	Yes	The installations are under two CDM PDDs 1) 19.27 MW Grid connected wind electricity generation project by KPR Mills in Tamil Nadu. http://cdm.unfccc.int/Projects/Validation/DB/KBAXDG75UAPOH4J4P20YB2AIQKM36G/view.html 2) 19.8 MW grid connected Wind farm project by KPR Mill Private Limited, Tamil Nadu, India http://cdm.unfccc.int/Projects/Validation/DB/AB7TO0OZGUKE6HYPB4TWCP5536AGVF/view.html
Grace Infrastructure (P) Ltd.	31.000	Yes	Installations under CDM PDD titled "31 MW Wind energy project in, India by Grace Infrastructure Pvt Ltd" http://cdm.unfccc.int/Projects/Validation/DB/VLQQA5G0DHYVVJPOIUALLK00RALY1/view.html
Vishal Export Overseas Ltd	29.275	Yes	All the installations were envisaged to be CDM projects as reported publicly http://www.projectsmonitor.com/detailnews.asp?newsid=9284
Shanmugavel Group	25.500	Yes	The installations are under the PDD titled "Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)" http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG
Best & Co.	25.000	Yes	The installations are all under the CDM PDD titled "Bundled Wind power project in Tamil Nadu, India, co-ordinated by Tamil Nadu Spinning Mills Association (TASMA-II)" http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95NYIX8U14H3STGKAF2BEV
Bannari Amman Spinning Mills Ltd.	23.4	Yes	The installations are under the CDM PDDs titled 1) "STL Wind Power Project" http://www.dnv.com/focus/climate_change/Upload/Version%2020-%20PDD%20-%20Sept%2005.pdf 2) Eco Friendly Electricity Export to Grid http://cdm.unfccc.int/Projects/Validation/DB/6SWAELBL6JQ0FHJOHCFAPRY4B5IBZ0/view.html 3) Bannari Amman Spinning Mills Wind Power Project managed by Enercon (India) Ltd. https://cdm.unfccc.int/Projects/Validation/DB/FYPAQ52NJB35JZRDUIC0GVD36E6S33/view.html
Lakshmi Machine Works Ltd	23.00	Yes	Installations under PDD titled "27.95 MW wind energy project in Coimbatore district in Tamilnadu, India." http://cdm.unfccc.int/UserManagement/FileStorage/7LXZLFECVXR5YBOJ5TH8J6XNHPOCN
Premier Fine Yarns Pvt. Ltd.	22.850	Yes	The installations are under the PDD titled 1) "Grid connected renewable electricity generation project by M/s. Premier Mills Pvt Ltd in Tamilnadu, India" http://cdm.unfccc.int/Projects/Validation/DB/J0J2B6K3O92EEUAFD3OGYLE03TNZ7I/view.html 2) "Bundled wind power project in Tamil Nadu managed by

			Enercon India Limited-II". This is a VCS project. https://climatefriendly.com/skins/files/file/pdf/project_page/Tamil_Nadu_Wind_Project_Verification_Report.pdf?PHPSESSID=152vii0nmj23rchhaao4aofkd2
Sapthagiri Distilleries	21.000	Yes	The installations are under CDM project titled "53.75 MW Bundled wind Power project in Tamil Nadu and Karnataka by KBD Group, India" http://cdm.unfccc.int/Projects/Validation/DB/ZSGOS9T3629EQQBKKJ8S3S5KQCGRP9/view.html
TCS Textiles Ltd.	20.750	Yes	The installations are under the PDD titled 1) "Bundled Wind power project in TamilNadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)" http://cdm.unfccc.int/Projects/DB/TUEV-SUED1173364563.43/view 2) "19.80 MW bundled wind energy project in Tirunelveli and Coimbatore districts in Tamil Nadu, India" http://cdm.unfccc.int/Projects/Validation/DB/QCDOZFYAQ1NMR2SATF56PMJNH0TIU/view.html
Loyal Textile Mills Ltd	20.450	Yes	The installations are under the PDD titled "22.25 MW Captive Wind Power Project in Tamil Nadu" http://cdm.unfccc.int/Projects/Validation/DB/ED7XENPZW06ZNTMVUOXKGQXEGZMUZV/view.html
Ashok Leyland Fin. Ltd	20.025	Yes	The installations are in the CDM PDD titled "56.25 MW bundled wind energy project in Tirunelveli and Coimbatore districts in Tamil Nadu, India" http://cdm.unfccc.int/Projects/Validation/DB/37X42BG16GG63VK5L84D6WZ0UM8YGG/view.html
Arvind A Traders	19.350	Yes	The installations are under the PDDs titled 1) "16.45 MW bundled grid connected renewable energy project in Tamil Nadu, India" http://cdm.unfccc.int/Projects/Validation/DB/ABFMBRFUS8RHP90TSOL3MQ2K4PLTM5/view.html 2) 37.6 MW Bundled Wind Power Project in Nagercoil, Tamilnadu <a "="" href="http://cdm.unfccc.int/filestorage/1/M/N/1MNSGD49QZYL4ZR8QOU54A8M3WU4XA/India%20PDD.pdf?t=MDV8MTMwMjA2NTk0Ny40NA== gcNPNhJlqyOTtYxHwEhSirUP-MQ=">http://cdm.unfccc.int/filestorage/1/M/N/1MNSGD49QZYL4ZR8QOU54A8M3WU4XA/India%20PDD.pdf?t=MDV8MTMwMjA2NTk0Ny40NA== gcNPNhJlqyOTtYxHwEhSirUP-MQ=
MuthootFinance Corp Ltd.	18.750	Yes	Installations are under the CDM PDDs 1) Wind based bundled renewable energy project, Tamilnadu, India. http://cdm.unfccc.int/Projects/Validation/DB/NL768PUSVEEJJWKRMJ52W0F1GGT8A2/view.html 2) Emissions free electricity generation using wind energy http://cdm.unfccc.int/Projects/Validation/DB/0KHOIO3K9P0Z86DVCHDOHQ7XBZH58S/view.html 3) 23.75MW grid connected electricity generation project at Tirunelveli in Tamil Nadu. http://www.sgsqualitynetwork.com/tradeassurance/ccp/proje

			cts/512/PDD%2023.75MW%20grid%20connected%20electricity%20generation%20project%20at%20Tirunelveli%20in%20Tamil%20Nadu.pdf
CPCL	17.600	Yes	Installations are under PDD titled "17.6 MW captive grid connected electricity generation from wind energy project by Chennai Petroleum Corporation Limited." http://cdm.unfccc.int/Projects/DB/BVQI1257245548.54/view
Suzlon Infrastructure Limited	17.500	Yes	The installations are under the PDDs 1. "16.25 MW grid connected electricity generation project at Coimbatore in Tamil Nadu" http://cdm.unfccc.int/Projects/Validation/DB/X1W2URT6QDN2GVGATM1WN7EXSFH89N/view.html 2. "38.75 MW grid connected electricity generation project at Tirunelveli in Tamil Nadu" http://cdm.unfccc.int/Projects/Validation/DB/01HFZ32O165S7S2CESB81LQ0C46PYL/view.html 3. "23.75MW grid connected electricity generation project at Tirunelveli in Tamil Nadu" http://www.sgsqualitynetwork.com/tradeassurance/ccp/projects/512/PDD%2023.75MW%20grid%20connected%20electricity%20generation%20project%20at%20Tirunelveli%20in%20Tamil%20Nadu.pdf
Premier Spg&Wvg Mills Pvt. Ltd	16.250	Yes	The installations are under the PDD 1) "Grid connected renewable electricity generation project by M/s. Premier Mills Pvt Ltd in Tamilnadu, India" http://cdm.unfccc.int/Projects/Validation/DB/J0J2B6K3O92EEUAFD30GYLE03TNZ7I/view.html 2) "Bundled wind power project in Tamil Nadu managed by Enercon India Limited-II". This is a VCS project. https://climatefriendly.com/skins/files/file/pdf/project_page/Tamil_Nadu_Wind_Project_Verification_Report.pdf?PHPSESSID=152vii0nmj23rchhaao4aofkd2
Rasi Seeds (P) Ltd.	16.250	Yes	The installations are under the CDM PDDs titled 1) "Bundled Wind power project in Tamil Nadu, India, coordinated by Tamil Nadu Spinning Mills Association (TASMA-II)" http://cdm.unfccc.int/Projects/Validation/DB/F6GT20QKMW3G6AOEUUNKK0UD2RG3F3/view.html 2) "Bundled Wind power project in Tamilnadu, India coordinated by the TamilNadu Spinning Mills Association (TASMA)" http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG
Ambika Cotton Mills Ltd.	15.400	Yes	The installations are under CDM PDDs 1) Bundled Wind power project in Tamilnadu, India coordinated by the Tamil Nadu Spinning Mills Association (TASMA) http://cdm.unfccc.int/Projects/DB/TUEV-SUED1173364563.43/view 2) Bundled Wind power project in Tamil Nadu, India, coordinated by Tamil Nadu Spinning Mills Association (TASMA-II)

			http://cdm.unfccc.int/Projects/Validation/DB/4R4NBZ8HU31NRZMNQAMH37GJN07926/view.html
Jayajyoti & Co. Ltd	15.000	Yes	The installations are under the PDD titled "Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)" http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG

It can be seen all private wind farm installations, in the similar regulatory and investment climate as that of the project activity and with capacity of over 15 MW in the state of Tamil Nadu, are CDM projects.

The analysis presented in the table above, shows that almost all similar project activities (except Simran wind power project, Premier Fine Yarns Pvt. Ltd. & Premier Spg&Wvg Mills Pvt. Ltd which under VCS projects and available carbon credits) are CDM projects, i.e. and non-CDM large scale wind energy investments is not a common practise in the region.

Sub-steps 4a is satisfied.

Sub-step 4b Discuss any similar options that are occurring:

From sub-step 4a it is clear that similar activities are not widely observed or commonly carried out and that all similar projects have been undertaken only as CDM projects. Therefore Sub-step 4b is not applicable. Based on the above considerations, the project activity is considered to be additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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According to the approved methodology ACM0002 (Version 12.1.0) Emission Reductions are calculated as:-

$$ER_y = BE_y - PE_y \dots\dots\dots (1)$$

Where:

BE_y Baseline Emissions in year y (t CO₂e/yr)

PE_y Project Emissions in year y (t CO₂e/yr)

Estimation of Baseline Emissions:

Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y} \dots\dots\dots (2)$$

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)

Since the project activity is the installation of a new grid connected renewable power plant the EG_{PJ,y} is calculated as :

$$EG_{PJ,y} = EG_{facility,y} \dots\dots\dots (3)$$

Where:

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

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

The proposed project activity is in the state of Tamilnadu which falls under Southern grid, baseline emission factor is calculated as combined margin, consisting of a combination of operating margin and build margin factors according to the procedures prescribed in the latest tool for calculating the emission factor for an electricity system. The steps of calculation are as follows:

STEP 1: Identifying the relevant electricity systems:

The Indian electricity system is divided into two regional grids, viz. (1) Northern, Eastern, Western, North-Eastern and (2) Southern grid. Each grid covers several states. As the regional grids are

interconnected, there is inter-state and inter-regional exchange. A small power exchange also takes place with neighboring countries like Bhutan and Nepal.

Power generation and supply within the regional grid is managed by Regional Load Dispatch Centre (RLDC). The Regional Power Committees (RPCs) provide a common platform for discussion and solution to the regional problems relating to the grid. Each state in a regional grid meets its demand with its own generation facilities and also with allocation from power plants owned by the Central Sector such as NTPC and NHPC etc. Specific quotas are allocated to each state from the Central Sector power plants. Depending on the demand and generation, there are electricity exports and imports between states in the regional grid. The regional grid thus represents the largest electricity grid where power plants can be dispatched without significant constraints and thus, represents the “project electricity system” for the project activity. As the project activity is connected to the Southern regional electricity grid, the Southern grid is the “project electricity system”.

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

Option I is opted for the project activity i.e. only grid power plants are included in the calculation.

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

According to the tool, the calculation of the operating margin emission factor is based on one of the following methods:

- (a) Simple OM, or
- (b) Simple adjusted OM, or
- (c) Dispatch data analysis OM, or
- (d) Average OM.

Any of the four methods can be used for calculating OM, The simple adjusted OM and dispatch data analysis OM cannot be currently applied in India due to lack of necessary data however, 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.

The Share of Low Cost / Must-Run (% of Net Generation) in the generation profile of the different grids in India in the last five years is as follows:

	2004-05	2005-06	2006-07	2007-08	2008-09
NEWNE	16.84%	18.0%	18.5%	19.0%	17.3%
South	21.61%	27.0%	28.3%	27.1%	22.8%
India	18.01%	20.1%	20.9%	21.0%	18.6%

Source: CO₂ Baseline Database for the Indian Power Sector – Central Electricity Authority

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of five most recent years) for the Southern regional grid is less than 50 % of the total generation. Hence the Simple OM method can be used to calculate the Operating Margin Emission factor. The average operating margin method cannot be applied, as low cost/ must run resources in Southern grid constitute less than 50% of total grid generation.

The project proponents choose an ex ante option for calculation of the OM with a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

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 CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

- Based on the net electricity generation, and a CO₂ emission factor of each power unit. (Option A), or
- 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 (option B)

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 CO₂ 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”. We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

The CEA database uses the option A i.e. data on net electricity generation and CO₂ emission factor for each power unit, the average efficiency of each power unit and the fuel type(s) used in each power unit, to calculate the OM of the different regional grids.

The simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \sum (EG_{m,y} \times EF_{EL,m,y}) / \sum EG_{m,y} \dots \dots \dots (a)$$

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

$$EF_{EL,m,y} = (\sum FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}) / EG_{m,y} \dots \dots \dots (b)$$

Where:

$EF_{EL,m,y}$	=	CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO_2,i,y}$	=	CO ₂ emission factor of fossil fuel type i in year y (tCO ₂ /GJ)

EG _{m,y}	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m		All power units serving the grid in year y except low-cost / must-run power units
l		All fossil fuel types combusted in power unit m in year y
y		The relevant year as per the data vintage chosen in step 3

STEP 5: Identify the group of power units to be included in the build margin:

The sample group of power units m used to calculate the build margin consists of either:

- (a) The set of five power units that have been built most recently, or
- (b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation. Accordingly, the CEA database calculates the build margin as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation.

The build margin emission factor has been calculated ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. This option does not require monitoring the emission factor during the crediting period.

STEP 6: Calculate the build margin emission factor:

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:

$$EF_{grid,BM,y} = (\sum EG_{m,y} \times EF_{EL,m,y}) / \sum EG_{m,y} \dots \dots \dots (c)$$

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 power generation data is available

The CO₂ 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 option A1 for y most recent historical year for which power generation data is available, and using for m the power units included in the build margin.

STEP 7: Calculate the combined margin emissions factor:

The emission factor $EF_{grid,CM,y}$ of the grid is represented as a combination of the Operating Margin (OM) and the Build Margin (BM). Considering the emission factors for these two margins as $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$, then the $EF_{grid,CM,y}$ is given by:

$$EF_y = W_{OM} * EF_{grid,OM,y} + W_{BM} * EF_{grid,BM,y} \dots \dots \dots (d)$$

Where:

$EF_{grid,BM,y}$ Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EF_{grid,OM,y}$	Operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
W_{OM}	Weighting of operating margin emissions factor (%)
W_{BM}	Weighting of build margin emissions factor (%)

(where $W_{OM} + W_{BM} = 1$).

According to ACM0002 the weights for OM and BM are 0.75 and 0.25 respectively.

Using the values for operating and build margin emission factor provided in the CEA database and their respective weights for calculation of combined margin emission factor, the baseline carbon emission factor (CM) is 945.15 tCO₂e/GWh.

Details of Baseline data:

Data of operating for the three financial years from 2006-07, 2007-08 and 2008-09 and Build Margin for 2008-09 has been obtained from -

The CO₂ Baseline Database for the Indian Power Sector

Ministry of Power: Central Electricity Authority (CEA)
Version 5

Key baseline information is reproduced in Appendix 4.
The detailed user guide and excel sheet are available at:

- http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/database_5.zip
- http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver5.pdf

Estimation of Project Emissions

The project activity involves harnessing of wind energy and its conversion to electricity. Hence according to ACM0002 Version 12.1.0, there will be no project emissions in the project activity

$$PE_y = 0 \dots \dots \dots (4)$$

Estimation of Leakage Emissions

As per ACM0002 Version 12.1.0, no leakage has been considered for the calculation of emission factor

$$LE_y = 0 \dots \dots \dots (5)$$

The details on OM, BM and CM estimates as provided by the CEA are shown in Appendix- 4

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$EF_{grid,OM,y}$
Data unit	tCO ₂ e/MWh
Description	Operating Margin Emission Factor of Southern Regional Electricity Grid
Source of data	“CO ₂ Baseline Database for Indian Power Sector”, version 5 published by the Central Electricity Authority, Ministry of Power, Government of India. The “CO ₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in
Value(s) applied	0.98756
Choice of data or measurement methods and procedures	Operating Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with ACM0002.
Purpose of data	To calculate the baseline emission.
Additional comment	The value is calculated on ex-ante basis and it will remain same throughout the crediting period.

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO ₂ e/MWh
Description	Build Margin Emission Factor of Southern Regional Electricity Grid
Source of data	“CO ₂ Baseline Database for Indian Power Sector” version 5 published by the Central Electricity Authority, Ministry of Power, Government of India. The “CO ₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in
Value(s) applied	0.81792
Choice of data or measurement methods and procedures	Build Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with ACM0002.
Purpose of data	To calculate the baseline emission.
Additional comment	The value is calculated on ex-ante basis and it will remain same throughout the crediting period.

Data/Parameter	EF_y or EF_{grid,CM,y}
Data unit	tCO _{2e} /MWh
Description	Combined Margin Emission Factor of Southern Regional Electricity Grid
Source of data	“CO ₂ Baseline Database for Indian Power Sector” version 5 published by the Central Electricity Authority, Ministry of Power, Government of India. The “CO ₂ Baseline Database for Indian Power Sector” is available at www.cea.nic.in
Value(s) applied	In case of wind power projects default weights of 0.75 for <i>EF_{OM}</i> and 0.25 for <i>EF_{BM}</i> are applicable as per ACM0002. = 0.94515 Refer Appendix 4 for comprehensive calculation of Combined Margin Emission Factor.
Choice of data or measurement methods and procedures	Combined Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with CDM methodologies: ACM0002, and Tool to Calculate the emission Factor for an Electricity System.
Purpose of data	To calculate the baseline emission.
Additional comment	The value is calculated on ex-ante basis and it will remain same throughout the crediting period.

B.6.3. Ex ante calculation of emission reductions

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Emission reductions from the project activity are equal to the baseline emissions as project emissions and leakage are nil.

Baseline emission factor (Combined Margin) (EF_y)
= 0.94515 tCO_{2e}/MWh

Annual electricity supplied to the grid by the Project (EG_y) is calculated as:
= 50.4 MW (Capacity) x 24.83% (PLF) x 8,760 (hours) MWh
= 109,625.44 MWh

Annual Baseline Emissions Reduction: ER_y = EF_y * EG_y
= 0.94515 tCO_{2e}/MWh x 109625.44 MWh
= 103,612 tCO_{2e}

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})
*June 2011 to May 2012	103,612	0	0	103,612
June 2012 to May 2013	103,612	0	0	103,612
June 2013 to May 2014	103,612	0	0	103,612
June 2014 to May 2015	103,612	0	0	103,612

June 2015 to May 2016	103,612	0	0	103,612
June 2016 to May 2017	103,612	0	0	103,612
June 2017 to May 2018	103,612	0	0	103,612
June 2018 to May 2019	103,612	0	0	103,612
June 2019 to May 2020	103,612	0	0	103,612
June 2020 to May 2021	103,612	0	0	103,612
Total	1,036,120	0	0	1,036,120
Total number of crediting years	10			
Annual average over the crediting period	103,612	0	0	103,612

***1st year begins from the date of registration, and each year extends for 12 months.**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{P,J,y}$
Data unit	MWh (Mega-watt hour)
Description	Net Electricity Exported to the grid and/or third party by the project
Source of data	For both 44 WEGs of VIPCPL and 19 WEGs of VREGPL: Monthly Generation Statement showing the electricity generated through wind turbines issued by Tamilnadu Electricity Board (TNEB)/ Tirunelveli Electricity Distribution Circle, Tirunelveli (or TANGEDCO).
Value(s) applied	Annual electricity supplied to the grid by the Project Activity = 50.4 MW (Capacity) x 24.83% (PLF) x 8760 (hours) MWh = 109625.44 MWh

Measurement methods and procedures

- Metering system for the project activity consists of clusters of individual metering points (i.e. dedicated meter/individual meter at WEG end) at 33 kV (one main meter) at project site for the project activity. Summation of meter reading for all the meters (connecting 63 machines) will provide total electricity generated by the project activity after adjustment of transmission loss. For different clusters of meters for both VIPCPL & VREGPL, please refer to the single line diagram in section B.7.3 and Appendix 5.
- In addition the 33kV metering points there is one set of main & check meter at WWIL Pooling sub-station (110kV metering point/Bulk metering point) where all the WEGs of the wind farm including machines of the project activity and other project developers are connected.
- All main and check meters are two-way tri-vector meters capable of recording import and export of electricity and under the control of state electricity utility.
- All main and check meters are of 0.2% of accuracy class.
- The procedures for metering and meter reading will be as per the provisions of the power purchase agreement (for VIPCPL) and wheeling agreement (for VREGPL) except or otherwise explicitly stated in the revised PDD (version 10, dated 03/10/2018). Currently, there is no change in metering and reading method even after the ownership change.
- Monthly Joint Meter Reading will be recorded at all the meters will be done by TNEB in the presence of PP's representative (WWIL).
- Joint meter reading recorded at 33kV metering point indicates the values of export & import by the WEGs of project activity connected to 33 kV metering point for both for 44 WEGs of VIPCPL and 19 WEGs of VREGPL (as described under the single line diagram). There will be individual Joint meter reading for individual metering points (i.e. based on dedicated meters w.r.t the HTSC nos.).
- Joint meter reading recorded at 110kV metering point at WWIL pooling sub-station indicates the values of export & import by the all the WEGs of project activity and WEGs of other project developers connected to 110 kV metering point.

Refer Appendix- 5 for an illustration of the provisions for measurement methods.

Detailed procedure calculating net electricity supplied to the grid is given in section B.7.3.

Monitoring frequency	Monthly recording (calculated parameter).
QA/QC procedures	<p>QA/QC procedures will be as implemented by Discom/State utility pursuant to the provisions of the power purchase agreements (applicable to both - existing PPAs for 44 WEGs of VIPCPL and new PPAs for 19 WEGs of VREGPL) except or otherwise explicitly stated in the revised PDD.</p> <p>Cross checking of net electricity export post 12/02/2016:</p> <p><u>For 44 WEGs of VIPCPL:</u> Value of $EG_{BL,y}$ as indicated in monthly statement provided by TNEB/TANGEDCO can be crosschecked with the invoices raised by PP to TNEB/TANGEDCO and/or sales receipts either in the form of cheque or the bank statement indicating the payment made by the TNEB.</p> <p><u>For 19 WEGs of VREGPL:</u> The electricity generated by the project activity is supplied to the industrial unit of the third party (i.e. JK Tyres & Industries Ltd), where electricity from other sources is also consumed. Hence, the electricity bill raised by state utility to the third party does not have the figure of net electricity export specifically for the project activity. Bill reflects the cumulative consumption figure by the industrial unit (including the value of the project activity along with other sources of electricity), based on which the invoice is raised (which also shows a cumulative figure). Whereas, based on monthly statements provided by TNEB/TANGEDCO, VREGPL issues monthly invoices to the third party and payment is made based on the same (please refer to the section B.7.3. for description).</p> <p>Hence, in order to establish a proper cross checking method it has been proposed that the total monthly value of net export calculated from monthly statement shall be cross checked with the monthly invoice raised to third party by VREGPL. And this shall be the primary cross checking mechanism.</p> <p>Further (as a further reference point for cross checking, if required by DOE), the net electricity export from the 19 WEGs of VREGPL can be compared with the readings of their LCS meters after deducting import and transmission loss.</p> <p>Additionally, all the main meter and check meters (referring to both VIPCPL & VREGPL) are calibrated by state utility once in five years and records are available with PP. Refer Appendix- 5 for an illustration of the provisions for QA/QC procedures.</p>
Purpose of data	To calculate the baseline emission
Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.

Data/Parameter	$EG_{Export,y}$
Data unit	MWh (Mega-Watt hour)
Description	Electricity exported by project activity to grid and/or third party recorded at 33kV metering points (Cluster meter)

Source of data	For both 44 WEGs of VIPCPL and 19 WEGs of VREGPL: Monthly Generation Statement showing the electricity generated through wind turbines issued by Tamilnadu Electricity Board (TNEB)/ Tirunelveli Electricity Distribution Circle, Tirunelveli (or TANGEDCO).
Value(s) applied	This value will be directly applied.
Measurement methods and procedures	Refer Appendix 5 and section B.7.3 for an illustration of the provisions for measurement methods.
Monitoring frequency	Continuous monitoring, hourly measurement and monthly recording.
QA/QC procedures	QA/QC procedures will be as implemented by Discom/State utility (TNEB) pursuant to the provisions of the power purchase agreements (applicable to both - existing PPAs for 44 WEGs of VIPCPL and new PPAs for 19 WEGs of VREGPL) except or otherwise explicitly stated in the PDD. All the main meter installed at 33kV metering point at project site are calibrated by state utility once in five years and records are available with PP. Refer Appendix- 5 for an illustration of the provisions for QA/QC procedures.
Purpose of data	To calculate the baseline emission
Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.

Data/Parameter	EG_{Import,y}
Data unit	MWh (Mega-Watt hour)
Description	Electricity imported by project activity to grid and/or third party recorded at 33kV metering point (Cluster meter)
Source of data	For both 44 WEGs of VIPCPL and 19 WEGs of VREGPL: Monthly Generation Statement showing the electricity generated through wind turbines issued by Tamilnadu Electricity Board (TNEB)/ Tirunelveli Electricity Distribution Circle, Tirunelveli (or TANGEDCO).
Value(s) applied	This value will be directly applied.
Measurement methods and procedures	Refer Appendix- 5 and section B.7.3 for an illustration of the provisions for measurement methods.
Monitoring frequency	Continuous monitoring, hourly measurement and monthly recording.
QA/QC procedures	QA/QC procedures will be as implemented by Discom/State utility (TNEB) pursuant to the provisions of the power purchase agreements (applicable to both - existing PPAs for 44 WEGs of VIPCPL and new PPAs for 19 WEGs of VREGPL) except or otherwise explicitly stated in the PDD. All the main meter installed at 33kV metering point at project site are calibrated by state utility once in five years and records are available with PP. Refer Appendix- 5 for an illustration of the provisions for QA/QC procedures.
Purpose of data	To calculate the baseline emission

Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.
Data/Parameter	T_E
Data unit	MWh (Mega-watt hour)
Description	Line loss between the metering point at 33 kV metering points of project activity and the metering point at 110 kV at the WWIL pooling substation.
Source of data	For 44 WEGs of VIPCPL and 19 WEGs of VREGPL: Monthly Generation Statement showing the electricity generated through wind turbines issued by Tamilnadu Electricity Board (TNEB)/ Tirunelveli Electricity Distribution Circle, Tirunelveli (or TANGEDCO).
Value(s) applied	This value will be directly applied.
Measurement methods and procedures	Line loss between metering point at 33kV and the metering point at 110kV at WWIL substation is applied to the meter reading taken at meters connected at 33 KV for the project activity. WWIL pooling Substation is connected to the machines of the project activity and the machines commissioned by the other project owners. Therefore Line loss is applied to the project activity by the state utility as reflected in the Monthly billing records taken at 33kV level. The line loss calculation is done by TNEB which is a state utility and is directly used for adjusting the net export recorded at 33kV metering clusters. Refer Appendix- 5 and Section B.7.3 for an illustration of the provisions for measurement methods.
Monitoring frequency	Monthly recording.
QA/QC procedures	QA/QC procedures will be as implemented by Discom/State utility (TNEB) pursuant to the provisions of the power purchase agreements (applicable to both - existing PPAs for 44 WEGs of VIPCPL and new PPAs for 19 WEGs of VREGPL) except or otherwise explicitly stated in the PDD. Refer Appendix- 5 for an illustration of the provisions for QA/QC procedures.
Purpose of data	To calculate the baseline emission
Additional comment	The data will be archived both in electronic and hard paper format for crediting period + 2 years.

B.7.2. Sampling plan

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Not applicable to this project activity.

B.7.3. Other elements of monitoring plan

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Approved monitoring methodology ACM0002 Version 12.1.0, "Consolidated baseline monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources", by CDM - Meth Panel is proposed to be used to monitor the emission reductions.

WWIL is O&M contractor for the project activity. WWIL will be responsible for the maintaining all the monitoring data on behalf of VIPCPL and VREGPL for their respective machines in respect of the project activity. WWIL has implemented the management structure for managing the monitored data.

This approved monitoring methodology requires monitoring of the following:

Electricity generation from the project activity; and

Operating margin emission factor and build margin emission factor of the grid, where *ex post* determination of grid emission factor has been chosen

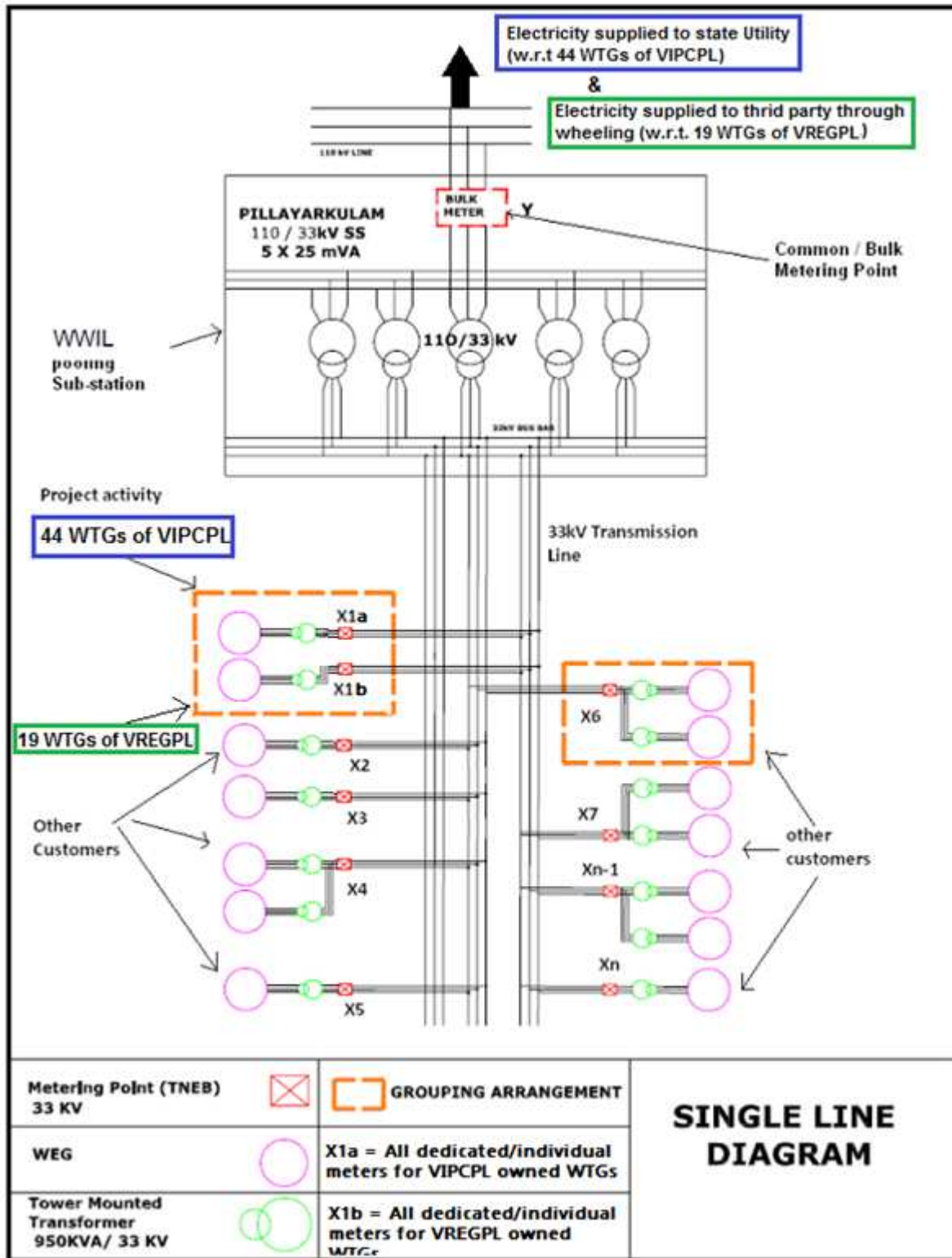
Since the baseline methodology is based on *ex ante* determination of the baseline, the monitoring of operating margin emission factor and build margin emission factor is not required. Further, wind based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity generated by the project and supplied to the grid.

The Project is operated by WWIL and managed by the PP. The operational and maintenance contract for the project is with WWIL. WWIL is an ISO 9001:2000 certified Quality Management system from Germanischer Lloyd. WWIL follows the documentation practices to ensure the reliability and availability of the data for all the activities as required from the identification of the site, wind resource assessment, logistics, finance, construction, commissioning and operation of the wind power project.

Calculation of Net Electricity Supplied to the grid by project activity:

Single Line diagram of Metering arrangement for project activity is shown in below picture:-

The line diagram shown below refers to the entire project as a whole, thus it refers to the machines owned by both the parties VIPCPL & VREGPL. As there is no physical change in location, power evacuation systems, metering points etc, hence the same line diagram can be considered as applicable for the project after the ownership change as well.



*Please refer to the Appendix 5 for more details on X1a and X1b.

From the above line diagram it is clear that the machines of the project activity (i.e. 44 WEGs by VIPCP and 19 WEGs by VREGPL) and other project developers at the wind farm have individual metering points at 33 kV at the project site. Further PP will make clusters of WEGs at the project site for the purpose of metering. Each cluster will have a main meter. The WEGs of the project activity will be connected to individual dedicated cluster meters.

From the above layout it is clear that the clusters meters (i.e. dedicated meters/ individual meters attached to the WEGs w.r.t. HTSC nos.) of project activity and other customers are connected to the WWIL pooling sub-station at Pillayarkulam at bulk metering point at 110 kV. There is one main and one check meter at the WWIL substation. Since the main and check meters (bulk meter) at 110 kV metering point at the WWIL pooling substation is connected to the machines of the project activity and the machines commissioned by the other project developers, therefore in order to determine the net electricity supplied to the grid and/or third party at 110 kV at the WWIL substation, the state utility apply Line loss to the meter reading recorded at the 33 kV. There is no any physical change to the WEGs and their power evacuation system post the ownership change

The total % of Line loss from WEGs (33kV metering point) to WWIL substation (110kV metering point) is calculated by the state utility. Net Electricity supplied to the grid and/or third party by project activity is calculated by applying Line loss to the meter readings taken at 33 kV metering point of the project activity.

The procedure for calculation of the percentage Line loss is set-out below:

$$Z = \frac{(X1+X2+X3+X4+....Xn) - Y}{(X1+X2+X3+X4+....Xn)} \times 100\%$$

Where,

Z = Percentage Line loss incurred in Line between the meters located at 33 kV metering point (including the machines of the project activity and other project developers) and the meters located at 110kV metering point (bulk meter: main and check) at high voltage side of receiving sub-station. Refer above picture for schematic of the flow diagram.

(X1+X2+X3+X4+.....Xn) = Summation of meter readings (Export- Import) at 33 kV metering points for all the project developers connected to receiving substation (including the machines of the project activity and other project developers)

Xi = Net Export (Export – Import) Reading (Xi) noted at energy meter installed at 33kV metering point where i vary from 1 to n which represents the meters connected to project activity and other project developers. X1, X2, X3,...Xn are the meters that are installed at 33kV metering point (including the machines of the project activity and other project developers) and further connected to the receiving substation at 110 kV by internally connected lines. Refer above picture for schematic of the flow diagram.

As per prevailing practice at Tamil Nadu, there are dedicated metering systems for each WEG (for individual WEG or sometime for a group of WEGs) at generation end and bulk metering system available at receiving end based on which TNEB/TANGEDCO estimates net exports for each client and monthly generation statements are produced.

Here, X1 is the representation of series of such dedicated meters (i.e. either individual or clusters) attached to the total 63 WEGs of the project. Erstwhile entire 63 WEGs were under the direct ownership of VIPCPL, hence X1 represented as the cluster of dedicated meters attached to WEGs w.r.t. their HTSC nos. for VIPCPL. However, during post registration change, 19 WEGs were taken under the ownership of VREGPL; therefore this representation has been changed in terms of their line diagram interpretation; whereas physical status of the evacuation system, actual practice of metering and method of calculating net export to generate monthly statement etc. all remain the same. The 44WEGs of VIPCPL continues to supply electricity to TNEB for which the monthly statement for WEGs is issued separately as per the HTSC nos. of the machines. The 19 WEGs of VREGPL supplies power to the third party via wheeling for which monthly statements are also issued by TNEB/TANGEDCO separately as per the HTSC nos. of the machines. Thus, power

generation dedicated to both VIPCPL & VREGPL are still separately available as per the monthly generation statements issued by TNEB/TANGEDCO. The single line diagram has been modified as per the post registration changes and revised version (as included above) presents the current scenario.

Y = Net Export (Export-Import) Reading at bulk meter installed at high voltage side of transformer of the receiving sub-station at 110 kV connecting machines of the project activity and other project developers. Refer above picture for schematic of the flow diagram.

Therefore Line Loss for the project activity (between 33kV & 110kV metering point) is calculated as follows:-

Line Loss (TE) = Percentage Line Loss * Net Export recorded at 33kV metering point of project activity

$$T_E = Z \times (E_{G_{Export,y}} - E_{G_{Import,y}})$$

Therefore Net Energy Supplied to Grid and/or third party(or net generation) after adjustment of Line loss is calculated as below:-

$$E_{G_{P,J,y}} = E_{G_{Export,y}} - E_{G_{Import,y}} - T_E$$

The monthly statement showing the Energy Generated by the project activity as provided and duly signed by TNEB/Tirunelveli Electricity Distribution Circle, Tirunelveli) contains the following data:-

1. Electricity Export (EG_{export})
2. Electricity Import (EG_{import})
3. Line Loss (TE) between 33 kV metering point and 110 kV metering point at WWIL substation
4. Net Generation to the Grid [EG_{export}-EG_{import}-TE]

The cross checking mechanism for parameter EG_{BL,Y} net generation is prescribed under the data tables above. However, as per applied methodology ACM0002 the cross checking mechanism is stipulated only for the parameter “EG_{BL,y}”. Therefore, no specific cross check mechanism is prescribed for export, import and line loss parameters.

The accuracy of monitoring parameter is ensured by adhering to the calibration and testing of the metering equipment once in five year in line with line with para 18.1.b of the notification dated 17/03/2006 published by Central Electricity Board, Govt. of India (www.aegcl.co.in/Metering_Regulations_Of_CEA_17_03_2006.pdf). WWIL provides the daily generation report to the Project proponent. The project proponent also maintains the records of daily generation report and joint meter report.

Few more information are provided in the Appendix 5.

Training and maintenance requirements:

Training on the machine is an essential pre-requisite, to ensure necessary safety of man and machine. Further, in order to maximize the output from the WECs, it is extremely essential, that the engineers and technicians understand the machines and keep them in good health. In order to ensure, that WWIL’s service staff is deft at handling technical snags on top of the turbine, the necessity of ensuring that they are capable of climbing the tower with absolute ease and comfort has been established. The WWIL Training Academy provides need-based training to meet the training requirements of WWIL projects. The training is contemporary, which results in imparting focused knowledge leading to value addition to the attitude and skills of all trainees. This ultimately leads to creativity in problem solving.

Action plan for monitoring of 2% CER revenue contributed towards sustainable development

Vaayu (India) Wind Power Corporation Private Limited (VIPCPL)¹⁷ is committed to contribute a minimum of 2% of the CER revenue accrued every year for sustainable development activities for the local population.

VIPCPL will undertake an annual review process of the actual CERs accrued and the price transacted. On the basis of the actual price and exchange rate, VIPCPL will commit 2% of the revenue for sustainable development activities in the local areas.

As part of the annual review, VIPCPL will undertake informal discussions with the locals at the project site and commit the revenue towards society / community developmental activities in areas that are of most concern to the local population. These areas could include health, education, sanitation, skill development, infrastructure development, etc. The annual review process will detail the exact activities that would be undertaken using the 2% revenue and the detailed mode of implementation of the proposed activity.

VIPCPL commits that a CSR team will be appointed to oversee the activities towards sustainable development and also that the activities are undertaken and concluded in a timely manner each year.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>

05/12/2009, being the date of placement of purchase order for the wind energy generators.

C.2. Expected operational lifetime of project activity

>>

20 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>

The project proponent has selected the fixed crediting period for the project activity.

C.3.2. Start date of crediting period

>>

19/07/2011.

(Project activity was registered on 19 Jul 2011 and start date of crediting period was assigned by UNFCCC as 19 July 2011.)

C.3.3. Duration of crediting period

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¹⁷ As requested under PRC, the ownership of 19 WEGs are changed to VREGPL however, the CDM project activity shall be represented by the existing proponent, i.e. "Vaayu (India) Power Corporation Pvt. Ltd.".

10 years and 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

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As per the Schedule 1 of Ministry of Environment and Forests (Government of India) notification dated January 27, 1994 and EIA Notification (S.O 1533) dated 14th September 2006, a list of activities that require undertaking environmental impact assessment studies¹⁸ has been provided. EIA is not a regulatory requirement in India for wind energy projects and PP does not expect any adverse impacts of the proposed CDM project activity on the environment. Further MoEF published 2 other amended notification dated, 11th Oct 2007¹⁹ & 01st December 2009²⁰ and these amendment doesn't provide any change in regulatory requirement for WIND power project related to EIA.

D.2. Environmental impact assessment

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The project activity does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India. Hence, EIA is not required by the host party.

¹⁸ <http://envfor.nic.in/legis/eia/so1533.pdf>

¹⁹ <http://www.fedmin.com/html/not-11-10-07.pdf>

²⁰ <http://mnre.gov.in/notification/env-notifn.pdf>

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

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The comments from local stakeholders were invited through a local stakeholder meeting conducted at Tirunelveli District in Tamilnadu on 23 February 2010. A local newspaper advertisement was placed in Daily Thanti on 8 February 2010 inviting the local stakeholders for the meeting. The personal invitations were also sent to the local villagers. The meeting was presided over by Mr. CR Venkateshwaran (EIL-Coimbatore), Ms Sapna Pednekar (EIL-CDM) and Mr. K V Suresh (EIL-Coimbatore).

E.2. Summary of comments received

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Mr. CR Venkateshwaran welcomed the participants and introduced the company. Ms. Sapna Pednekar briefed about project activity, reasons for setting up the project, costs and benefits of setting up the project and role and benefits of wind power project to reduce the emissions of green house gases in the atmosphere.

Mr. CR Venkateshwaran gave an explanation on global warming and its impacts, Kyoto Protocol, Clean Development Mechanism and role of wind power in mitigating the global warming and then requested the Chairperson to give his viewpoints on the wind power projects taken up at district Tirunelveli.

The Chairperson, Mr. Chelliah appreciated the management of VIPCPL for proposing pollution free technology for power generation. Mr. Arumugam, President in his speech; explained about the Distribution of Electricity to villages improved dramatically. He pointed out that there is no adverse impact of Wind Energy Projects.

Mr. S.Shanmugam, Executive Engineer TNEB in his speech explained about the present socio-economic condition of Tirunelveli and he compared the recent developments to the olden days.

Mr. Rajasekaran, Assistant Executive Engineer, TNEB in his speech explained about the advancements in the villages after the installation of wind power projects. He opined that after setting-up of wind projects in these villages, the village roads were developed significantly and employment opportunities are being created in wind power projects such as casual labours, securities, drivers and technicians.

The following queries were raised by the stakeholders:

1. Whether wind turbines have any impact on the rain clouds?
2. Does the noise of WECs affect the milk yield of cattle's?
3. The electricity generated from this project will be directly fed to the local community?
4. What is the procedure and steps involved in installation of the wind power project in Tamilnadu?
5. Will installation of wind mill affect the groundwater level or water level of nearby lake/ well?

E.3. Consideration of comments received

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The clarifications that were addressed by the representatives of WWIL (WWIL is authorized by the PP to execute all the activities in relation to CDM i.e. project registration and verification including local stakeholder consultation) are listed in the table below:

S.No	Villager Name	Question	Reply by WWIL representative
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1.	Mr.Perumal	Whether wind turbines move away rain clouds?	The clouds are at much higher height than the height of the wind turbines and it is absolutely unlikely that it would be the obstacle in the way of rain clouds. This has already been established by various studies undertaken in this aspect.
2.	Mr.Subramani	Does the noise of WECs affect the milk yield of cattle's?	The noise level in Enercon WEC's is around 46 DB. As per Indian Industrial Act, the noise level should be less than 50 DB. So, there is no chance of the cattles getting disturbed by this sound.
3.	Mr. N Vishwanathan	Will the electricity generated from this project be directly fed to the local community?	The electricity generated will be supplied to the state electricity grid which further distributes the electricity as per the state policy.
4.	Mr. Gurusamy	What is the procedure and steps involved in installation of the wind power project in Tamilnadu?	The procedure to set up windfarm in Tamilnadu involves various steps from identifying the potential wind farm site to get evacuation approvals from TNEB. On the approval of TNEB only the activity can be carried forward.
5.	Mr. Murugan	Will installation of Wind machines affect the groundwater level or water level in lakes/ wells nearby to the project	The foundation level of the wind mills are in depth upto the maximum of 2 meters only and it will not disturb the level of water in the earth while the depth for installation of earth pit will be maximum of 20 feet only and it also doesn't disturb the water level.

SECTION F. Approval and authorization

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Host country approval has been received dated 22/12/2010.

Appendix 1. Contact information of project participants

Organization name	Vaayu (India) Power Corporation Private Limited
Country	India
Address	Plot No. 33, Daman Patalia Road, Bhimpore, Daman (UT) - 396210
Telephone	+91-260-2220624, 2220628
Fax	+91-260-2221508
E-mail	yogeshh.mehra@windworldindia.com
Website	
Contact person	Mr. Yogesh Mehra

Appendix 2. Affirmation regarding public funding

The project activity does not involve any public funding from parties included in Annex 1.

Appendix 3. Applicability of methodologies and standardized baselines

Please refer above section B.2 for Applicability of selected methodology.

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

The Operating Margin data for the most recent three years and the Build Margin data for the Southern Region Electricity Grid as published in the CEA database are as follows:

Simple Operating Margin

	Southern Grid (tCO _{2e} /MWh)
Simple Operating Margin – 2006-07	0.99912
Simple Operating Margin – 2007-08	0.99062
Simple Operating Margin – 2008-09	0.97293
Average Operating Margin of last three years	0.98756

Build Margin

	Southern Grid (tCO _{2e} /MWh)
Build Margin – 2008-09	0.81792

Combined Margin Calculations

	Weights	Southern Grid (tCO _{2e} /MWh)
Operating Margin	0.75	0.98756
Build Margin	0.25	0.81792
Combined Margin		0.94515

Detailed information on calculation of Operating Margin Emission Factor and Build Margin Emission Factor is available at www.cea.nic.in.

Appendix 5. Further background information on monitoring plan

Metering and Monitoring Plan details: The general conditions set out for metering, recording, meter readings, meter inspections, Test & Checking and communication shall be applicable as per the PPAs (Power purchase agreements) with the State electricity board except or otherwise explicitly mentioned in the PDD.

Metering: The electricity supplied to the grid will be metered from main meters that are connected to the 63 turbines of the project activity. The electricity export and import for the project activity will be taken from the monthly joint meter readings noted from the dedicated meters (individual meters to WEGs or in some cases group of WEGs as can be indentified from the allotted HTSC nos.) connecting 63 turbines of the project activity.

The project activity has clusters of WECs at the project site for the purpose of metering. Each cluster (i.e. individual/dedicated meter either for individual WEG or for group of WEGs as per allotted HTSC nos.) will have one main meter. Summation of meter reading for all the clusters (connecting 63 total machines) will provide net electricity generated by the project activity after adjustment of transmission loss.

Currently, there are 44 WEGs under the ownership of VIPCPL wherein 40 WEGs have individual/dedicated meters and remain 4 WEGs have 2 group meters each with 2 WEGs. In case of 19 WEGs under the ownership of VREGPL, 11 WEGs have one dedicated cluster meter and remaining 8 WEGs have individual/dedicated meters. These metering arrangements (i.e. reference of the Individual and group/cluster meters) correspond to the different HTSC nos., as listed in the last table under the Annex 1 of the PDD. In the single line diagram, referred under the Section B.7.3, the individual/dedicated meters and group/cluster meters are represented as cluster meters "X1a" and "X1b" for VIPCPL and VREGPL, respectively.

In addition to the cluster meters there is one main & check meter at high voltage side of WWIL Sub-station Pillyarkulam.at 110kV. The machines of the project activity and other project developers are connected to 110 KV metering point.

Metering Equipment: Metering equipment is electronic trivector meter of 0.2% accuracy class.

Meter Readings: The monthly meter reading is taken jointly by the parties (WWIL personals and personals of TNEB) for every last month. At the conclusion of each meter reading an appointed representative of TNEB and WWIL sign a document indicating the number of Kilowatt-hours (kWh) indicated by the meter.

QA/QC Procedure: All the meters are calibrated/ tested once in five years in line with line with para 18.1.b of the notification dated 17/03/2006 published by Central Electricity Board, Govt. of India (www.aegcl.co.in/Metering_Regulations_Of_CEA_17_03_2006.pdf). Copy of calibration/testing certificate will be kept as record by the PP and will be presented to the DoE during verification exercise.

Main and Check meter: In case the main meter(s) at 33kV metering point (cluster meter) is found to operate outside the permissible limits, the main meter will be either replaced or calibrated immediately and for the period during which meter was faulty the LCS controller reading will be referred to calculate electricity exported by WEGs.

At 110kV metering point at WWIL pooling sub-station; in case the main meter(s) is found to operate outside the permissible limits, the main meter will be either replaced or calibrated immediately. Whenever a main meter goes defective, the consumption recorded by the Check meter will be referred.

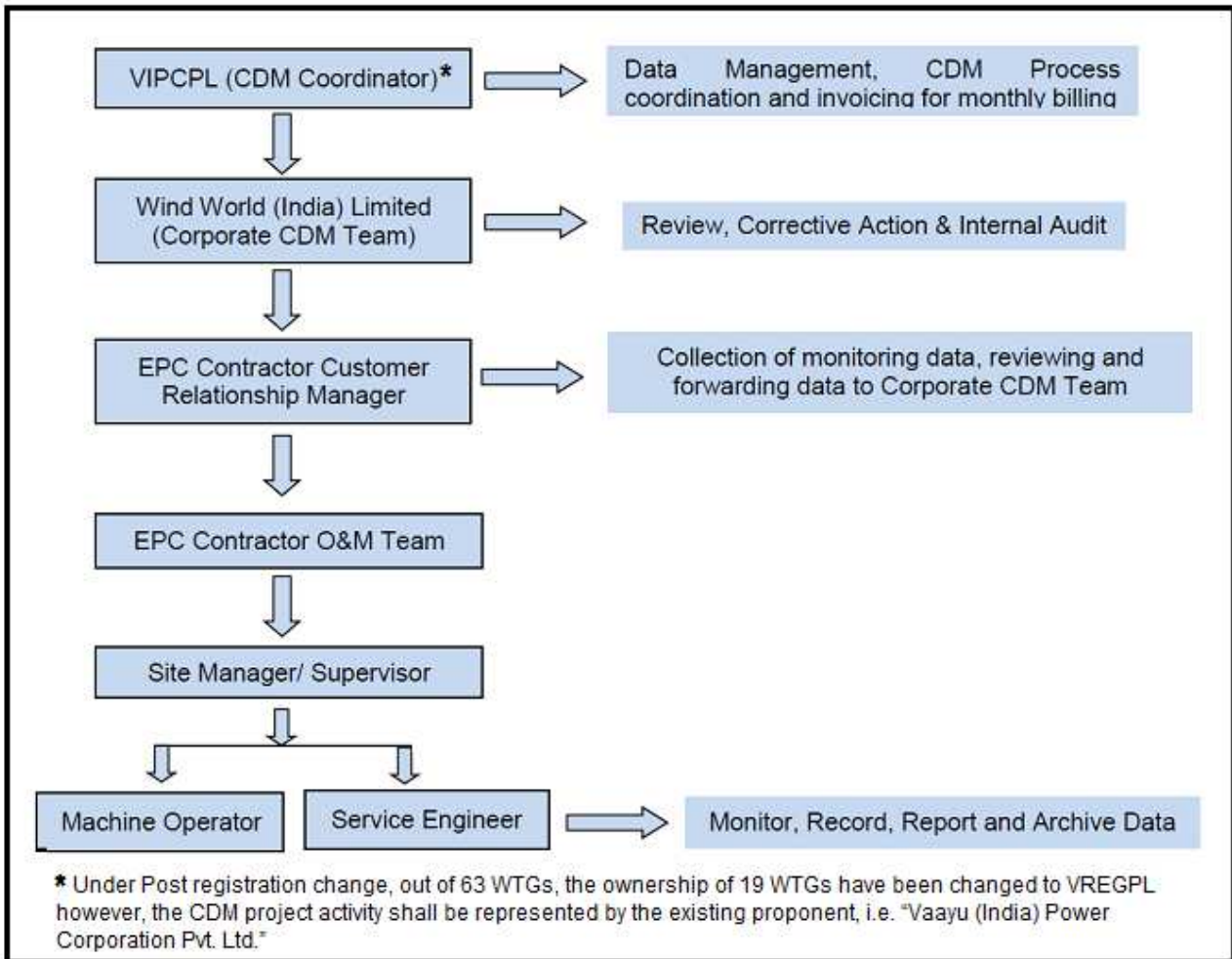
In case the date of registration or start date of the crediting period of the project does not match with the date of joint meter report, the apportioning for net electricity exported to the grid for first month will be done based upon the meter reading of the controller meter (also known as Local Control System (LCS) meter) located in the WEG tower and thereafter the readings from main meter will be referred.

PP will be monitoring the data sent by the O&M contractor and the data for electricity generated by the project activity will be kept as records for the period of 10+2 years i.e. 2 years beyond the term of crediting period. WWIL is O&M contractor and will be responsible for data recording.

All the main meters and check meters are calibrated once in five years in line with line with para 18.1.b of the notification dated 17/03/2006 published by Central Electricity Board, Govt. of India (www.aegcl.co.in/Metering_Regulations_Of_CEA_17_03_2006.pdf) and LCS meters do not require calibration as the energy readings of electricity generated at the LCS meter is cross verified by the energy calculated by inverting system installed in the WEGs. In case there is any mismatch in the energy values recorded by the LCS meter and the energy values calculated by the inverting system; the machine will stop working and generate the error report. Furthermore the net electricity supplied to the grid that is used for calculation of emission reductions can be cross checked from the invoices raised by the PP on the state utility w.r.t. the 44 WEGs of VIPCPL; and procedure for cross checking for the 19 WEGs of VREGPL has been demonstrated under the QA/QC section of the table1 under the section B.7.1. Therefore there is no data uncertainty.

Both the project participants Vaayu (India) Power Corporation Private Limited and Vaayu Renewable Energy (Godavari)Pvt. Ltd. will be keeping and monitoring the data for electricity generation and calibration reports post project implementation. WWIL will be the O&M contractor who will be having the responsibility of activities such as maintaining electricity generation records, calibration records and maintenance of the WEGs (Wind Energy Generators).

The operational and management structure implemented for data monitoring is as follows:



Appendix 6. Summary report of comments received from local stakeholders

Please refer section E.

Appendix 7. Summary of post-registration changes

Previously Approved PRC:

During registration, calibration frequency has been considered once in a year. However, in actual practice, state utility conducted the accuracy check of all interface meters at least once in five years. These meters also tested whenever the energy and other quantities recorded by the meter are abnormal or inconsistent with electrically adjacent meters. Same is in line with para 18.1.b of the notification dated 17/03/2006 published by Central Electricity Board, Govt. of India (www.aegcl.co.in/Metering_Regulations_Of_CEA_17_03_2006.pdf). Testing and calibration has been done by state utility which is beyond the control of Project Participant.

Further, name of the equipment supplier and the operations and maintenance contractor for the project activity has been changed from Enercon (India) Limited to Wind World (India) Limited (WWIL). Revised name of the equipment supplier and the operations and maintenance contractor has been considered in this revised PDD.

Furthermore, necessary changes have been incorporated pertaining to the revised CDM-PDD template ver 06.0.

PRC reference number: PRC-4930-001.

Current:

During the current monitoring period, there is a permanent change in the project activity as out of the 63 registered WEGs, the ownership of 19 WEGs had been changed from “Vaayu (India) Power Corporation Pvt. Ltd.” to “Vaayu Renewable Energy (Godavari) Pvt. Ltd.” w.e.f. Feb 2016. Therefore, a request for post registration change is being submitted to UNFCCC by submitting the revised PDD, version 09.

The details of post registration change requests are as follows:

➤ **Design Change:**

The ownership change of partial capacity (i.e. 15.2 MW consists of 19 WEGs) of the registered project activity has been addressed under the section A.1. And corresponding details in all other sections such as B.3, B.7 etc. are updated accordingly.

This change has been made in the registered PDD as ownership change of corresponding machines occurred in real and due to this change few elements in monitoring parameters are also changed. However, there is no change in total project capacity and physical status of the machines.

➤ **Revision in Monitoring Plan:**

Section B.7.1 and B.7.3 of the registered monitoring plan are revised as per ownership change. The 19 WEGs which were undergone ownership change from VIPCPL to VREGPL, are now under new PPA terms for third party power sale. Therefore, few elements of monitoring parameters were also undergone change which include “Source of Data” and “QA QC procedure”. Also, as the 19 WEGs are now under third party power sale, therefore project boundary diagram and single line diagram are also revised.

Section B.7.1:

Due to the change of ownership of 19 WEGs, there is a need of revision in the monitoring plan. The descriptions under “source of data” in the monitoring parameter tables are updated to address

the changes in data source due to ownership change. Also, the descriptions under “QA/QC procedures are updated appropriately.

Section B.7.3:

The line diagram of the metering arrangement of the project activity has been updated in line with the ownership change and a paragraph has been added for better representation. Also, few typographical changes are made across the section to present segregated information of the project WEGs respective to the two owners. The information pertaining to cluster of meters at dedicated metering end is explained in detail.

➤ Other corrections:

The following corrections have been made in the registered PDD version 06, dated 28/12/2015 as a result of the ownership change:

Section A.1:

Description has been revised to address the ownership change and change in power sale mode. Also, footnote 1 has been included to provide reference information. Footnote 2 & 3 have been revised as earlier link was not functional.

Section A.3:

Corrections are made in the name of technology supplier. Also, the footnote reference 4 has been corrected.

Section A.4:

Other project participants added to the project are now included in the table under the section A.4. Also, a footnote reference #5 has been included.

Section B.3:

Project boundary description has been updated in line with ownership change and also the flow diagram has been updated.

Section B.4:

Typographical change in the table showing Indian grid system and a footnote reference #6 has been included. Also, the footnote ref. #8 has been updated.

Section B.5:

Typographical changes made across the section to address the current status due to ownership change. Also, in the table of “Assumption for Financial Model” the name of the WEG and O&M supplier has been corrected to provide the current name and the new power tariff for the ownership changed WEGs has been included.

Additionally, a para has been added to justify the applicability of change in other parameters due to ownership change. Also, the results of the IRR value have been updated after the re-assessment due to ownership change.

Similarly, the description related to the revised tariff of the ownership changed machines is included under the Tariff section and a footnote #9 has been included to provide required reference.

Also, the tables of sensitivity analysis have been updated as per the two sets of IRR.

Section B.6.1:

Few typographical corrections made for consistency and also the CEA database references under the “Details of Baseline data” are updated.

Section C.3.2:

Information related to start date of the crediting period has been corrected.

Appendix 1:

Updated contact information has been included under the table in the Appendix 1.

Appendix 5:

Few typographical additions have been made in this section in line with the ownership change. Also, a few information related to metering arrangement has been explained. Also, the chart related to Operational & management structure has been updated under this section.

Appendix 7:

Appendix 7 has been updated with PRC related information.

Annex 1:

This section has been updated with information related to WEGs for the respective owners and also the details of the ownership change of 19 WEGs are highlighted.

Annex-1

Geo-coordinates of Project Activity

Sl.No	Location Number	Village	Latitude	Longitude
1	7	KURUCHIKULAM	8° 53' 26.985" N	77° 35' 43.461" E
2	8	KURUCHIKULAM	8° 53' 18.435" N	77° 35' 51.873" E
3	146	VAGAIKULAM	8° 55' 58.299" N	77° 37' 54.634" E
4	147	KALAKUDI	8° 56' 23.880" N	77° 37' 48.373" E
5	149	VAGAIKULAM	8° 55' 38.340" N	77° 37' 38.952" E
6	150	VAGAIKULAM	8° 55' 37.857" N	77° 37' 24.555" E
7	151	VAGAIKULAM	8° 55' 47.538" N	77° 37' 26.390" E
8	153	VAGAIKULAM	8° 55' 37.857" N	77° 37' 24.555" E
9	154	VAGAIKULAM	8° 56' 37.357" N	77° 37' 19.517" E
10	155	VAGAIKULAM	8° 56' 19.107" N	77° 37' 15.101" E
11	156	VAGAIKULAM	8° 55' 55.775" N	77° 37' 11.630" E
12	157	VAGAIKULAM	8° 55' 42.415" N	77° 37' 10.193" E
13	158	VAGAIKULAM	8° 55' 48.057" N	77° 36' 59.013" E
14	159	MUTHAMMALPURAM	8° 56' 33.966" N	77° 37' 6.832" E
15	160	MUTHAMMALPURAM	8° 56' 28.029" N	77° 36' 55.438" E
16	163	VAGAIKULAM	8° 56' 11.019" N	77° 36' 36.636" E
17	165	UKKIRANKOTTAI	8° 56' 12.215" N	77° 36' 19.240" E
18	167	KALAKUDI	8° 55' 8.373" N	77° 36' 58.664" E
19	179	VAGAIKULAM	8° 56' 45.130" N	77° 37' 33.509" E
20	180	VAGAIKULAM	8° 56' 6.770" N	77° 37' 11.676" E
21	181	VAGAIKULAM	8° 56' 3.605" N	77° 36' 54.544" E
22	V48	KURUCHIKULAM	8° 53' 6.300" N	77° 35' 0.824" E
23	V49	KURUCHIKULAM	8° 52' 57.577" N	77° 35' 10.805" E
24	V51	KURUCHIKULAM	8° 52' 40.412" N	77° 35' 9.180" E
25	V58	KURUCHIKULAM	8° 53' 30.146" N	77° 35' 9.922" E
26	V59	KURUCHIKULAM	8° 53' 22.443" N	77° 35' 13.695" E
27	V60	KURUCHIKULAM	8° 53' 10.091" N	77° 35' 16.977" E
28	V63	KURUCHIKULAM	8° 52' 34.838" N	77° 35' 29.519" E
29	V72	KURUCHIKULAM	8° 53' 12.156" N	77° 35' 33.445" E
30	V73	KURUCHIKULAM	8° 53' 2.788" N	77° 35' 33.248" E
31	V74	KURUCHIKULAM	8° 52' 53.993" N	77° 35' 34.953" E
32	V90	KALAKUDI	8° 52' 44.966" N	77° 36' 14.566" E
33	V94	KALAKUDI	8° 52' 22.001" N	77° 36' 14.274" E
34	V100	KALAKUDI	8° 52' 58.118" N	77° 36' 31.636" E
35	V101	KALAKUDI	8° 52' 48.402" N	77° 36' 30.161" E
36	V104	KALAKUDI	8° 52' 20.945" N	77° 36' 35.036" E
37	V105	KALAKUDI	8° 52' 12.502" N	77° 36' 32.883" E
38	V106	KALAKUDI	8° 52' 2.346" N	77° 36' 33.826" E
39	V107	KALAKUDI	8° 53' 21.734" N	77° 36' 59.574" E
40	V108	KALAKUDI	8° 53' 8.659" N	77° 36' 45.416" E
41	V109	KALAKUDI	8° 53' 0.568" N	77° 36' 44.148" E
42	V110	KALAKUDI	8° 52' 51.507" N	77° 36' 46.537" E
43	V114	ETTANKULAM	8° 52' 12.368" N	77° 36' 51.919" E
44	V116	KALAKUDI	8° 53' 12.200" N	77° 37' 22.992" E
45	V119	KALAKUDI	8° 53' 5.291" N	77° 37' 1.747" E
46	V120	KALAKUDI	8° 52' 54.106" N	77° 37' 5.527" E
47	V123	VAGAIKULAM	8° 54' 1.042" N	77° 37' 7.115" E
48	V125	KALAKUDI	8° 53' 20.931" N	77° 37' 25.769" E
49	V127	KALAKUDI	8° 53' 32.234" N	77° 37' 9.822" E

50	V129	KALAKUDI	8° 53' 21.809" N	77° 37' 11.906" E
51	V130	KALAKUDI	8° 53' 2.610" N	77° 37' 22.073" E
52	V132	KALAKUDI	8° 52' 47.738" N	77° 37' 22.916" E
53	V134	VAGAIKULAM	8° 54' 1.377" N	77° 37' 24.029" E
54	V137	KALAKUDI	8° 53' 52.241" N	77° 37' 23.375" E
55	V139	KALAKUDI	8° 53' 44.058" N	77° 37' 25.901" E
56	V141	KALAKUDI	8° 53' 30.641" N	77° 37' 23.385" E
57	V145	KALAKUDI	8° 53' 4.624" N	77° 37' 36.251" E
58	V147	KALAKUDI	8° 52' 56.356" N	77° 37' 32.431" E
59	V164	KALAKUDI	8° 53' 28.505" N	77° 36' 44.968" E
60	V165	KALAKUDI	8° 52' 32.752" N	77° 36' 25.961" E
61	V166	KALAKUDI	8° 53' 36.953" N	77° 36' 41.757" E
62	V167	KALAKUDI	8° 52' 30.367" N	77° 37' 13.700" E
63	W23	VAGAIKULAM	8° 55' 29.524" N	77° 37' 39.052" E

The list of WEGs own by the two project participants are as follows:

S. No.	WEG HTSC No	No. & Capacity (kW)	Project Participant
1	3376	11 X 800	Vaayu Renewable Energy (Godavari) Pvt. Ltd. (VREGPL)
2	3462	1 X 800	
3	3500	1 X 800	
4	3501	1 X 800	
5	3502	1 X 800	
6	3503	1 X 800	
7	3504	1 X 800	
8	3505	1 X 800	
9	3506	1 X 800	
10	3461	1 X 800	Vaayu (India) Power Corporation Pvt. Ltd. (VIPCPL)
11	3463	1 X 800	
12	3464	1 X 800	
13	3465	1 X 800	
14	3466	1 X 800	
15	3467	1 X 800	
16	3470	2 X 800	
17	3507	1 X 800	
18	3508	1 X 800	
19	3509	2X 800	
20	3510	1 X 800	
21	3511	1 X 800	
22	3512	1 X 800	
23	3513	1 X 800	
24	3514	1 X 800	
25	3515	1 X 800	
26	3516	1 X 800	
27	3517	1 X 800	
28	3518	1 X 800	
29	3519	1 X 800	

30	3528	1 X 800
31	3768	1 X 800
32	3769	1 X 800
33	3770	1 X 800
34	3771	1 X 800
35	3772	1 X 800
36	3773	1 X 800
37	3774	1 X 800
38	3775	1 X 800
39	3776	1 X 800
40	3777	1 X 800
41	3778	1 X 800
42	3779	1 X 800
43	3780	1 X 800
44	3781	1 X 800
45	3782	1 X 800
46	3783	1 X 800
47	3784	1 X 800
48	3785	1 X 800
49	3789	1 X 800
50	3790	1 X 800
51	3791	1 X 800
Total		50.4 MW

Details of ownership change:

- ✓ VIPCPL has decided to go for ownership change of 19 WEGs (as listed above) from VICPL to its subsidiary company VREGPL, confirmed via declaration note from Director dated 12th Oct 2015.

(The certified copy of the declaration from director, dated 12th Oct 2015 is submitted to DOE)

- ✓ The new PPAs (i.e. third party power sale to JK Tyre & Industries Limited) were signed on 19th Nov 2015 (for 7 WEGs) and 3rd Nov 2016 (for 12 WEGs) respectively.

(The copies of the PPA are submitted to DOE)

- ✓ The ownership transfer was occurred during the month of February 2016.

(Same is visible in the JMR and invoices of the month of February 2016).

Annex-2

Calculation on Cost of Equity

Selection of Appropriate Benchmark:

In choosing an appropriate benchmark we have based our approach on the principles of financing and investment decision making that are well found in theory and practice of corporate financing worldwide. We have derived from text book on “Corporate Finance Theory and Practice” by Dr.AswathDamodaran of Stern School of Business, New York University. Dr.Damodaran is one of the foremost authorities in the world in the field of Investment Analysis.

The guidance to investment analysis issued in EB 51 states that in cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR and cost of Equity is appropriate benchmark for equity IRR.

It is also worthwhile to note that the captioned project is a Greenfield wind power generation project that generates and supplies electricity to the state grid, therefore the project cannot have only one possible project developer. The tool for demonstration and assessment of additionality [para-5, sub step 2(b)] states that in such cases (where the project has more than one potential developer) the benchmark cannot be based on internal cost of equity or WACC and shall be based on parameters that are standard in the market, considering the specific characteristics of the project type. Hence, we have not used company or project specific parameters for the calculation of the benchmark.

Risk free rate:

The risk free rate is understood as the rate of return on an asset that is theoretically free of any risks, therefore the yeild rates are considered as risk free rates. Page 188 of text book on “Corporate Finance Theory and Practice” by Dr. Aswath Damodaran¹⁵, Stern School of Business, New York University, describes that the yield rates are suitable indicators of risk free rates when the time horizon for the investment is long term.

Accordingly the risk free rate has been taken from yield rates available at the decision making date. This has been considered as it was in the year of investment (i.e in that year, the company had the alternative of this long term risk free investment). The data on yield rates is published by Reserve Bank of India dated Nov 11, 2009. Being conservative we PP used the average of 4 month risk free rate as mentioned below:-

	Jun-09	Jul-09	Aug-09	Sep-09
Risk Free Rate	7.78%	7.79%	8.18%	8.16%
Average value	7.98%			
(Web-link: http://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/27CT_BUNOV09.pdf)				

The applicable risk free rate is 7.98%.

Market Risk Premium:

The most common approach for estimating the risk premium is to base it on historical data, in the CAPM, the premium is estimated by looking at the difference between average return on stocks and risk free return. It is preferred to use long term premiums, i.e over a period of 25 years, since considering shorter time periods can lead to large standard errors because volatility in stock returns [page 191, Corporate Finance Theory and Practice, Dr.AswathDamodaran]. It is also preferred to calculate the risk premium based on geometric mean of the returns since arithmetic mean overstates the risk premium. Geometric mean is defined as the compounded annual return over the same period [page 191, Corporate Finance Theory and Practice, Dr.AswathDamodaran].

In India, there is no power sector index available with long term data. The stock exchanges have only recently started publishing index for power sector comprising of companies in the power sector business and one such index available is BSE POWER index (<http://www.bseindia.com/about/abindices/sectoralindices.asp>), launched in November 2007 with index data available from January 2005. This index was not considered in benchmark determination, since only the less than 5 year data was available at the time of decision.

The research paper titled “equity risk premiums” by Dr. Damodaran (Page no [6] of “Equity Risk Premium”) states that the standard errors are large in case data used is for shorter duration (source: http://www1.worldbank.org/finance/assets/images/Equity_Risk_Premiums.pdf) . Thus for calculation of equity risk premiums, longer time periods are considered as appropriate. We have considered market data for four indices that have data available for more than 10 years (BSE Sensex, BSE 100, BSE 200 and BSE 500). The data for these four indices was analysed and minimum market return was used for computing benchmark. Furthermore the market return is adjusted for beta of power sector stocks used for determining cost of equity.

Market Return	BSE Sensex	BSE-100	BSE-200	BSE-500
Investment Decision Date	Nov-09	Nov-09	Nov-09	Nov-09
Data available	Oct-09	Oct-09	Oct-09	Oct-09
No of years of Index	30.60	26.60	20.59	10.75
Market return	18.01%	18.09%	15.55%	18.39%

Therefore the risk premium has been calculated as the difference in compounded annual return between the BSE-200 and the yield rate since the year of inception of BSE 200. The detailed calculations are presented in the attached excel sheet.

The applicable risk premium = 15.55%- 7.98%

= 7.58%.

Beta:

Beta (B) indicates the sensitivity of the company to market risk factors. Beta represents the market risk for an asset and is calculated as the statistical measure of volatility of a specific asset/investment relative to the movement of a market group. The conventional approach for estimating beta of an investment is a regression of returns on investment against returns on a market index. For companies that are not publicly listed, the beta is determined by referring beta values of publicly listed companies that are engaged in similar types of business. The project activity type is wind power generation; the approach therefore should be to base the beta for the project on the beta values of listed wind power generation companies in India. Therefore, in the absence of adequate data on companies which are exclusively into the exactly same type of business (i.e wind power projects), the next best option for assessing the risk of these projects is to consider the data available on companies which are involved in similar businesses.

Therefore, we have considered beta values of all major electricity generating companies in India. The group of companies considered includes renewable as well as conventional power generating companies. It is understood that risky businesses are likely to have higher cost of equity than safer businesses; projects in riskier businesses will have to cover these higher costs. Hence, investors demand a higher return from renewable energy projects than from conventional energy ones, given the higher risks in renewable, including risks of technology, risks from significantly varying and unpredictable resource availability (e.g. wind), and a lower established support base for such projects relative to that for conventional power (e.g. grid connections, bank finance, suppliers, etc.). The use of this Beta value is therefore considered conservative, as it does not add for the higher risk of non conventional energy.

The applicable Beta value has been determined on the basis of the Beta values of major power generating companies in India which were listed on the stock exchange at the time of this investment. Beta values of individual companies have been sourced from Bloomberg.

The table below summarises the beta values:

Company Name	Beta
CESE	1.11
Energy Dev	1.19
Gujarat Industries	0.96
Reliance	1.57
Tata Power	1.03
Average	1.17
Period: Five years up to October 2009 from Bloomberg	

Calculation of Benchmark Cost of Equity:

Cost of Equity:

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM)¹⁶. The CAPM economic model is used worldwide to determine the required/expected return on equity based on potential risk of an investment. The CAPM framework is the Nobel award winning work of financial economist Dr. William Sharpe.

$$K_e = R_f + B \times (R_m - R_f)$$

where:

K_e = Rate of return on equity capital;

R_f = Risk-free rate of return;

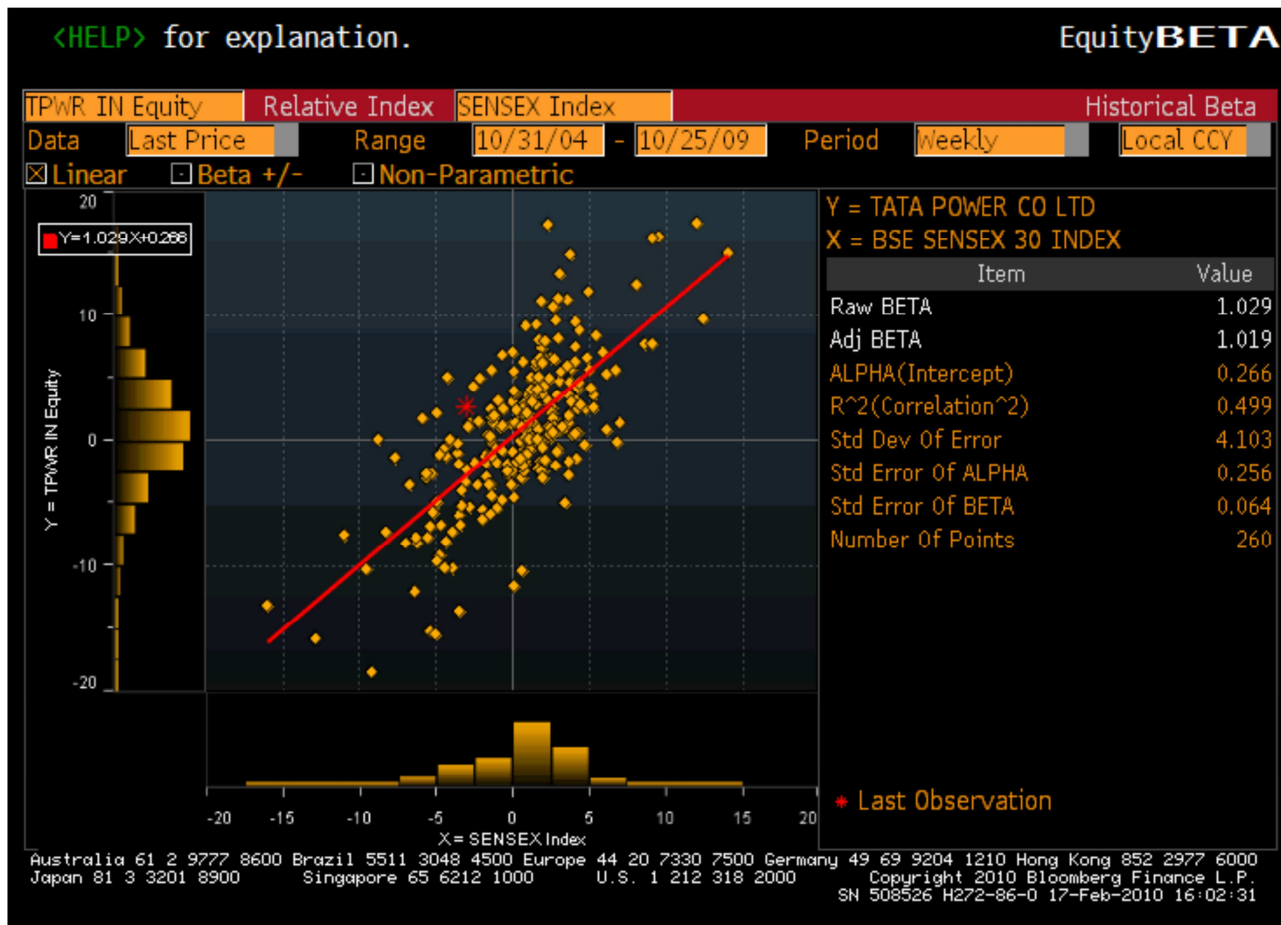
B = Beta;

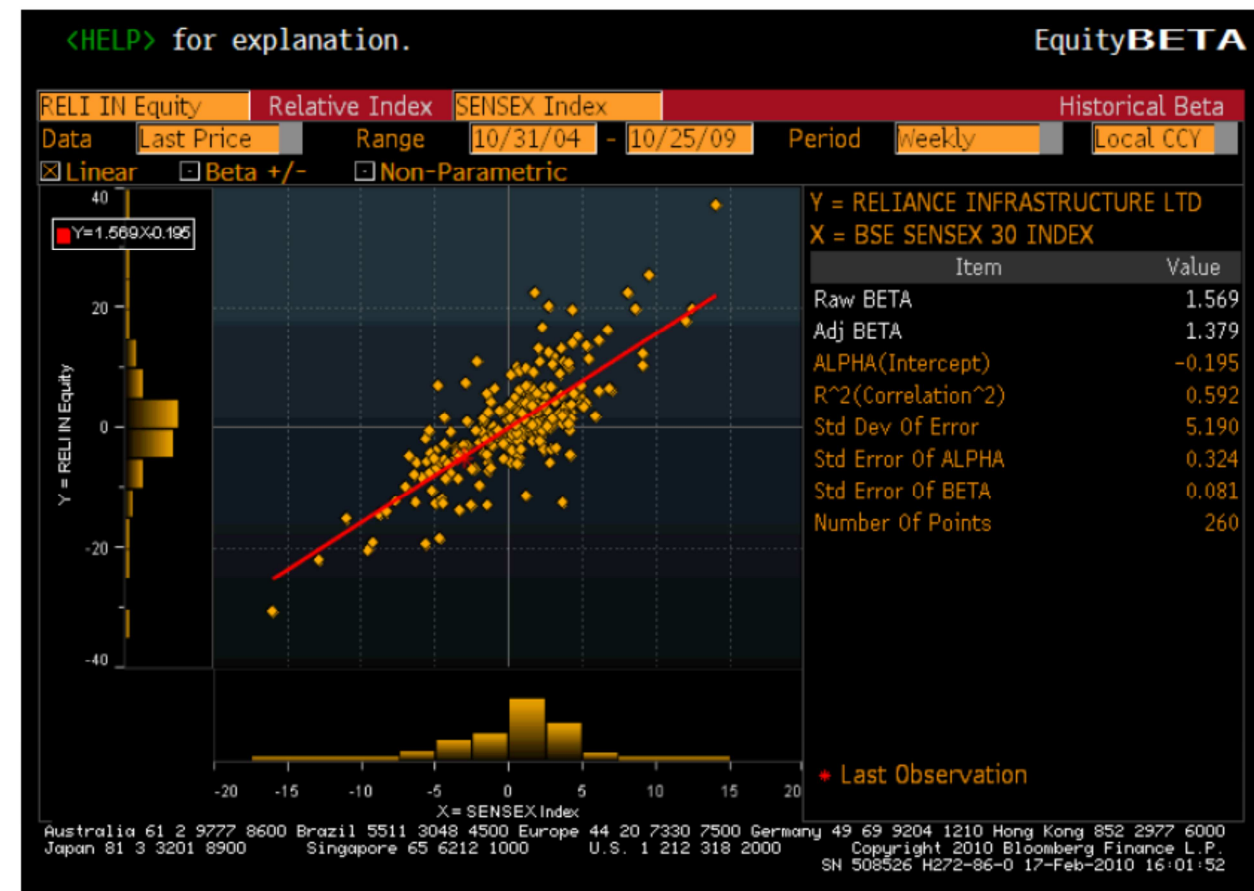
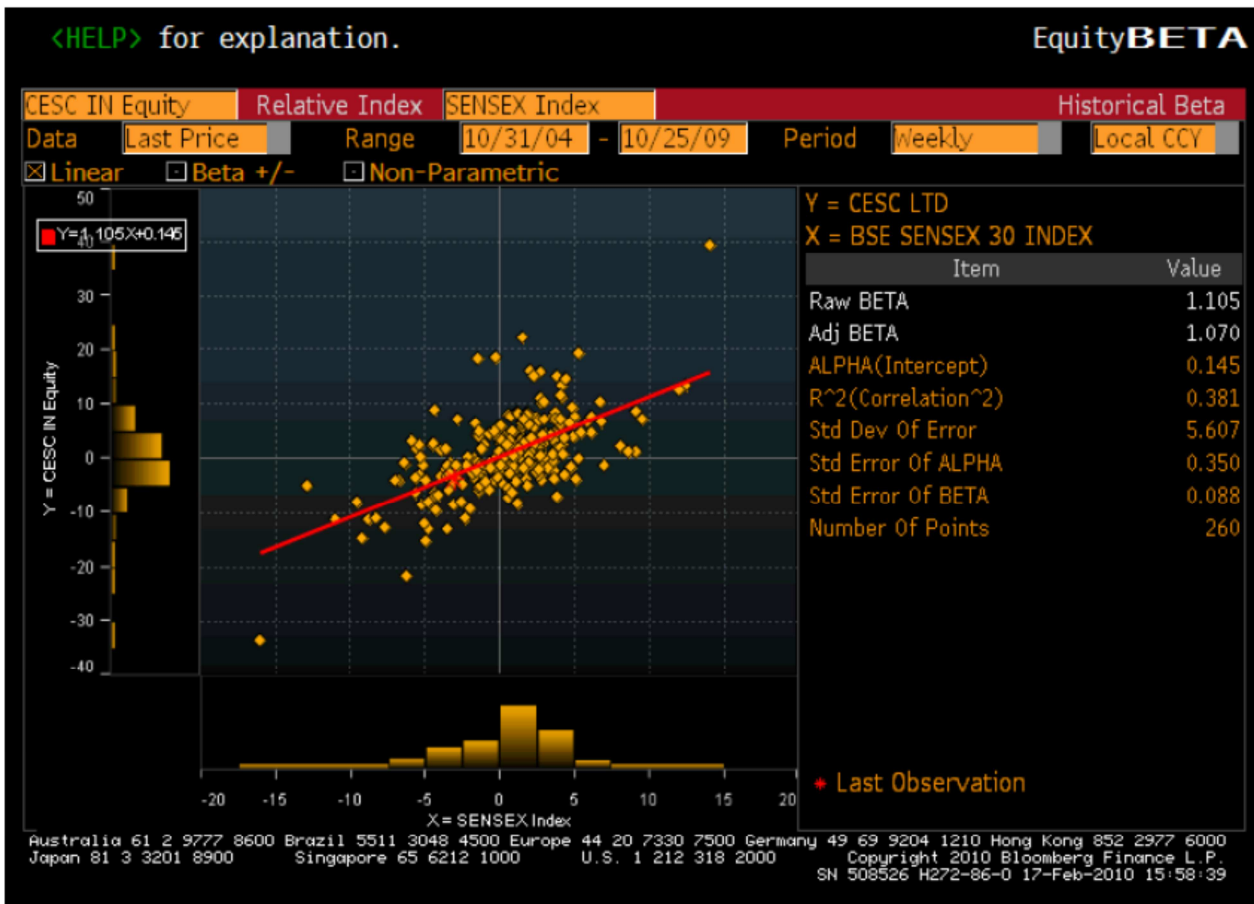
$R_m - R_f$ = Market risk premium;

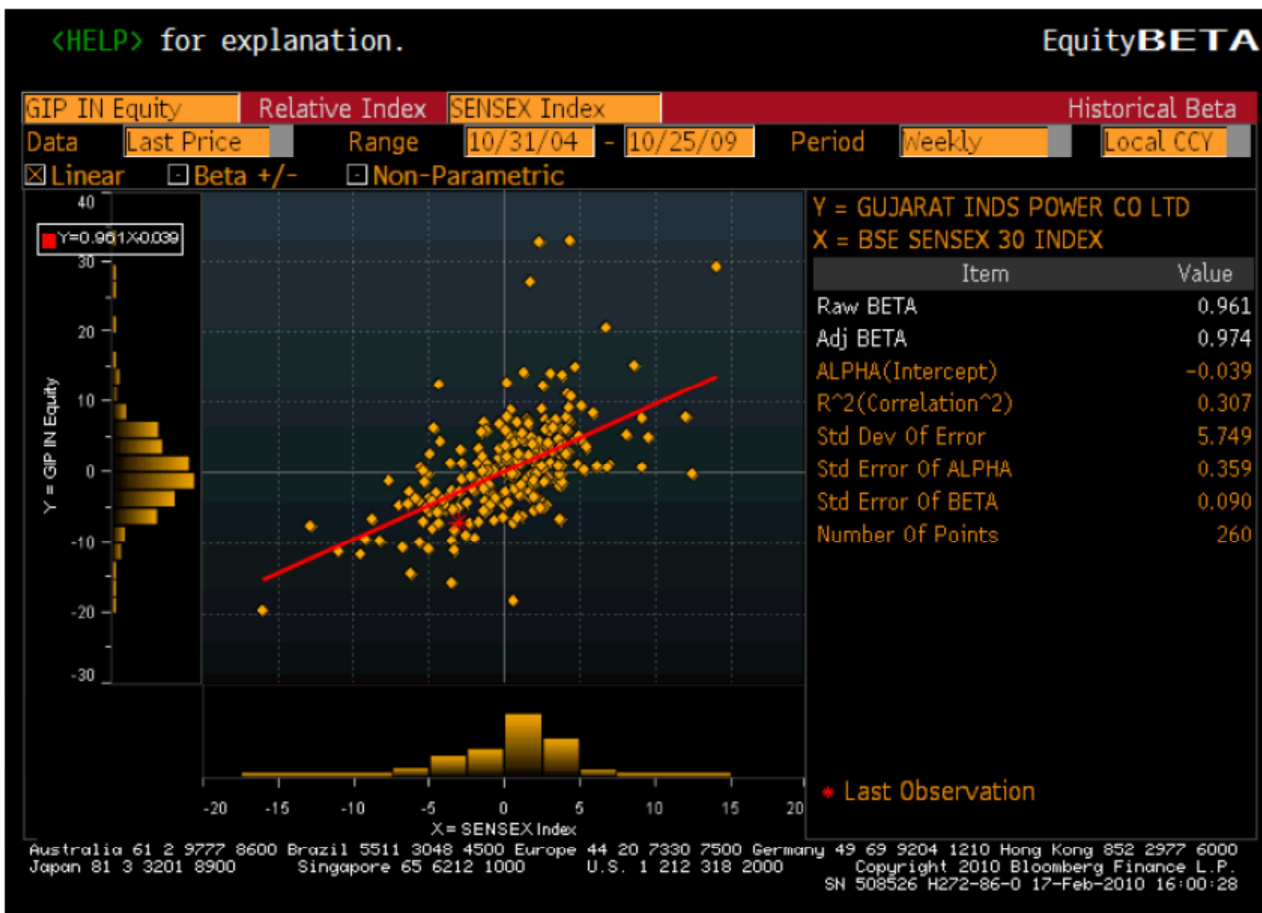
$$\begin{aligned} \text{Cost of Equity} &= \text{Risk Free Rate} + \text{Beta} \times \text{Market risk premium} \\ &= 7.98\% + 1.17 \times 7.58\% \\ &= 16.84\% \end{aligned}$$

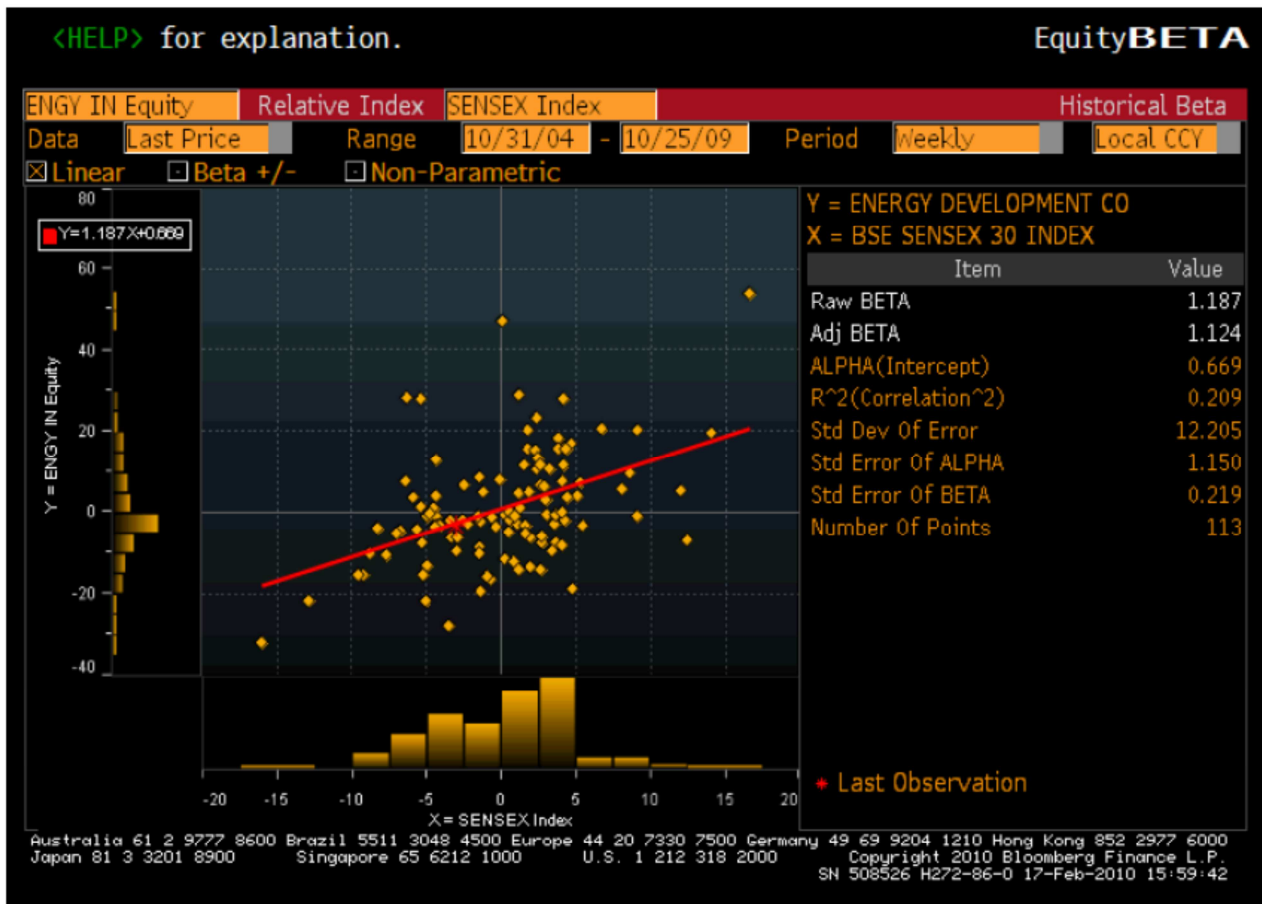
Annex- 3

BETA SNAPSHOTS FROM BLOOMBERG









Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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.
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

<i>Version</i>	<i>Date</i>	<i>Description</i>
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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