



**CLEAN DEVELOPMENT MECHANISM  
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)  
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

Title: Vaayu India Wind Power Project in Tamilnadu.

Version: 1.0

Date of completion of PDD: 22/03/2010

**A.2. Description of the project activity:**

Vaayu (India) Power Corporation Private Limited (VIPCPL) is developing 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 shall be 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.

**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<sub>2</sub>e 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 fuels<sup>1</sup>. 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. Enercon (India) Limited ("Enercon") 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).

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<sup>1</sup> <http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>

**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 India<sup>2</sup>. The contributions of this project activity towards these indicators are provided below:

**1. 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.

**2. 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.

**3. 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.

**4. 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

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<sup>2</sup>[http://cdmindia.nic.in/host\\_approval\\_criteria.htm](http://cdmindia.nic.in/host_approval_criteria.htm)



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.

**A.3. Project participants:**

| Name of Party involved ((host) indicates a host Party) | Private and/or public entity(ies) project participants (*) (as applicable) | Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|--|--|---|
| India (Host)   | Vaayu (India) Power Corporation Private Limited                            | No  |

The contact details of the entities are provided in Annex – 1.

**A.4. Technical description of the project activity:**
**A.4.1. Location of the project activity:**
**A.4.1.1. Host Party(ies):**

India

**A.4.1.2. Region/State/Province etc.:**

Southern Region/Tamilnadu State

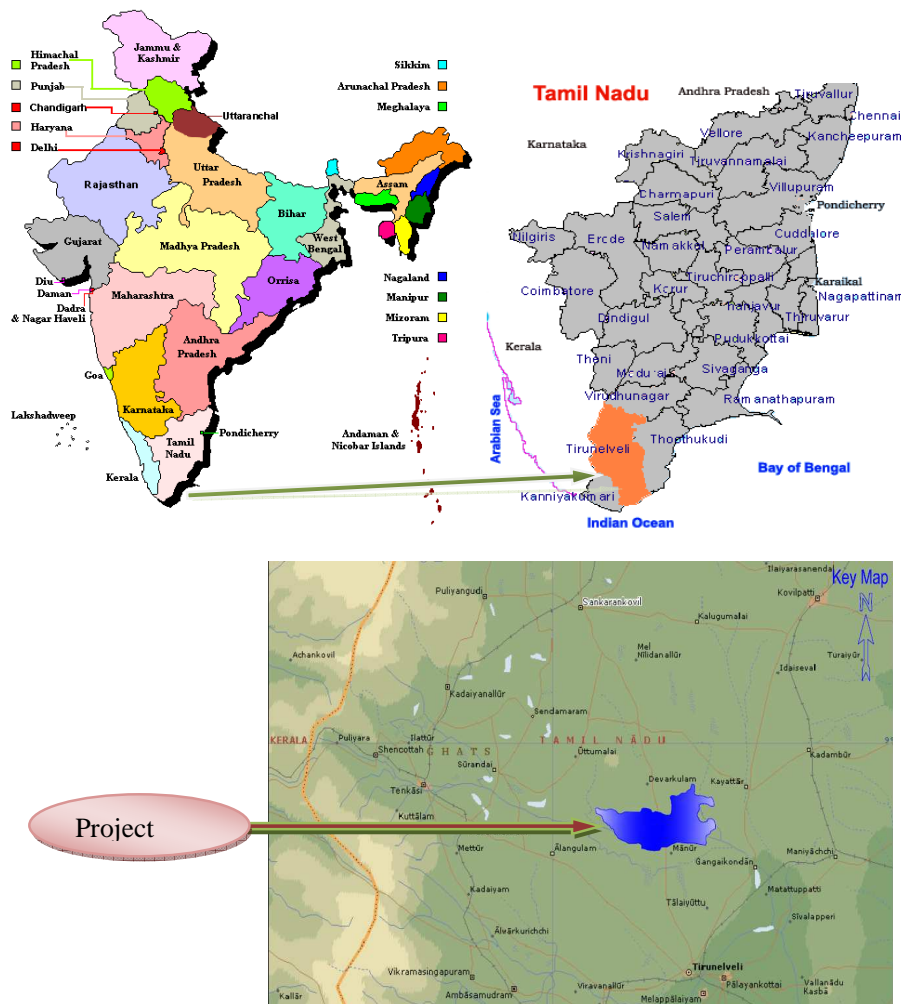
**A.4.1.3. City/Town/Community etc:**

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

**A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):**

The project area extends between latitude 8° 51' and 8° 54' North and longitude 77° 35' and 77° 37' East.

Tirunelveli railway station is about 25 kms away from the site. Nearest airport is at Tuticorin about 70 kms from the site.



#### A.4.2. Category(ies) of project activity:

The project activity is considered under CDM category zero-emissions ‘**grid-connected electricity generation from renewable sources**’ that generates electricity in excess of 15 MW (limit for small scale project). Therefore as per the scope of the project activity enlisted in the ‘list of sectoral scopes and related approved baseline and monitoring methodologies’, the project activity may principally be categorized in **Scope Number 1, Sectoral Scope - Energy industries (renewable/ non-renewable sources)**.

**A.4.3. Technology to be employed by the project activity:**

The project activity involves 63-wind energy converters (WECs) of 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  $\pm$  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              | Enercon E- 53  |
| Rated power                | 800 KW   |
| Rotor diameter             | 53 m   |
| Hub height                 | 75 m   |
| 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  |

Enercon 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 fuels<sup>3</sup>, 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.4.4 Estimated amount of emission reductions over the chosen crediting period:**

The estimated emission reductions over the 10 year fixed crediting period would be 10,36,120 tCO<sub>2</sub>e as per details on annual emission reductions provided below:

| <b>Years</b>   | <b>Annual estimation of emission reductions in tonnes of CO<sub>2</sub>e</b> |
|--|--|
| *1 <sup>st</sup> year  | 103,612  |
| 2 <sup>nd</sup> year   | 103,612  |
| 3 <sup>rd</sup> year   | 103,612  |
| 4 <sup>th</sup> year   | 103,612  |
| 5 <sup>th</sup> year   | 103,612  |
| 6 <sup>th</sup> year   | 103,612  |
| 7 <sup>th</sup> year   | 103,612  |
| 8 <sup>th</sup> year   | 103,612  |
| 9 <sup>th</sup> year   | 103,612  |
| 10 <sup>th</sup> year  | 103,612  |
| Total estimated reductions (tonnes of CO <sub>2</sub> e)                                       | 10,36,120  |
| Total number of crediting years  | 10   |
| Annual average over the crediting period of estimated reductions (tonnes of CO <sub>2</sub> e) | 103,612  |

\*1<sup>st</sup> year begins from the date of registration, and each year extends for 12 months.

#### **A.4.5. Public funding of the project activity:**

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

<sup>3</sup> <http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

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

**Reference:** Approved consolidated baseline methodology ACM0002 (Version 11, EB 52)

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 Justification of the choice of the methodology and why it is applicable to the project activity:**

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 11 is the relevant baseline and monitoring methodology and it is applicable because:

| Para No. | Applicability Conditions as per ACM 0002  | Applicability to this Project Activity  |
|----------|---|---|
| 1.       | <p>The project activity is the installation capacity addition, retrofit or replacement of a power plant/unit of one of the following types:</p> <ul style="list-style-type: none"> <li>• Hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir)</li> <li>• Wind power plant/unit,</li> <li>• Geothermal power plant/unit,</li> <li>• Solar power plant/unit,</li> <li>• Wave power plant/unit</li> <li>• Tidal power plant/unit.</li> </ul> | 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  | This condition is not relevant, as the project activity does not involve capacity additions, retrofits or replacements. |





|    |   |   |
|----|---|---|
|    | 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;  |   |
| 3. | <p>In case of hydro power plants:</p> <ul style="list-style-type: none"><li>• The project activity is implemented in an existing reservoir, with no change in the volume of reservoir.</li><li>• 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/m<sup>2</sup>.</li><li>• 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/m<sup>2</sup>.</li></ul> | This condition is not relevant, as the project activity is not the installation of a hydro power plant.   |
| 4. | <p>The methodology is not applicable to the following:</p> <ul style="list-style-type: none"><li>• 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;</li><li>• Biomass fired power plants;</li><li>• 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/m<sup>2</sup>.</li></ul>   | The project activity does not involve any of the given criteria hence methodology is applicable for the project activity.   |
| 5. | 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”.   | 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. |

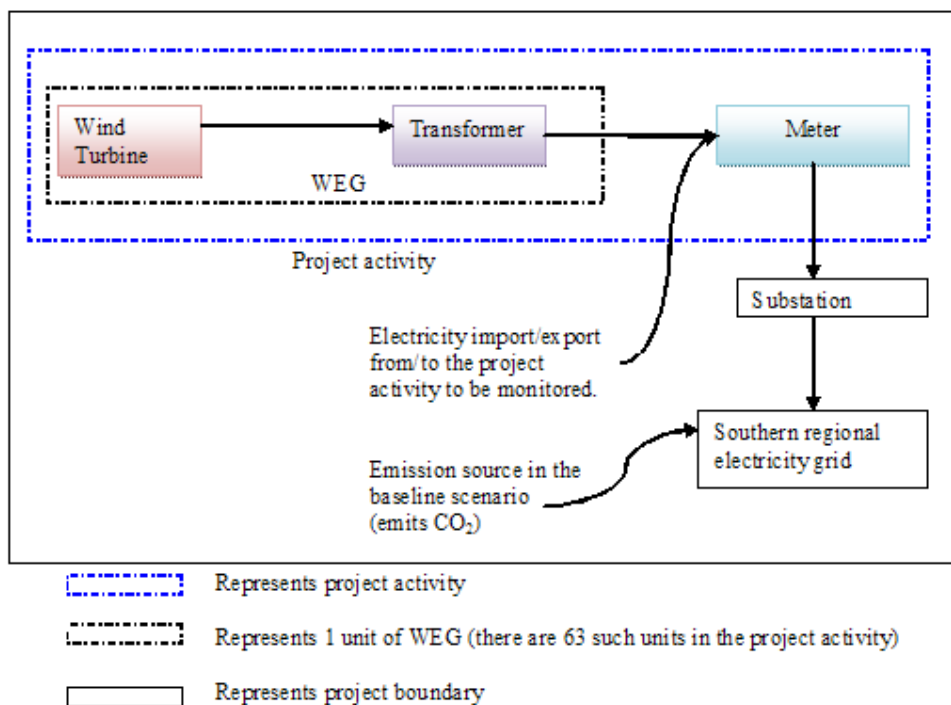


The description provided in the table above shows that the project activity satisfies the applicable conditions of the methodology, ACM0002.

### B.3. Description of the sources and gases included in the project boundary

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.

#### Flow diagram of the project boundary:



The baseline study of Southern grid shows that the main sources of GHG emissions in the baseline are CO<sub>2</sub> emissions from the conventional power generating systems, the other emissions are that of CH<sub>4</sub> and N<sub>2</sub>O 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 | Gas | Included? | Justification/Explanation |
|--|--------|-----|-----------|---------------------------|
|--|--------|-----|-----------|---------------------------|



|                         |  |                  |     |   |
|-------------------------|--|------------------|-----|---|
| <b>Baseline</b>         | Grid-connected electricity generation    | CO <sub>2</sub>  | 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 <sub>2</sub> . |
|                         |  | CH <sub>4</sub>  | No  | No methane generation is expected to be emitted.  |
|                         |  | N <sub>2</sub> O | No  | No nitrous oxide generation is expected to be emitted.  |
| <b>Project Activity</b> | Greenfield wind energy conversion system | CO <sub>2</sub>  | No  | The project activity does not emit any emissions.   |
|                         |  | CH <sub>4</sub>  | No  | No methane generation is expected to be emitted.  |
|                         |  | N <sub>2</sub> O | No  | No nitrous oxide generation is expected to be emitted.  |

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

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 India grid system is described in the table below:

| S.No. | Electricity Grid (Present) | Electricity Grid (Earlier) | Geographical Areas Covered   |
|-------|----------------------------|----------------------------|--|
| 1.    | NEWNE Grid                 | 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, Tripura  |
| 2. | Southern Grid | Southern | Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Pondicherry, Lakshadweep |

Tamilnadu state falls under Southern grid. The power sector in India including the Southern region largely comprises thermal power stations<sup>4</sup>; as can be seen from the table below<sup>5</sup>:

| Sector    | Hydro    | Thermal  |          |         |          | Nuclear | Renewable | Total     |
|-----------|----------|----------|----------|---------|----------|---------|-----------|-----------|
|           |          | Coal     | Gas      | Diesel  | Total    |         |           |           |
| State     | 27055.76 | 42537.5  | 3672.12  | 602.61  | 46812.23 | 0.00    | 2247.68   | 76115.67  |
| Central   | 8592.00  | 29620.00 | 6638.99  | 0.00    | 36258.99 | 4120.00 | 0.00      | 48970.99  |
| Private   | 1230.00  | 5491.38  | 4565.50  | 597.14  | 10654.02 | 0.00    | 10994.73  | 22878.75  |
| All India | 36877.76 | 77648.88 | 14876.61 | 1199.75 | 93725.24 | 4120.00 | 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 CO<sub>2</sub> 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 <sub>PJ,y</sub> = 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                                    |
| Parameter   | Data Source   |
| EF <sub>OM, y</sub> = Operating Margin Emission Factor (tCO <sub>2</sub> /MWh)  | CEA Database for CO <sub>2</sub> emission factor, version 5                 |
| EF <sub>BM, y</sub> = Build Margin Emission Factor (tCO <sub>2</sub> /MWh)  | CEA Database for CO <sub>2</sub> emission factor, version 5                 |
| EF <sub>y</sub> – Grid Emission Factor  | Calculated as the weighted average of the operating margin and build margin |

<sup>4</sup> <http://www.cea.nic.in/>

<sup>5</sup> <http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

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**

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 Proponent proposes to use **Option III – Benchmark Analysis** and the financial indicator is identified as *post-tax* equity IRR.

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



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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%**.

**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:

| Assumptions for Financial Model   |                 |                   |   |
|---|-----------------|-------------------|---|
| Capacity of Machines in kW  | 800             |                   | Enercon Offer   |
| Number of Machines  | 63              |                   | Enercon Offer   |
| Project Capacity in MW  | 50.40           |                   | Enercon Offer   |
| Expected project commissioning date   | 01-Apr-11       |                   | Enercon Offer   |
| Project Cost per MW (Rs. In Millions)   | 59.34           |                   | Calculated  |
| <b>Operations</b>   |                 |                   |   |
| Plant Load Factor Base Case   | 24.83%          |                   | C-WET Report  |
| Transformation loss and Transmission Loss up to metering point  | 0.0%            |                   |   |
| Effective PLF   | 24.83%          |                   | Calculated  |
| Insurance Charges @ % of capital cost   | 0.12%           |                   | Normative   |
| Operation & Maintenance Cost base year @ % of capital cost  | 1.30%           |                   | Enercon's offer   |
| % of escalation per annum on O & M Charges  | 6.0%            |                   | Enercon's offer   |
| <b>Tariff</b>   |                 |                   |   |
| Base year Tariff for 20 years - Rs./Kwh   | 3.39            |                   | TNERC Order   |
| <b>Project Cost</b>   |                 |                   |   |
| Land and Infrastructure, Generator & Electrical Equipments, Mechanical Equipments, Civil Works, Instrumentation & Control, Other Project Cost, Pre operative Expenses, etc. |                 |                   |   |
| <b>Total Project Cost</b>   | <b>2,990.61</b> |                   | Enercon Offer   |
| <b>Means of Finance</b>   |                 |                   |   |
|   |                 | <b>Rs Million</b> |   |
| 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          |   |



|  |        |       |  |
|--|--------|-------|--|
| <b>Terms of Loan</b>   |        |       |  |
| Interest Rate  | 11.50% |       | PLR rate published by RBI dated 30 October 2009; |
| Tenure   | 10     | Years | Normative for power generation Sector India      |
| <b>Income Tax Depreciation Rate (Written Down Value basis)</b> |        |       |  |
| on Wind Energy Generators                                      | 80%    |       | Income Tax Act                                   |
| <b>Book Depreciation Rate (Straight Line Method basis)</b>     |        |       |  |
| On all assets  | 4.50%  |       | Straight line Method Adopted                     |
| Book Depreciation up to (% of asset value)                     | 90%    |       |  |
| <b>Income Tax</b>  |        |       |  |
| Income Tax rate  | 33.99% |       | Income Tax Act                                   |
| Minimum Alternate Tax  | 17.00% |       | Income Tax Act                                   |
| <b>Working capital</b>   |        |       |  |
| Receivables (no of days)                                       | 30     |       | Billing Cycle                                    |
| O & m expenses (no of days)                                    | 90     |       | Enercon's Offer                                  |

**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 form 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 is 4.84% i.e. less than the benchmark.

**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 | 7.14%                        | 4.84%             | 2.88%                        |

**Tariff**

Tamilnadu state electricity commission has fixed the tariff for the period of 20 years (Lifetime) for the wind power projects. The tariff for the entire life of the project activity is fixed a Rs. 3.39 per Unit. Therefore it is not appropriate to conduct sensitivity on tariff.

**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 | 2.80%  | 4.84%                    | 6.90%  |

The sensitivity analysis clearly shows even with a higher PLF, the project is not able to generate sufficient returns. It can therefore be concluded that the project is financially not viable without CDM benefits.

**Debt Equity Ratio**





The debt equity ratio envisaged for the project is 70:30, evident from the Detailed Project Report; the same has been considered for Investment Analysis. A sensitivity analysis of IRR to 10% variations in the debt-equity ratio is carried out in the table below:

|                     | 10% decrease over base case [68:32] | Base Debt Equity ratio [70:30] | 10% Increase over base case [72:28] |
|---------------------|-------------------------------------|--------------------------------|-------------------------------------|
| Post tax Equity IRR | 4.90%                               | 4.84%                          | 4.79%                               |

It may also be noted that at 100% equity, the Equity IRR is 5.94%.

### **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 | 5.21%                    | 4.84%         | 4.47%                    |

**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 Rs. 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 Rs. 2.70 per unit, wheeling and banking charged of 5%, etc. (b) TNERC order of 2006 with fixed tariff of Rs. 2.9 per unit, etc.



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

| Electricity tariff<br>(Rs/kWh) | 2006-<br>07 | 2007-<br>08 | 2008-<br>09 | 2009-<br>10 | 2010-<br>11 | 2011-<br>12 | 2012-<br>13 | 2013-<br>14 | 2014-<br>15 | 2015-<br>16 | Average |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------|
| <b>REGIME 1</b>                |             |             |             |             |             |             |             |             |             |             |         |
| MNES Policy <sup>6</sup>       | 3.60        | 3.72        | 3.83        | 3.94        | 4.05        | 4.17        | 4.28        | 4.39        | 4.50        | 4.62        | 4.11    |
| <b>REGIME 2</b>                |             |             |             |             |             |             |             |             |             |             |         |
| TNEB order 2001 <sup>7</sup>   | 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 <sup>8</sup>  | 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.

| Name of Owner <sup>9</sup> | Capacity MW in the Regime 2 <sup>10</sup> | CDM <sup>11</sup> | Web-links and Explanation  |
|----------------------------|---|-------------------|--|
| 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."<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/8VW717YLM7QAINAKXV3USR446DSWZX">http://cdm.unfccc.int/UserManagement/FileStorage/8VW717YLM7QAINAKXV3USR446DSWZX</a> 2) 46.2 MW wind energy project in Tamilnadu, India.<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/Y6B79J5VNDMS800LGQ4IXRTCAZFE2P">http://cdm.unfccc.int/UserManagement/FileStorage/Y6B79J5VNDMS800LGQ4IXRTCAZFE2P</a> 3) 74 MW wind energy project in Tamilnadu, India.<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/QKS35DUH7M1">http://cdm.unfccc.int/UserManagement/FileStorage/QKS35DUH7M1</a> |

<sup>6</sup> Rs.2.25 for 1994-95 and 5% annual escalation thereafter

<sup>7</sup> Rs.2.70 for 2001 fixed for next 10 years

<sup>8</sup> Rs. 2.90 for 2006, fixed for next 10 years

<sup>9</sup> The data on private wind farm owners with greater than 15 MW installed capacity has been taken from <http://www.windpowerindia.com/statpriv.html>.

<sup>10</sup> The 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.

<sup>11</sup> The CDM status of the projects has been taken from the CDM pipeline in <http://cdm.unfccc.int>, MoEF site and other publicly available sources.



|                               |               |            |   |
|-------------------------------|---------------|------------|---|
|                               |               |            | <a href="#">L86BOYX20TA9GJEWPCF</a>   |
| Simran wind power project     | <b>51.600</b> | <b>Yes</b> | Installations under 2 PDDs 1) Grid connected wind energy project in Tamil Nadu by Simran Wind Project Private Ltd.<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/GEVSCPXKMH DY9FQ42ZNJI1RAU6BO85">http://cdm.unfccc.int/UserManagement/FileStorage/GEVSCPXKMH DY9FQ42ZNJI1RAU6BO85</a> 2) 33.9 MW bundled wind power project in states of Karnataka and Tamil Nadu. This is a VCS project.   |
| Super wind power project      | <b>36.000</b> | <b>Yes</b> | PDD titled "Grid connected wind energy project in Tamil Nadu by Super Wind project private ltd"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/WKRL8XZM9Q 03VES6ICJF7YOG42B1TA">http://cdm.unfccc.int/UserManagement/FileStorage/WKRL8XZM9Q 03VES6ICJF7YOG42B1TA</a>  |
| DLF Home developers           | <b>34.500</b> | <b>Yes</b> | PDD titled "Wind Power based electricity generation project in India by DLF Home Developers Limited"<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/34CAG54CUL49MIL W9S0SKWCWU38SSX/view.html">http://cdm.unfccc.int/Projects/Validation/DB/34CAG54CUL49MIL W9S0SKWCWU38SSX/view.html</a>   |
| Soundararaja Mills Ltd.       | <b>33.850</b> | <b>Yes</b> | Installations are under the CDM PDDs titled 1) 10.005 MW captive grid connected wind power project by the members of IWPA at Coimbatore.<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/3COOHDRDG8 SZBFGC437328KXEIBKCV">http://cdm.unfccc.int/UserManagement/FileStorage/3COOHDRDG8 SZBFGC437328KXEIBKCV</a> 2) 40.68 MW grid connected electricity generation project by Indian Wind Power Association at Tirunelveli in Tamil Nadu.<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/J9R5JA7N8U1S S5YVOAT77VR38US32P">http://cdm.unfccc.int/UserManagement/FileStorage/J9R5JA7N8U1S S5YVOAT77VR38US32P</a> 3) Bundled Wind power project in Tamil Nadu, India, co-ordinated by Tamil Nadu Spinning Mills Association (TASMA-II)<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95N YIX8U14H3STGKAF2BEV">http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95N YIX8U14H3STGKAF2BEV</a> 4) 21.00 MW grid connected electricity generation project by Indian Wind Power Association at Tirunelveli in Tamil Nadu.<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/UMHY7TQXXE BNNYBUIC017UDWWZXTCT">http://cdm.unfccc.int/UserManagement/FileStorage/UMHY7TQXXE BNNYBUIC017UDWWZXTCT</a> |
| KPR Mill Pvt. Ltd.            | <b>32.250</b> | <b>Yes</b> | The installations are under two CDM PDDs 1) 19.27 MW Grid connected wind electricity generation project by KPR Mills in Tamil Nadu.<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/YKCHA6D5FCSEO3J MVP8UXJWRMDBCH8/view.html">http://cdm.unfccc.int/Projects/Validation/DB/YKCHA6D5FCSEO3J MVP8UXJWRMDBCH8/view.html</a> , 2) 19.8 MW grid connected Wind farm project by KPR Mill Private Limited, Tamil Nadu, India<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/AB7TO0OZGUKE6H YPB4TWCP5536AGVF/view.html">http://cdm.unfccc.int/Projects/Validation/DB/AB7TO0OZGUKE6H YPB4TWCP5536AGVF/view.html</a>  |
| Grace Infrastructure (P) Ltd. | <b>31.000</b> | <b>Yes</b> | Installations under CDM PDD titled "31 MW Wind energy project in, India by Grace Infrastructure Pvt Ltd" <a href="http://www.global-warming.de/files/new_mediagallery/2008-05-09Grace.pdf">http://www.global-warming.de/files/new_mediagallery/2008-05-09Grace.pdf</a>  |
| Vishal Export                 | <b>29.275</b> | <b>Yes</b> | All the installations were envisaged to be CDM projects as reported publicly  |



|                                   |               |            |  |
|-----------------------------------|---------------|------------|--|
| Overseas Ltd                      |               |            | <a href="http://www.projectsmonitor.com/detailnews.asp?newsid=9284">http://www.projectsmonitor.com/detailnews.asp?newsid=9284</a> as well as in the company's annual report Page 18<br><a href="http://vishalexports.co.in/annual%20reports/Annau1%20Report-2005-06.pdf">http://vishalexports.co.in/annual%20reports/Annau1%20Report-2005-06.pdf</a>   |
| Shanmugavel Group                 | <b>25.500</b> | <b>Yes</b> | The installations are under the PDD titled "Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12S BXNF29XDKVT2BCEWG">http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12S BXNF29XDKVT2BCEWG</a>  |
| Best & Co.                        | <b>25.000</b> | <b>Yes</b> | 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)"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95N YIX8U14H3STGKAF2BEV">http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95N YIX8U14H3STGKAF2BEV</a>  |
| Bannari Amman Spinning Mills Ltd. | <b>23.400</b> | <b>Yes</b> | The installations are under the CDM PDDs titled 1) "STL Wind Power Project"<br><a href="http://www.dnv.com/focus/climate_change/upload/version%202%20-%20pdd%20%20sept%2005.pdf">http://www.dnv.com/focus/climate_change/upload/version%202%20-%20pdd%20%20sept%2005.pdf</a> 2) Eco Friendly Electricity Export to Grid<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/5YH92G186JW1 2SR91FFB9RC302T651 3) Bannari Amman Spinning Mills Wind Power Project managed by Enercon (India) Ltd. https://cdm.unfccc.int/Projects/Validation/DB/FYPAQ52NJB35JZR DUIC0GVD36E6S33/view.html">http://cdm.unfccc.int/UserManagement/FileStorage/5YH92G186JW1 2SR91FFB9RC302T651 3) Bannari Amman Spinning Mills Wind Power Project managed by Enercon (India) Ltd. https://cdm.unfccc.int/Projects/Validation/DB/FYPAQ52NJB35JZR DUIC0GVD36E6S33/view.html</a> |
| Lakshmi Machine Works Ltd         | <b>23.000</b> | <b>Yes</b> | Installations under PDD titled "27.95 MW wind energy project in Coimbatore district in Tamilnadu, India."<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/7LXZLFECVXR 5YBOJ5TH8J6XNHIPOCN">http://cdm.unfccc.int/UserManagement/FileStorage/7LXZLFECVXR 5YBOJ5TH8J6XNHIPOCN</a>   |
| Premier Fine Yarns Pvt. Ltd.      | <b>22.850</b> | <b>Yes</b> | The installations are under the PDD "Grid connected renewable electricity generation project by M/s. Premier Mills Pvt Ltd in Tamilnadu, India"<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/J0J2B6K3O92EEUAF D3OGYLE03TNZ7I/view.html">http://cdm.unfccc.int/Projects/Validation/DB/J0J2B6K3O92EEUAF D3OGYLE03TNZ7I/view.html</a> 2) "Bundled wind power project in Tamil Nadu managed by Enercon India Limited-II"<br><a href="http://cdmindia.nic.in/cdmindia/projects/PCN_785_07.pdf">http://cdmindia.nic.in/cdmindia/projects/PCN_785_07.pdf</a>  |
| Sapthagiri Distilleries           | <b>21.000</b> | <b>Yes</b> | The installations are under CDM project titled "53.75 MW Bundled wind Power project in Tamil Nadu and Karnataka by KBD Group, India"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/QN0BCHDRZ8P I17S2JEMPLVW9TYFGO65">http://cdm.unfccc.int/UserManagement/FileStorage/QN0BCHDRZ8P I17S2JEMPLVW9TYFGO65</a>  |
| TCS Textiles Ltd.                 | <b>20.750</b> | <b>Yes</b> | The installations are under the PDD titled 1) "Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12S BXNF29XDKVT2BCEWG">http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12S BXNF29XDKVT2BCEWG</a> 2) "19.80 MW bundled wind energy project in Tirunelveli and Coimbatore districts in Tamilnadu, India"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/F6UP274DD1D">http://cdm.unfccc.int/UserManagement/FileStorage/F6UP274DD1D</a>  |



|                               |        |     |  |
|-------------------------------|--------|-----|--|
|                               |        |     | CT3XJTKRJZDZNPZY7  |
| Loyal Textile Mills Ltd       | 20.450 | Yes | The installations are under the PDD titled "22.25 MW Captive Wind Power Project in Tamil Nadu"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/TPAONMX73C HPZ69AQ5CSP9BI1UKU99">http://cdm.unfccc.int/UserManagement/FileStorage/TPAONMX73C HPZ69AQ5CSP9BI1UKU99</a>  |
| 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 Tamilnadu, India."<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/37X42BG16GG63VK5 L84D6WZ0UM8YGG/view.html">http://cdm.unfccc.int/Projects/Validation/DB/37X42BG16GG63VK5 L84D6WZ0UM8YGG/view.html</a>   |
| 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"<br><a href="http://www.tuvdotcom.com/pi/web/PinDownload.xml?strUrlId=3&amp;strUserId=&amp;TUVdotCOMID=9105043814&amp;strType=UserManualDownload&amp;strDocumentID=19694&amp;strTypeID=8&amp;menuOption=process&amp;isManualNeeded=true&amp;isPictureNeeded=false&amp;isRatingNeeded=false&amp;isSecureNeeded=false&amp;isIDNeeded=false&amp;isTypeNeeded=true&amp;isHolderNeeded=true">http://www.tuvdotcom.com/pi/web/PinDownload.xml?strUrlId=3&amp;strUserId=&amp;TUVdotCOMID=9105043814&amp;strType=UserManualDownload&amp;strDocumentID=19694&amp;strTypeID=8&amp;menuOption=process&amp;isManualNeeded=true&amp;isPictureNeeded=false&amp;isRatingNeeded=false&amp;isSecureNeeded=false&amp;isIDNeeded=false&amp;isTypeNeeded=true&amp;isHolderNeeded=true</a> 2) 37.6 MW Bundled Wind Power Project in Nagercoil, Tamilnadu<br><a href="http://www.dnv.com/focus/climate_change/Upload/Nagercoil%20PDD.pdf">http://www.dnv.com/focus/climate_change/Upload/Nagercoil%20PDD.pdf</a> |
| Muthoot Fincorp Ltd.          | 18.750 | Yes | Installations are under the CDM PDDs 1) Wind based bundled renewable energy project, Tamilnadu, India.<br><a href="http://www.dnv.com/certification/climatechange/upload/pdd%20-%2020.15%20mw.pdf">http://www.dnv.com/certification/climatechange/upload/pdd%20-%2020.15%20mw.pdf</a> 2) Emissions free electricity generation using wind energy<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/QIOVC8LXWS06YB91FZ5R3E4KTJGUPA">http://cdm.unfccc.int/UserManagement/FileStorage/QIOVC8LXWS06YB91FZ5R3E4KTJGUPA</a> 3) 23.75MW grid connected electricity generation project at Tirunelveli in Tamil Nadu.<br><a href="http://www.sgsqualitynetwork.com/tradeassurance/ccp/projects/512/PDD%2023.75MW%20grid%20connected%20electricity%20generation%20project%20at%20Tirunelveli%20in%20Tamil%20Nadu..pdf">http://www.sgsqualitynetwork.com/tradeassurance/ccp/projects/512/PDD%2023.75MW%20grid%20connected%20electricity%20generation%20project%20at%20Tirunelveli%20in%20Tamil%20Nadu..pdf</a>  |
| 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."<br><a href="http://cdm.unfccc.int/Projects/DB/BVQI1257245548.54/view">http://cdm.unfccc.int/Projects/DB/BVQI1257245548.54/view</a>   |
| 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"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/FM6BIMO4FTL NNUKVLSTLYJLM14NRCM">http://cdm.unfccc.int/UserManagement/FileStorage/FM6BIMO4FTL NNUKVLSTLYJLM14NRCM</a> 2) "38.75 MW grid connected electricity generation project at Tirunelveli in Tamil Nadu"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/Y5UO445ZIR7V MGE34PQUDGRTHCKRSB">http://cdm.unfccc.int/UserManagement/FileStorage/Y5UO445ZIR7V MGE34PQUDGRTHCKRSB</a> 4) "23.75MW grid connected electricity generation project at Tirunelveli in Tamil Nadu"<br><a href="http://www.sgsqualitynetwork.com/tradeassurance/ccp/projects/512/">http://www.sgsqualitynetwork.com/tradeassurance/ccp/projects/512/</a>   |



|                                  |               |            |   |
|----------------------------------|---------------|------------|---|
|                                  |               |            | PDD%2023.75MW%20grid%20connected%20electricity%20generation%20project%20at%20Tirunelveli%20in%20Tamil%20Nadu..pdf   |
| Premier Spg & Wvg Mills Pvt. Ltd | <b>16.250</b> | <b>Yes</b> | The installations are under the PDD "Grid connected renewable electricity generation project by M/s. Premier Mills Pvt Ltd in Tamilnadu, India"<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/J0J2B6K3O92EEUAFD3OGYLE03TNZ7I/view.html">http://cdm.unfccc.int/Projects/Validation/DB/J0J2B6K3O92EEUAFD3OGYLE03TNZ7I/view.html</a> 2) "Bundled wind power project in Tamil Nadu managed by Enercon India Limited-II"<br><a href="http://cdmindia.nic.in/cdmindia/projects/PCN_785_07.pdf">http://cdmindia.nic.in/cdmindia/projects/PCN_785_07.pdf</a>   |
| Rasi Seeds (P) Ltd.              | <b>16.250</b> | <b>Yes</b> | The installations are under the CDM PDDs titled 1) "Bundled Wind power project in Tamil Nadu, India, co-ordinated by Tamil Nadu Spinning Mills Association (TASMA-II)"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95NYIX8U14H3STGKAF2BEV">http://cdm.unfccc.int/UserManagement/FileStorage/6QDL0CJW95NYIX8U14H3STGKAF2BEV</a> 2) "Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG">http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG</a> |
| Ambika Cotton Mills Ltd.         | <b>15.400</b> | <b>Yes</b> | The installations are under CDM PDDs 1) Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)<br><a href="http://cdm.unfccc.int/Projects/DB/TUEV-SUED1173364563.43/view">http://cdm.unfccc.int/Projects/DB/TUEV-SUED1173364563.43/view</a> 2) Bundled Wind power project in Tamil Nadu, India, co-ordinated by Tamil Nadu Spinning Mills Association (TASMA-II)<br><a href="http://cdm.unfccc.int/Projects/Validation/DB/4R4NBZ8HU31NRZMNQAMH37GJN07926/view.html">http://cdm.unfccc.int/Projects/Validation/DB/4R4NBZ8HU31NRZMNQAMH37GJN07926/view.html</a>  |
| Jayajyoti & Co. Ltd              | <b>15.000</b> | <b>Yes</b> | The installations are under the PDD titled "Bundled Wind power project in Tamilnadu, India co-ordinated by the TamilNadu Spinning Mills Association (TASMA)"<br><a href="http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG">http://cdm.unfccc.int/UserManagement/FileStorage/AE2042RXII12SBXNF29XDKVT2BCEWG</a>   |

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 one) 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. Emission reductions:**

### **B.6.1. Explanation of methodological choices:**

According to the approved methodology ACM0002 (Version 11) Emission Reductions are calculated as:-

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

Where:

|        |   |
|--------|---|
| $BE_y$ | Baseline Emissions in year y (t CO <sub>2</sub> e/yr) |
| $PE_y$ | Project Emissions in year y (t CO <sub>2</sub> e/yr)  |

#### **Estimation of Baseline Emissions:**

Baseline emissions include only CO<sub>2</sub> 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<sub>2</sub>/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<sub>2</sub> 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<sub>2</sub>/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)



$EG_{\text{facility},y}$  = 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%   |





|       | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|-------|---------|---------|---------|---------|---------|
| South | 21.61%  | 27.0%   | 28.3%   | 27.1%   | 22.8%   |
| India | 18.01%  | 20.1%   | 20.9%   | 21.0%   | 18.6%   |

Source: CO<sub>2</sub> 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 CO<sub>2</sub> emissions per unit net electricity generation (tCO<sub>2</sub>/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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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:

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

Where:

$EF_{\text{grid,OMsimple},y}$  Simple operating margin CO<sub>2</sub> emission factor in year y (tCO<sub>2</sub>/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 <sub>2</sub> emission factor of power unit m in year y (tCO <sub>2</sub> /MWh) |
| m             | All power units serving the grid in year y except low-cost / must-run power units |
| y             | The relevant year as per the data vintage chosen in step 3                        |

The emission factor of each power unit m has been determined as follows:

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

Where:

|                 |   |
|-----------------|---|
| $EF_{EL,m,y}$   | CO <sub>2</sub> emission factor of power unit m in year y (tCO <sub>2</sub> /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 <sub>2</sub> emission factor of fossil fuel type i in year y (tCO <sub>2</sub> /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               |
| i               | 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 <sub>2</sub> emission factor in year y (tCO <sub>2</sub> /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 <sub>2</sub> emission factor of power unit m in year y (tCO <sub>2</sub> /MWh)               |



$m$  Power units included in the build margin  
 $y$  Most recent historical year for which power generation data is available

The CO<sub>2</sub> 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  $EF_y$  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  $EF_{OM,y}$  and  $EF_{BM,y}$ , then the  $EF_y$  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 CO<sub>2</sub> emission factor in year  $y$  (tCO<sub>2</sub>/MWh)  
 $EF_{grid,OM,y}$  Operating margin CO<sub>2</sub> emission factor in year  $y$  (tCO<sub>2</sub>/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 tCO<sub>2</sub>e/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 CO<sub>2</sub> Baseline Database for the Indian Power Sector

Ministry of Power: Central Electricity Authority (CEA)

Version 5

Key baseline information is reproduced in Annex 3.

The detailed excel sheet is available at:

<http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>

#### Estimation of Project Emissions

The project activity involves harnessing of wind energy and its conversion to electricity. Hence according to ACM0002 Version 11, 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 11, no leakage has been considered for the calculation of emission factor



$LE_y = 0$  ..... (5)

The details on OM, BM and CM estimates as provided by the CEA are shown in Annex-3.

**B.6.2. Data and parameters that are available at validation:**

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | $EF_{OM,y}$  |
| Data unit:   | tCO <sub>2</sub> e/MWh   |
| Description:   | Operating Margin Emission Factor of Southern Regional Electricity Grid   |
| Source of data used:   | “CO <sub>2</sub> Baseline Database for Indian Power Sector”, version 5 published by the Central Electricity Authority, Ministry of Power, Government of India.<br><br>The “CO <sub>2</sub> Baseline Database for Indian Power Sector” is available at <a href="http://www.cea.nic.in">www.cea.nic.in</a> |
| Value applied:   | 0.98756  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Operating Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with ACM0002.   |
| Any Comment  | The value is calculated on ex-ante basis and it will remain same throughout the crediting period.  |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | $EF_{BM,y}$   |
| Data unit:   | tCO <sub>2</sub> e/MWh  |
| Description:   | Build Margin Emission Factor of Southern Regional Electricity Grid  |
| Source of data used:   | “CO <sub>2</sub> Baseline Database for Indian Power Sector” version 5 published by the Central Electricity Authority, Ministry of Power, Government of India.<br><br>The “CO <sub>2</sub> Baseline Database for Indian Power Sector” is available at <a href="http://www.cea.nic.in">www.cea.nic.in</a> |
| Value applied:   | 0.81792   |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Build Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with ACM0002.   |
| Any Comment  | The value is calculated on ex-ante basis and it will remain same throughout the crediting period.   |

|                          |                       |
|--------------------------|-----------------------|
| <b>Data / Parameter:</b> | $EF_y$ or $EF_{CM,y}$ |
|--------------------------|-----------------------|



|  |   |   |         |
|--|---|---|---------|
| Data unit:   | tCO <sub>2</sub> e/MWh  |   |         |
| Description:   | Combined Margin Emission Factor of Southern Regional Electricity Grid   |   |         |
| Source of data used:   | <p>The “CO<sub>2</sub> Baseline Database for Indian Power Sector” version 5 published by the Central Electricity Authority, Ministry of Power, Government of India.</p> <p>The “CO<sub>2</sub> Baseline Database for Indian Power Sector” is available at <a href="http://www.cea.nic.in">www.cea.nic.in</a></p>  |   |         |
| Value applied:   | <p>In case of wind power projects default weights of 0.75 for <math>EF_{OM}</math> and 0.25 for <math>EF_{BM}</math> are applicable as per ACM0002.</p> <table border="1"> <tr> <td>Combined Margin Emission Factor (<math>EF_y</math> or <math>EF_{CM,y}</math>)</td><td>0.94515</td></tr> </table> <p>Refer Annex – 3 for comprehensive calculation of Combined Margin Emission Factor.</p> | Combined Margin Emission Factor ( $EF_y$ or $EF_{CM,y}$ ) | 0.94515 |
| Combined Margin Emission Factor ( $EF_y$ or $EF_{CM,y}$ )  | 0.94515   |   |         |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | 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.  |   |         |
| Any 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:

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<sub>2</sub>e/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  
= 1,09,625.44 MWh

Annual Baseline Emissions Reduction:  $ER_y = EF_y * EG_y$   
= 0.94515 tCO<sub>2</sub>e/MWh x 109625.44 MWh  
= 1,03,612 tCO<sub>2</sub>e

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

| Year                                     | Estimation of project activity emissions (tonnes of CO <sub>2</sub> e) | Estimation of baseline emissions (tonnes of CO <sub>2</sub> e) | Estimation of leakage (tonnes of CO <sub>2</sub> e) | Estimation of overall emission reductions (tonnes of CO <sub>2</sub> e) |
|--|--|--|---|---|
| 1 <sup>st</sup> year*                    | 0  | 103,612  | 0   | 103,612   |
| 2 <sup>nd</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 3 <sup>rd</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 4 <sup>th</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 5 <sup>th</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 6 <sup>th</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 7 <sup>th</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 8 <sup>th</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 9 <sup>th</sup> year                     | 0  | 103,612  | 0   | 103,612   |
| 10 <sup>th</sup> year                    | 0  | 103,612  | 0   | 103,612   |
| <b>Total (tonnes of CO<sub>2</sub>e)</b> | 0  | 10,36,120  | 0   | 10,36,120   |

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

**B.7 Application of the monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:**

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>EGey</b>  |
| Data unit:   | MWh (Mega-watt hour)   |
| Description:   | Electricity Exported to the grid by 63 WEC's of the project activity   |
| Source of data to be used:   | Monthly billing records which is given by Tamilnadu Electricity Board (TNEB).  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Annual electricity supplied to the grid by the Project<br>= 50.4MW (Capacity) x 24.83% (PLF) x 8760 (hours)<br>= 109625.44 MWh   |
| Description of measurement methods and procedures to be applied:                                 | Power exported will be measured through meter readings of the two-way export meter installed by TNEB. For billing purpose, the meter readings are taken every month by TNEB officials in the presence of company representatives and the readings are jointly certified. |
| QA/QC procedures to be applied:  | Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.  |



|              |  |
|--------------|--|
| Any comment: | The data will be archived for two years after the crediting period, or of the last issuance of CER's of this project activity. Whichever occur later |
|--------------|--|

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>EGiy</b>  |
| Data unit:   | MWh (Mega-watt hour)   |
| Description:   | Electricity Imported from the grid by 63 WEC's of the project activity   |
| Source of data to be used:   | Monthly billing records which is given by Tamilnadu Electricity Board (TNEB).  |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0 MWh  |
| Description of measurement methods and procedures to be applied:                                 | Power imported will be measured through meter readings of the two-way export meter installed by TNEB. For billing purpose, the meter readings are taken every month by TNEB officials in the presence of company representatives and the readings are jointly certified. |
| QA/QC procedures to be applied:  | Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.  |
| Any comment:   | The data will be archived for two years after the crediting period, or of the last issuance of CER's of this project activity. Whichever occur later   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>EGy</b>  |
| Data unit:   | MWh (Mega-watt hour)  |
| Description:   | Net Electricity Exported to the grid  |
| Source of data to be used:   | Monthly billing records which is given by Tamilnadu Electricity Board (TNEB).   |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Net electricity exported to the grid is calculated as:<br><br><b>EGey – EGiy</b><br><br>= 109625.44 MWh   |
| Description of measurement methods and procedures to be applied:                                 | Net electricity supplied to the grid will be measured through meter readings of the two-way export meter installed by TNEB. The procedures for metering and meter reading will be as per the provisions followed by the TNEB. Monthly joint meter readings will be taken and on the basis of these readings, the net electricity supplied to the grid will be calculated. |
| QA/QC procedures to be applied:  | Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.   |
| Any comment:   | The data will be sourced from the JMR and its hard copies will be preserved.  |

**B.7.2 Description of the monitoring plan:**

Approved monitoring methodology ACM0002 Version 11, “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.

Enercon (India) Limited is O&M contractor for the project activity. Enercon (India) Limited will be responsible for the maintaining all the monitoring data on behalf of VIPCPL in respect of the project activity. Enercon (India) Limited 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 Enercon and managed by the PP. The operational and maintenance contract for the project is with Enercon. Enercon is an ISO 9001:2000 certified Quality Management system from Germanischer Lloyd. Enercon 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.

Net Electricity Exported to the Grid:  $EG_y : EG_y - EG_{iy}$

The Energy export and Energy import data will be directly measured from the energy meters that are connected to 63 turbines of the project activity. The meter readings are noted in the form of joint meter report and are signed jointly by the representatives of Enercon and the state utility.

The accuracy of monitoring parameter is ensured by adhering to the calibration and testing of the metering equipment once each year. Enercon provides the daily generation report to the Project proponent. The project proponent also maintains the records of daily generation report and joint meter report.

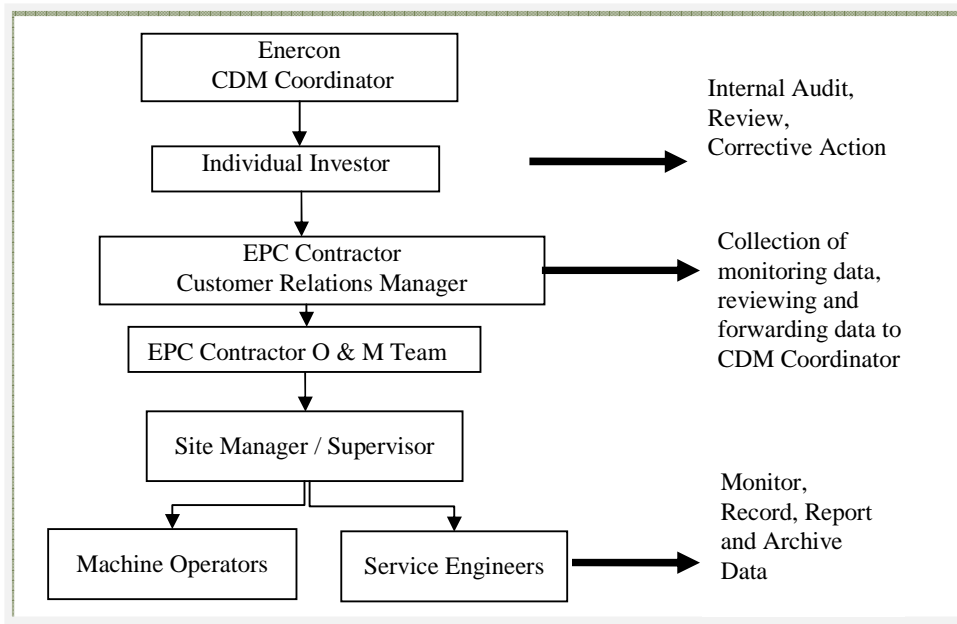
**Training and maintenance requirements:**

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 Enercon'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 Enercon Training Academy provides need-based training to meet the training requirements of Enercon 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.





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



**B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)**

Date of completion: 22/03/2010

Name of responsible person/entity: Vaayu (India) Power Corporation Private Limited (Project Participant). The details are given in Annex-1.

**SECTION C. Duration of the project activity / crediting period****C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

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

**----- C.1.2. Expected operational lifetime of the project activity:**

20 years

**C.2 Choice of the crediting period and related information:**

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

**C.2.1. Renewable crediting period:****C.2.1.1. Starting date of the first crediting period:**

Not Applicable

**C.2.1.2. Length of the first crediting period:**

Not Applicable

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

01/04/2011, being the expected date of Commissioning of the Project or the date of Project registration with UNFCCC whichever occurs later.

**C.2.2.2. Length:**

10 years and 0 months

**SECTION D. Environmental impacts****D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

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 14<sup>th</sup> September 2006, a list of activities that require undertaking environmental impact assessment studies<sup>12</sup> 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.

**D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party.**

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.

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<sup>12</sup> <http://envfor.nic.in/legis/eia/so1533.pdf>

**SECTION E. Stakeholders' comments****E.1. Brief description how comments by local stakeholders have been invited and compiled:**

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 the comments received:**

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. Report on how due account was taken of any comments received:**

The clarifications that were addressed by the representatives of Enercon (Enercon 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 Enercon representatives   |
|-------|--------------------|--|--|
| 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. |

The meeting was very cordial and ended on a positive note. No adverse comments were received.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

|                  |  |
|------------------|--|
| Organization:    | Vaayu (India) Power Corporation Private Limited                                  |
| Street/P.O.Box:  | Plot No. 33, Daman Patalia Road  |
| Building:        |  |
| City:            | Bhimpore   |
| State/Region:    | Daman (UT)   |
| Postfix/ZIP:     | 396210   |
| Country:         | India  |
| Telephone:       | +91-260-2220624, 2220628   |
| FAX:             | +91-260-2221508  |
| E-Mail:          | <a href="mailto:yogesh.mehra@enerconindia.net">yogesh.mehra@enerconindia.net</a> |
| URL:             |  |
| Represented by:  |  |
| Title:           | Managing Director  |
| Salutation:      | Mr.  |
| Last Name:       | Mehra  |
| Middle Name:     |  |
| First Name:      | Yogesh   |
| Department:      | Corporate  |
| Mobile:          | +91-98200 40301  |
| Direct FAX:      | +91-260-2221508  |
| Direct tel:      | +91-22-22-6702 2832 extn. 7111   |
| Personal E-Mail: | <a href="mailto:yogesh.mehra@enerconindia.net">yogesh.mehra@enerconindia.net</a> |



**Annex 2**  
**INFORMATION REGARDING PUBLIC FUNDING**

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



**Annex 3**  
**BASELINE INFORMATION**

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**

|  | <b>Southern Grid<br/>(tCO<sub>2</sub>e/MWh)</b> |
|--|---|
| 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**

|                       | <b>Southern Grid<br/>(tCO<sub>2</sub>e/MWh)</b> |
|-----------------------|---|
| Build Margin- 2008-09 | 0.81792   |

**Combined Margin Calculations**

|                  | <b>Weights</b> | <b>Southern Grid<br/>(tCO<sub>2</sub>e/MWh)</b> |
|------------------|----------------|---|
| 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](http://www.cea.nic.in).





#### Annex 4

### MONITORING INFORMATION

**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 PPA (Power purchase agreement) 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 and check 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 summation of the joint meter readings noted from the dedicated meters connecting 63 turbines of the project activity.

**Metering Equipment:** Metering equipment is electronic trivector meter of 0.2% / 0.5% accuracy class.

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

**QA/QC Procedure:** All the meters are calibrated/ tested once each year as per the PPA. The calibration is done by the officials of the state utility. 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) 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 WEC tower and thereafter the readings from main meter will be referred.

The 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 WECs. 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. The operations and maintenance staff will calibrate the meter immediately and correction factor will be determined.