**CLEAN DEVELOPMENT MECHANISM**
**SIMPLIFIED PROJECT DESIGN DOCUMENT**
**FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)**
**Version 02**

## CONTENTS

**Revision history of this document**

| Version Number | Date | Description and reason of revision |
|---|---|---|
| 01 | 21 January 2003 | Initial adoption |
| 02 | 8 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |

## SECTION A. General description of the small-scale project activity

### A.1. Title of the small-scale project activity:

7.25 MW wind energy project of Aruppukottai Sri Jayavilas Ltd, Tamilnadu, India.

Number of the version : 01

Date : 15/09/2006

### A.2. Description of the small-scale project activity:

Purpose of the project activity

The main purpose of the project activity is the implementation and operation of 7.25 MW wind farm in high wind speed areas of Tamilnadu state in India to generate electricity for consumption for captive use displacing grid electricity.

Project description

Aruppukottai Sri Jayavilas Limited, ("Jayavilas"), the project proponent, owns and operates textile mils manufacturing high quality yarn. Jayavilas operates two textile mills with an installed capacity of 90,240 spindles, manufacturing yarn out of cotton. These textile mills consume considerable quantity of electricity for their operations. This electricity was consumed from the fossil fuel dominated state owned electric utility. Realizing the impacts of electricity produced from fossil fuels, Jayavilas has decided to install wind farms to generate and consume "green and clean" electricity for its operations.

The project activity consists of 17 wind turbine generators (WTGs) in Tirunelveli district of Tamil Nadu state in India. The project activity has 5 WTGs of 850 kW and 12 WTGs of 250 kW. All the windmills have been commissioned and the generated electricity from WTGs is connected to state electric utility namely Tamil Nadu Electricity Board (TNEB) and transmitted through state grid for consumption for their textile mills.

The project activity generates electricity from a renewable source of energy and the project proponents consume the generated electricity for their operations displacing grid electricity. Thus, the project activity results in reduction of GHG emissions by generating renewable energy without generation of any GHG and additionally displaces grid electricity for the operation of textile mills.

Contribution of the project activity to sustainable development in view of project participant

The project proponent believes that the project activity has contributed to sustainable development in following manners:

i) Social well being

ii) Economical well being

iii) Environmental well being

iv) Technological well being

i) Social well being

The social well being is assessed by contribution by the project activity to improvement in living standards of the local community. The project activity provides job opportunities to the local population during erection and operation of the wind farms contributing in poverty alleviation of the local community and development of basic amenities to community leading to improvement in living standards of the local population. Thus the project activity has contributed to social well being.

ii) Economic well being

The wind farms need large area. As project proponents of similar wind energy developers procured land, the cost of land appreciated benefiting the landowners and local community directly. These lands were generally were unproductive. Most of the wind energy potential areas are in remote areas and are largely unfertile. These lands generally command low prices. But due to land demand for wind farms, the land price increased leading to economic well being of the local community. The project activity has created direct and indirect job opportunities to the local community during installation and operation of the WTGs. The investment for the project activity has increased the economic activity of the local area. The above have contributed to the economic well being and social well being of the local community.

The project activity also contributes in economic well being of the nation's economy by reducing import of coal and other fossil fuel for electricity generation in hard currency.

iii) Environmental well being

The project activity produces electricity without any greenhouse gas (GHG) emissions. Additionally, the project activity generates electricity from a 'renewable energy source'. The renewable energy source is generally defined as a source of energy that gets replenished naturally and does not suffer permanent depletion due to use.

The project activity is an environment friendly electricity generation project with no significant impact on the environment. The wind farms are located in Tamilnadu state in India, where about 71.56 % of installed capacity[1] is from thermal sources (7,216 MW is from thermal sources out of total installed capacity of 10,083MW as of 01 August 2006).

Additionally, the project activity generates electricity from a renewable source of energy where the source gets replenished and is available for use.

Therefore, the following environmental benefits are derived from the project activity:

- Produces electricity without GHG emissions.
- Produces electricity from a renewable energy source.
- Rural development as the project activity location
- Nil impact on the environment due to the project activity.

iv) Technological well being

There is continuous research and development on the geometry of the wind blades, height of towers, diameters of towers, etc., which augurs well for the technological well being in the development of wind energy to produce clean electricity. The project activity has higher capacity windmills of 850 kW which is technologically advanced to conventional smaller capacities.

Also, the generated electricity from the project activity is connected to the grid. The project activity improves the supply of electricity with clean, renewable wind power while contributing to the regional/local economic development. Wind energy plants provide local distributed generation, and provide site-specific reliability and transmission and distribution benefits including:

- improved power quality in the vicinity
- reactive power control;
- mitigation of transmission and distribution congestion,

All the above are the contributions of the project activity for the sustainable development.

**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 Party) | Aruppukottai Sri Jayavilas Limited. (Private entity – public limited company) | No |

[1] http://www.tneb.in/installed_capacity.php

**A.4. Technical description of the small-scale project activity:**

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**A.4.1. Location of the small-scale project activity:**

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**A.4.1.1. Host Party(ies):**

India

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

South India/Tamil Nadu state/ Tirunelveli district

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

Pazhavoor, Levenjipuram, Thanakkarkulam and Udayathur villages in Tirunelveli district.

The table A.4-1 gives the details of location of wind turbine generators of the project activity .

**Table A. 4-1- Details of WTGs of the project activity**

| Village name | Number of WTG | Capacity of each WTG | Installed capacity |
|---|---|---|---|
| Pazhavoor | 6 | 0.25 MW | 1.5 MW |
| | 1 | 0.85 MW | 0.85 MW |
| Levenjipuram | 6 | 0.25 MW | 1.5 MW |
| | 1 | 0.85 MW | 0.85 MW |
| Thanakkarkulam | 1 | 0.85 MW | 0.85 MW |
| Udayathur | 2 | 0.85 MW | 1.7 MW |
| **Total** | **17** | | **7.25 MW** |

**A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):**

The project activity is located in Tirunelveli district in Tamilnadu state in India. Tirunelveli district is located between 8º 8’ and 9º 23’ of the northern latitudes and 77º 09’ and 77º54’ of the eastern longitudes.

The project activity is about 15 –20 kilometres from Kanyakumari (Cape Comorin), the southern most point of India where three seas namely Bay of Bengal, Indian Ocean and Arabian sea confluence. The nearest big railway station is at Kanyakumari and nearest airport is at Trivandrum at 100 kilometres away. *The exact location of each WTG indicated as Survey Field No (S.F.No), High Tension Service Connection Number (HTSC .No.), make of each machine, capacity, location of the village and the date of commissioning are provided in attached Appendix 1.*The S.F.No and HTSC No. would give unique identification of the windmills of the small scale project activity

The geographical location of project activity is detailed in the maps below.


**Fig A-1 showing Tamilnadu state in Indian map**

**Tamil Nadu state**

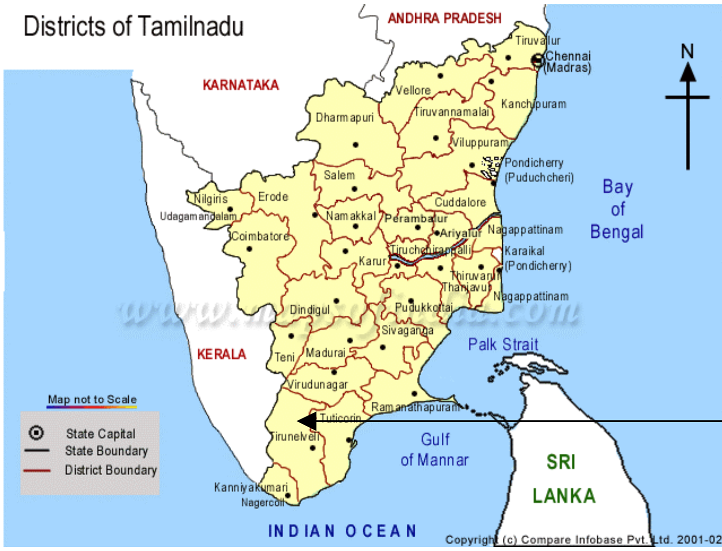


**Fig A-2 showing Tirunelveli and Kanyakumari districts**

Tirunelveli district


**Fig A-3 showing project activity**

Project activity

## A.4.2. Type and category(ies) and technology of the small-scale project activity:

| | | |
|---|---|---|
| Scope Number | : | 1 |
| Sectoral Scope | : | Energy industries (renewable - / non-renewable sources) |
| Type | : | I. Renewable energy projects |
| Category | : | AMS I.D. Grid connected renewable electricity generation |

The project activity is a wind energy project with an installed capacity of 7.25 MW which is lesser than 15 MW, qualifying for small scale CDM project activity. As per the provisions of Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities, approved small scale methodology AMS I.D /version 09 dated 28 July 2006, "this category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, ***wind,*** geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit". The project activity comprises ***wind energy*** supplying/ displacing electricity from the Tamilnadu state grid, which is part of southern regional grid, is being supplied by several fossil fuel generating units. With above considerations, the Type I.D. is the most appropriate for the project activity. The project activity does not comprise any electricity generation from non-renewable energy sources.

Technology

In wind energy generation, kinetic energy of wind is converted into mechanical energy and subsequently into electrical energy. Wind has considerable amount of kinetic energy when blowing at high speeds. This kinetic energy when passes through the blades of the WTG is converted into mechanical energy and rotates the wind blades. When the wind blades rotate, the connected generator also rotates, thereby producing electricity.

The technology is a clean technology since there are no GHG emissions associated with the electricity generation.

The project activity has 5 WTGs each of 850 kW and 12 WTGs each of 250 kW.

Technology of 850 kW wind turbine generator

The 850 kW WTGs are of PAWT technology with Gamesa make turbines. These are an advanced version over conventional low capacity WTGs. The towers of these WTGs are 65 metres height. The higher height gives the advantage of capturing higher power at higher height. This height also avoids disturbance from windmills located nearby. These turbines have state of art technology of variable speed and variable pitch with a double fed generator. The 'aerofoil' design of the blade, especially 58 metres rotor, as against conventional 48-50 metres contributes to a larger swept area for energy capture. The design of the blade is suitable for low and medium wind conditions in plain and complex terrain, which suits the region where wind farms are located. The WTG reaches the rated capacity of 850 kW at 10.5 meters itself as against 12 metres as per power curve.

Technology of 250 kW wind turbine generator

These are of Wincon, Denmark technology and are manufactured by Pioneer Wincon in India. These WTGs are of well established technology with very little maintenance. These WTGs are robust in construction and has a few moving parts as a fixed blade configuration.

The important parts of windmill are:

i. Main Tower
ii. Blades
iii. Nacelle
iv. Hub
v. Main shaft
vi. Gearbox, bearing and housing
vii. Brake
viii. Generator

i. Main Tower

This is a very tall structure of 65 metres height for 850 kW turbines and of 45 meters high for 250 kW turbines with a door and inside ladder at the bottom. The door is used to enter into the tower for operation and maintenance.

ii. Blades

The WTGs are provided with three blades. The blades are self supporting in nature made up of Fiber Reinforced Polyester. The blades are mounted on the hub.

iii. Nacelle

The Nacelle is the one which contains all the major parts of a WTG. The nacelle is made up of thick rugged steel and mounted on a heavy slewing ring. Under normal operating conditions the nacelle would be facing the upstream wind direction.

iv.Hub

The Hub is an intermediate assembly between the wing and the main shaft of the wind mill. Inside the hub, a system to actuate the aerodynamic brake is fitted. The hub is covered with nose cone.

v. Main Shaft

The shaft is to connect the gear box and the hub. Solid high carbon steel bars or cylinders are used as main shaft. The shaft is supported by two bearings.

vi. Gear Box, Bearing and housing

The gearbox is used to increase the speed ratio so that the rotor speed is increased to the rated generator speed. Oil cooling is employed to control the heating of the gearbox. Gearboxes are mounted over dampers to minimise vibration. The main bearings are placed inside housing.

vii. Brake

Brake is employed in the WTGs to stop the windmill mainly for maintenance check. Brakes are also applied during over speed conditions of the windmill. The brakes are placed on the high speed shaft.

viii. Generator

The generator uses induction type of generator. The generators are provided with monitoring sensors in each phase winding to prevent damage to the generators.

**A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:**

The emission reductions of the project activity arise from electricity displaced / exported to the grid. The project activity is a wind energy plant generating electricity from a renewable source of energy. The renewable energy source is a source of energy that gets replenished naturally and does not suffer permanent depletion due to use. The energy supplied by project activity to the state grid would reduce anthropogenic GHG emissions as per the combined margin carbon intensity of the grid, which is mainly dominated by fossil fuel based power plants.

The project activity would supply about 15,089 MWh of electricity per year . During the crediting period of first 7 years, the project activity would deliver to the grid at least 105,623MWh generated from a renewable energy. In the absence of the project activity, the same amount of electricity would have been produced from other sources of energy. The electricity generated from the project activity is connected to Tamil Nadu grid, which is part of southern regional grid, which is mostly supplied by electricity produced from thermal sources.

The electricity generation for Southern regional grid and Tamilnadu grid from various fuel sources for the years 2003-2004, 2004-2005 and 2005 –2006 in GWh are given in Table A –2 below;

**Table A -2 – Power generation from various fuel sources in southern regional grid**

| Southern regional grid | | | | | Tamilnadu grid | | | |
|---|---|---|---|---|---|---|---|---|
| **Fuel type** | 2003-04 | 2004-05 | 2005-06 | average % mix | 2003-04 | 2004-05 | 2005-06 | average % mix |
| | | | | | | | | ***All units in GWh*** |
| Thermal generation | 116,072 | 113,122 | 108,217 | **75.07%** | 43,049 | 42,050 | 40,767 | **83.61%** |
| Hydro generation | 16,670 | 25,280 | 33,506 | 16.79% | 2,044 | 4,413 | 6,110 | 8.35% |
| Nuclear generation | 4,700 | 4,407 | 4,713 | 3.07% | 1,577 | 1,480 | 1,853 | 3.26% |
| Low cost generation | 5,880 | 7,625 | 9,293 | 5.07% | 1,690 | 2,650 | 2,850 | 4.78% |
| **Total** | **143,322** | **150,434** | **155,729** | **100.00%** | **48,360** | **50,593** | **51,580** | **100.00%** |

From the table A-2, it may be seen that the average **thermal** power generation for the last three years is 75.07% in the southern regional grid and 83.61 % in the Tamilnadu grid which clearly evidences that the grid is predominantly based on thermal generation. Hence, in the absence of project activity, the same amount of electricity generated by the project activity would have been met from largely thermal generation with its associated GHG emissions.

The estimated total emission reductions be achieved by the project activity is **112,273 tonnes of $CO_2$** equivalent for the crediting period of 7 years. Detailed estimates are given in section E.

**A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:**

| **Years** | **Annual estimation of emission reductions in tonnes of $CO_2$ eq** |
|---|---|
| 2007 | 16,039 |
| 2008 | 16,039 |
| 2009 | 16,039 |
| 2010 | 16,039 |
| 2011 | 16,039 |
| 2012 | 16,039 |

| | |
|---|---|
| 2013 | 16,039 |
| **Total estimated reductions** (tonnes of $CO_2e$) | **112,273** |
| Total number of crediting years | 7 years |
| **Annual average over the crediting period of estimated reductions** (tonnes of $CO_2e$) | **16,039** |

### A.4.4. Public funding of the small-scale project activity:

There is no public funding for the project activity from parties included in Annex I of the convention.

### A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

The project activity is not a debundled component of a large project activity as there is **no** registered small scale project activity or application to register another project activity;

- with the same project participants
- in the same category and technology/measure; and
- whose project boundary is within 1 km of project boundary of the small scale project activity.

## SECTION B. Application of a baseline methodology:

### B.1. Title and reference of the approved baseline methodology applied to the small-scale project activity:

| | | |
|---|---|---|
| Title of approved baseline methodology | : | Grid connected renewable electricity generation |
| Reference | : | Approved small scale methodology AMS I. D. |
| Type I | : | Renewable energy project |
| Category I.D | : | Grid connected renewable electricity generation |

### B.2 Project category applicable to the small-scale project activity:

Appendix B of the simplified M&P for small-scale CDM project activities provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per the M&P, the project activity falls under the approved small scale methodologies :

AMS I.D. : Grid connected renewable electricity generation.

| Technology /Measure as per AMS I.D | Measure of project activity |
|---|---|
| This category comprises renewable energy generation units such as photovoltaics, hydro, tidal/wave, wind, geothermal and biomass, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit | The project activity is a renewable energy generation based on wind source. The generated energy is connected to TNEB grid, part of southern regional grid, which is being supplied by several fossil fuel fired generating units. |
| The capacity of the entire unit shall not exceed 15 MW. | The capacity of the project activity is 7.25 MW. |
| The sum of all forms of energy output shall not exceed 45 MW thermal | There is no thermal energy and the total capacity of the project activity is 7.25MW. |
| For project activities adding renewable energy capacity, to qualify as a small scale CDM project activity, the aggregate installed capacity, after adding the new units or of the more efficient units, should be lower than 15 MW. | There is no capacity addition and total installed capacity is 7.25 MW. |
| The total output of the modified, retrofitted unit shall not exceed the limit of 15 MW. | Not applicable, since no retrofitting is involved. |

From the above table, it is evident that the small scale project activity meets all the applicability conditions of the latest version of approved small scale methodology AMS I.D. – Grid connected renewable electricity generation version 09; 28 July 2006 as specified in *appendix B of the simplified modalities and procedures for small scale CDM project activities*.

Application of the methodology

The methodology is applied in the context of a project activity that comprises renewable energy generation based on wind energy that supplies to and displaces electricity to Tamilnadu sate grid, which is part of southern regional grid. The Tamilnadu grid is being supplied by several fossil fired generating stations

The key steps involved in the application of the methodology are given below:

Step 1 - Determination of baseline

Baseline as per AMS I.D/version 09 dated 28 July 2006

As per AMS I. D/ version 09, the applicable baseline is as per paragraph 9 of the approved methodology AMS I. D/ version 09 – " the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg $CO_2$ eq/ kWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM) consisting of the combination of operating margin (OM) and the build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the simple OM and the average OM calculations must be considered.

***OR,***

(b) The weighted average emissions (in kg CO2 eq/kWh) of the current generation mix. The date of the year in which project generation occurs must be used.

Step –2 Additionality of the project activity

Simplified modalities and procedures for small scale CDM project activities guides to establish additionality of the project activity as per Attachment A to Appendix B. The Attachment A to appendix B mentions various barriers and requires explanation to show that the project activity would not have occurred due to at least any one barrier.

Step 3 -Determining the baseline and project emissions, assessment of leakage and emission reductions.

The baseline emissions, project emissions, leakage from the project and the emission reductions due to project activity are elaborated in Section E as per approved small scale methodology AMS I.D /Version 09.

Step 4- Electricity baseline emissions

Grid system for determination of electricity baseline emission factor

As per ACM 0002, "In large countries with layered dispatch systems, such as India, the regional grid definition should be used and that a state/ provincial grid definition may be too narrow".

The small scale project activity is in Tamilnadu state in India which is part of southern regional grid. Hence, ***southern regional grid is considered*** for estimation of baseline emission factor by applying the combined margin method as per ACM0002 for the years of April 2003-March 2004, April 2004-March 05 and April 2005- March 2006 which are the most recent three years during the time of PDD submission. The period April to March is selected because it is the accounting year period in India and data are available for this period only.

The operating margin estimates the effect of the project activity on the operation of existing power plants and the build margin estimates the effect of the project activity on the building of future power plants.

**B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:**

**Justification for additionality of the project**

Simplified modalities and procedures for small scale CDM project activities guides to establish additionality of the project activity as per Attachment A to Appendix B. The Attachment A to appendix B mentions various barriers and requires explanation to show that the project activity would not have occurred due to at least ***any one*** barrier.

***Barrier analysis***

Establishing the project activity is a voluntary step undertaken by the project proponents with no direct or indirect mandate by law. The main driving forces to this 'climate change initiative' have been:

- To reduce the impact of fossil fuel generated electricity consumed by the project proponents for their industrial operations.
- To generate and consume clean and green energy
- Rural development of the region by creating job opportunities for the local people.

However, the project proponent was aware of the various barriers associated to project implementation. But it was felt that the availability of carbon financing against a sale consideration of carbon credits generated due to project activity would help to overcome these barriers.

The barriers faced by the project activity are discussed below:

***B.3.1. Investment barriers***

The investment barriers faced by the project activity are discussed below:

B.3.1. i) Increasing capital cost

There has been a continuous increase in the capital cost of WTGs. The cost of one 850 kW WTG was INR 38 Millions (US$0.844 Million) when the project was conceived during early 2005 which increased to INR 43.5 millions (US$0.966 million) during October, 2005 when the first set of WTGs were purchased. The increase in capital cost was 14.47 %. The cost further escalated to INR 46.5 millions per 850 kW (US$1.033 million) during February 2006 when second set of WTGs (3 WTGs of 850 kW) were purchased, which was nearly 7% increase within 5 months. That is, the capital cost has increased by 21.47 % from the time of conceiving the project and purchase of WTGs. There has been no corresponding increase in the power purchase tariff or power sale tariff by the state electric utility

B.3.1.ii) Higher capital cost

The capital cost of wind energy is more than that of other renewable energy plants and thermal energy plants. The total cost of establishing 7.25 MW wind turbine generators is INR 344.50 Millions (US$7.65 Millions). Therefore, the capital cost per MW is INR 47.5 Millions per MW (US$ 1.055 Million). The cost of biomass based power projects and small hydro power projects ranges from INR 20- 25 Million (US$ 0.444 – 0.555 Million). The thermal sources based power projects costs around INR 25-35 Million (US$0.55-0.77 Million). Hence, capital cost of wind energy is high as compared to other renewable energy plants and conventional thermal source based power plants.

B.3.1. iii) High interest rate

When the project proponents first approached Indian Bank, South Indian Bank Ltd and State Bank of India for financial assistance of the project activity, the rate of interest was 8.5 %. Subsequently, the rate of interest was raised to 10-11 % and the debt portion of the small scale project activity was financed at higher rate of interest of 11%. The extra interest burden on the project activity due to this was INR 7.85 Million /year (US$ 0.174Million/ year). This was a huge unexpected increase and would result in lower returns.

B.3.1. iv) Institutional Barriers - Power Purchase Tariff

Ministry of Non-conventional Energy Sources, Government of India had issued guidelines in 1995-96 for power purchase tariff to be INR2.25 per kWh with 5 % escalation every year for all renewable energy projects to promote generation of renewable energy. Tamil Nadu Electricity Board (TNEB), the state electric utility to which the power sources were connected to, had adopted the guidelines and was following the same. In 2001, TNEB changed its policy and froze the power purchase tariff for wind energy at INR2.70 per kWh (US$0.06 per kWh) with no escalation till 2006 and had informed that this power purchase tariff will be reviewed at 2006 and a new tariff will be fixed then. The power purchase tariff was fixed at INR2.70/kWh (US$0.06 per kWh) from the year 2001 as against INR 3.01 / kWh (US$0.066 per kWh) for the year. Recently Tamil Nadu Electricity Regulatory Commission vide its order dated 15/05/2006 directed that the projects signed before 15/05/2006 will have a power purchase tariff of INR2.75/kWh which is just Re.0.05 increase over the price which was applicable for more than 5 years

Investment in wind energy which received encouragement due to slightly higher tariff allowed on account of higher capital costs, lower utilization factor etc., had a setback due to this revision in policy. This had been a major barrier for establishing new wind farms as other renewable energy plants continued to get a higher tariff. For instance, the power purchase tariff for electricity from an industrial waste / municipal waste based generation is INR3.84 (US$0.08) for the year 2006 –07 as against INR2.70 (US$0.06 per kWh) for wind energy. Reduction in power purchase tariff encourages investors to invest in other renewable energy plants. Hence, reduction in power purchase tariff was a major investment barrier.

B.3.1. v) Less capacity utilization factor:

Though the potential locations for wind mill installations were identified through detailed micrositing by reputed organizations in the country, the capacity factor of the wind mills in the country is low which is around 20-22 % for lower capacity WTGs and 25-30 % for higher capacity WTGs. Over the years, due to change in the wind pattern and increase in the population of WTGs, the capacity utilization factor has been continuously decreasing. Initially when the population of WTGs were very less, the capacity utilization factor was 32-35 %, which has gradually reduced to present days' plant utilization factor of 20 –25 %. The low capacity factors of the wind farms adversely affects the returns from the project activity.

***B.3.2. Technological barrier***

B.3.2.1. Higher capacity WTG

The project activity consists of 5 nos. 850 kW for a total installed capacity of 4.25 MW, which is more than 60 % of the capacity of the project activity. Generally WTGs installed in these areas are of 225 kW and 250 kW. Higher capacity of WTGs is able to produce higher electricity in lesser area. Due to increased height of higher capacity WTGs (65 meters as against 45 meters), and rotor diameter of 58 meters as against 48-50 meters of conventional WTGs enable to capture more energy due to larger swept area..

Less expertise is available in the country for operation and maintenance of these higher capacity WTGs. The project proponents had to send its personnel to Spain, the country of manufacture of Gamesha turbines for training and operation and maintenance. The higher capacity of WTGs is a technological barrier for the project activity.

B.3.2.2. Spare parts availability

Since most of the components of 850 kW WTGs are imported, availability of spare parts in right time is a barrier for the project activity. Availability of spare parts in right time is one of the barriers of the wind energy industry. Sometimes the spare parts may not be available for three –four months and entire wind season may be lost affecting the generation and hence the returns from the project activity.

B.3.2.2. Not core business

The core business of the project proponents is textile and transport industry. The company was incorporated in the year 1951 and initially operated in transport industry and subsequently in textile industry. The company has been actively involved in manufacture of high quality yarn since 1978. Therefore, the installation and operation of wind farms is not a core business for the project proponents and the wind energy is totally a new field of industrial activity for the project proponents.

***B.3.3.Barrier due to prevailing practice***

Wind farms are located only in following 9 states of India out of 29 states and 6 union territories:
Tamil Nadu, Maharashtra, Karnataka, Gujarat, Rajasthan, Andhra Pradesh, Madhya Pradesh, Kerala and West Bengal, last two states being latest entries. The installed capacity in Madhya Pradesh is 40.3 MW, in Kerala is 2.0 MW and in West Bengal is just 1.1 MW. Hence, the wind energy is active only in six states of India. The total installed capacity of wind energy in India is 5340.6 MW[2] as on 31 March 2006 out of total installed capacity of power generation is 124,827.17MW[3] for the entire country. The share of installed capacity of wind source is just 4.2 %.
Similarly, the installed capacity of wind energy in states covered in southern regional grid is 3600.1 MW[3] and total installed capacity of southern regional grid is 36,447.52 MW[4]. The share of installed capacity of wind energy in southern regional grid is 9.8 % only.

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[2] Source : www. windpowerindia.com
[3] Source : Ministry of Power, Government of India www.powermin.nic.in/generation/generation_state_wise.htm
[4] Source : Central Electricity Authority

The generation of electricity from wind energy in southern regional grid and overall country as against the total generation in the respective regions are given in the Table B.3.1 and B.3.2 below:

**Table B.3.1 – Share of generation from wind energy vis a vis total generation of country**

| Year | Region | Generation from wind[2] | Total Generation[3] *(excluding renewable energy)* | % of wind energy generation |
|---|---|---|---|---|
| 2002-2003 | India –entire country | 2,446.8 GWh | 531,607 GWh | 0.46 % |
| 2003-2004 | India – entire country | 2811.1 GWh | 558,338 GWh | 0.5 % |
| April 2004 -Dec' 2004 | India – entire country | 1996.5 GWh | 411,365 GWh | 0. 47 % |

**Table B.3.1 – Share of generation from wind energy vis a vis total generation of southern region**

| Year | Region | Generation from wind[4] | Total Generation in southern region [5]*(excluding renewable energy)* | % of wind energy generation |
|---|---|---|---|---|
| 2002-2003 | Southern region | 1577.3 GWh | 135,161 GWh | 1.1 % |
| 2003-2004 | Southern region | 1993.03 GWh | 137,442 GWh | 1.4 % |
| April 2004 -Dec' 2004 | Southern region | 497 GWh | 100,696 GWh | 0.49 % |

From the above tables, it can be seen that the generation of electricity from wind is less than ***half percent*** for the entire country and is about 1 % in the southern regional grid. From this it can be evidenced that wind energy is not a common prevailing practice in India.

**Impact of CDM registration**

Registering the project activity as a CDM project expected after approval and registration, would provide additional revenue to the project activity improving the cash flows. The financial viability of the project activity would improve with CER revenues. It has been estimated that the IRR on equity of the project activity without CDM revenue is 13.66 % and with CDM revenue, IRR would be 14.91 %. The CDM revenues will assist the investor in realizing returns commensurate the risks in development and operations of the project. In addition to the investment barriers already faced, the project proponent is

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[4] Source : www. windpowerindia.com

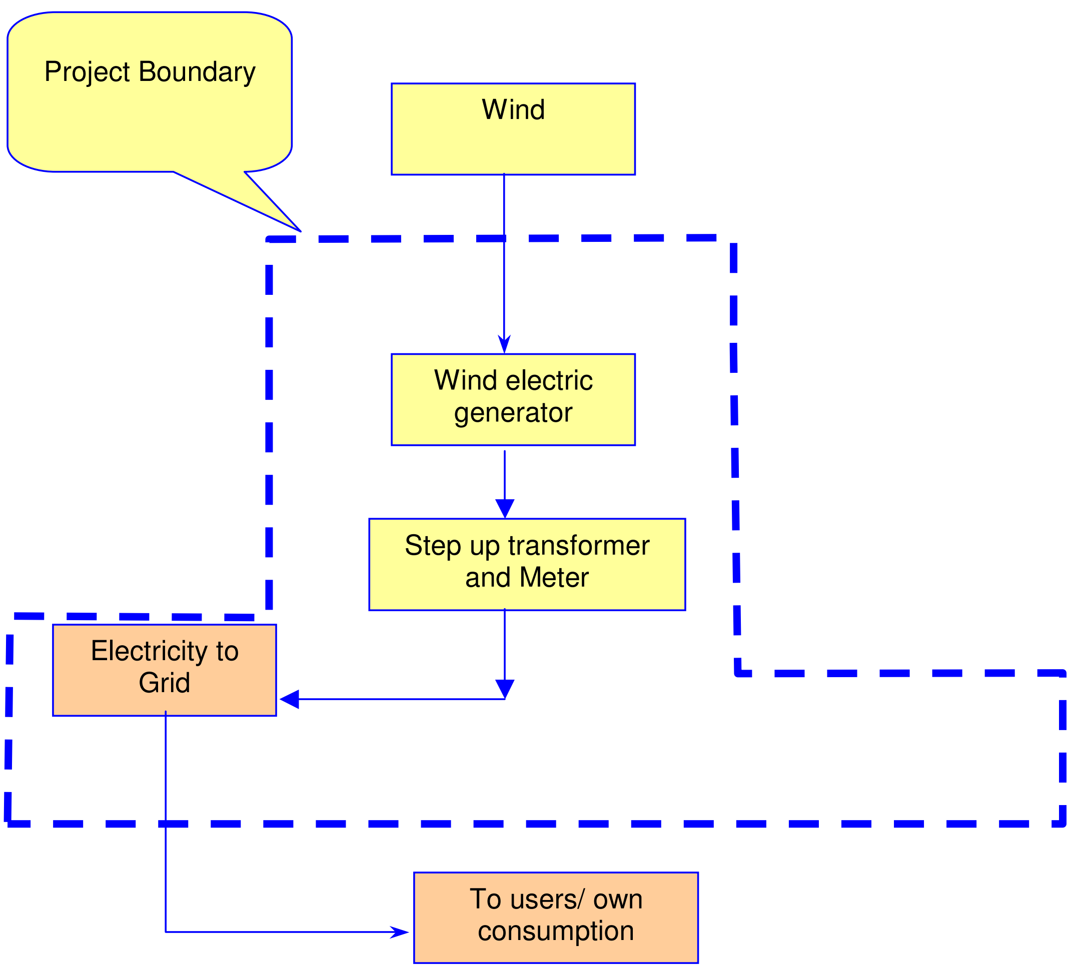
[5] Source : Central Electricity Authority

also bearing the additional transaction costs for CDM project by taking a pro-active approach in showing confidence in the Kyoto Protocol/CDM mechanism.

**B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:**

As mentioned under paragraph 6 of AMS I.D. version 09dated 28 July 2006, the project boundary encompasses the physical, geographical site of the renewable generation source. For the project activity the project boundary is WTG, to the point of electricity supply to the grid interconnection point where the project proponent has full control.

Thus, the project boundary covers wind turbine generator, step up transformer, grid interconnection point. Flow chart and project boundary is illustrated in the following diagram:



**B.5. Details of the baseline and its development:**

The project activity includes renewable electricity generation that displaces grid electricity. Hence, electricity baseline emission of the grid has to be determined for estimating the emission reductions due to the grid electricity generation that is displaced by the project activity.

As per latest version of AMS-I.D, the emission coefficient is calculated in a transparent and conservative manner as:

(c) A combined margin (CM) consisting of operating margin (OM) and the build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the simple OM and the average OM calculations must be considered.

***OR,***

(d) The weighted average emissions (in kg CO2 eq/kWh) of the current generation mix. The date of the year in which project generation occurs must be used.

Grid system

UNFCCC has recently clarified that "In large countries with layered dispatch systems, such as India, the regional grid definition should be used and that a state/ provincial grid definition may be too narrow".

Indian power grid system is divided into five regions namely northern, north eastern, eastern, southern and western regions. The small scale project activity is in Tamilnadu state, which is part of southern regional grid. The southern region consists of Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Pondicherry and Lakshadweep. Hence, southern regional grid is considered for estimation of baseline emission factor by applying the option of the combined margin method of the most recent three years of 2003-04, 2004-05 and 2005-06, which are the three most recent years during the time of PDD submission.

The power plants connected to the southern regional grid with installed capacity are given in Table B.5.1 – B. 5.6 below :

**LIST OF POWER PLANTS IN SOUTHERN REGIONAL GRID**

**Table B. 5.1 Hydro power plants in Southern regional grid**

| **Hydropower plants in Andhra Pradesh** | | |
|---|---|---|
| **S.No.** | **Name of the generating station** | **Installed Capacity MW** |
| 1 | Machkund | 114.7 |
| 2 | Upper Sileru | 240 |
| 3 | Lower Sileru | 460 |

| | | |
|---|---|---|
| 4 | T. B. Dam | 36 |
| 5 | Hampi | 36 |
| 6 | Nagarjuna Sagar | 810 |
| 7 | Nag Sagar right bank canal | 90 |
| 8 | Nag Sagar left bank canal | 60 |
| 9 | Donkarayi | 25 |
| 10 | Srisailam | 770 |
| 11 | Srisailam left bank | 900 |
| 12 | Pochampad | 27 |
| 13 | Nizam Sagar | 10 |
| 14 | Penna Ahobelam | 20 |
| 15 | Singur | 15 |
| 16 | Small Hydro | 30 |
| **Hydropower plants in Karnataka** | | |
| 17. | Sharavathy generating station | 1035 |
| 18. | Linganamakki dam power house | 55 |
| 19. | Nagajhari power house | 855 |
| 20. | Supa dam power house | 100 |
| 21. | Ghataprabha dam power house | 32 |
| 22. | Varahi underground power house | 230 |
| 23. | Mani dam power house | 9 |
| 24. | Bhadra right bank canal power house | 13.2 |
| 25. | Bhadra left bank canal power house | 26 |
| 26. | Kalmala mini hydel scheme | 0.4 |
| 27. | Sirwar mini hydel scheme | 1 |
| 28. | Ganekal mini hydel scheme | 0.35 |
| 29. | Mallapur mini hydel scheme | 9 |
| 30. | Kodasali dam power house | 120 |
| 31. | Gerusoppa dam power house | 240 |
| 32. | Khadra dam power house | 150 |
| 33. | Almatti Dam Power House | 180 |
| 34. | Sri K.Seshshadri Iyer hydro electric project | 42 |
| 35. | Shimshapura hydroelectric station | 17.2 |
| 36. | Mahatma Gandhi hydro electric station | 139.2 |

| | | |
|---|---|---|
| 37. | Munirabad power house | 37 |
| 38. | Mini Hydel | 186 |
| **Hydropower plants in Kerala** | | |
| 39. | Pallivasal | 37.5 |
| 40. | Sengulam | 48 |
| 41. | Poringalkuthu | 32 |
| 42. | Neriamangalam | 48 |
| 43. | Panniar | 30 |
| 44. | Sabarigiri | 310 |
| 45. | Sholayar | 54 |
| 46. | Kuttiyadi | 75 |
| 47. | Idukki | 780 |
| 48. | Idamalayar | 75 |
| 49. | Kallada | 15 |
| 50. | Peppara | 3 |
| 51. | Lower periyar | 180 |
| 52. | Maduppetty | 2 |
| 53. | Poringal left bank extn. | 16 |
| 54. | Kakkad | 50 |
| 55. | Kuttiadi extension scheme | 50 |
| 56. | Malampuzha | 2.5 |
| 57. | Chembukadavu - I | 2.7 |
| 58. | Chembukadavu - II | 3.75 |
| 59. | Urumi - I | 3.75 |
| 60. | Urumi - II | 2.40 |
| 61. | Malankara | 10.50 |
| 62. | Maniar | 12 |
| 63. | Kuthungal | 21 |
| **Hydropower plants in Tamil Nadu** | | |
| 64. | Pykara | 59 |
| 65. | Moyar | 36 |
| 66. | Kundah I | 60 |

| | | |
|---|---|---|
| 67. | Kundah II | 175 |
| 68. | Kundah III | 180 |
| 69. | Kundah IV | 100 |
| 70. | Kundah V | 40 |
| 71. | Mettur Dam | 40 |
| 72. | Mettur Tunnel | 200 |
| 73. | Lower Mettur | 120 |
| 74. | Periyar | 140 |
| 75. | Suruliyar | 35 |
| 76. | Papanasam | 28 |
| 77. | Servalar | 20 |
| 78. | Sarkarpathy | 30 |
| 79. | Sholayar I | 70 |
| 80. | Sholayar II | 25 |
| 81. | Aliyar | 60 |
| 82. | Kodayar I | 60 |
| 83. | Kodayar II | 40 |
| 84. | Kadaqmparai | 400 |
| 85. | Vaigai small | 6 |
| 86. | Pykara mini | 2 |
| 87. | Lower Bavani small | 8 |
| 88. | Punachi Mini | 2 |
| 89. | Maravakudy Mini | 0.75 |
| 90. | Lower Bavani right bank canal | 8 |
| 91. | Sathanur | 7.5 |
| 92. | Parsons Valley | 30 |
| 93. | Thirumurthy Mini | 1.95 |
| 94. | Mukurthy Mini | 0.7 |
| 95. | Aliyar Small | 2.5 |

**Table B. 5-2 Coal based power plants in southern regional grid**

| Coal based power plants in Andhra Pradesh | | |
|---|---|---|
| **S.No.** | **Name of the generating station** | **Installed Capacity MW** |
| 1. | Kothagudam | 1170 |
| 2. | Vijayawada | 1260 |
| 3. | Ramagundam | 62.5 |
| 4. | Nellore | 30 |
| 5. | Rayala Seema | 420 |

| Coal based power plants in Karnataka | | |
|---|---|---|
| 6 | Raichur thermal power | 1470 |
| **Coal / Lignite based power plants in Tamil Nadu** | | |
| 7. | Ennore | 450 |
| 8. | Tuticorin | 1050 |
| 9. | Mettur | 840 |
| 10. | North Chennai | 630 |
| 11. | Neyveli Zero unit Lignite | 250 |

**Table B. 5-3 Gas based power plants in southern regional grid**

| Gas based power plants in Andhra Pradesh | | |
|---|---|---|
| **S.No.** | **Name of the generating station** | **Installed Capacity MW** |
| 1. | Vijeshwaran | 272.3 |
| 2. | Peddapuram CCGT | 220 |
| 3. | Jegurupadu GT | 455.4 |
| 4. | Kondapalli | 350 |
| 5. | Godavari GT | 208 |
| 6. | Vemagiri Thermal | 233 |
| **Gas based power plants in Karnataka** | | |
| 7. | GMR Energy Ltd, Taneer Bhavi | 220 |
| 8. | Jindal Tractable Power Co. Ltd | 260 |
| **Gas based power plants in Kerala** | | |
| **9.** | B.S.E.S.Kerala Power Limited, Kochi | 157 |
| **Gas based power plants in Tamil Nadu** | | |
| 10. | Kovilkalappal | 107.88 |
| 11. | Basin Bridge | 120 |
| 12. | Valuthur GT | 95 |
| 13. | Kuttalam GT | 101.4 |
| 14. | Narimanam GT | 10 |
| 15. | Karuppur GT | 119.8 |
| 16. | Pillai Perumal Nallur GTPP | 330.5 |
| 17. | Valanthravi GT | 52.8 |
| **Gas based power plant in Pondicherry** | | |
| 17 | Pondicherry Power Corporation Ltd, Karaikkal | 32.5 |

**Table B. 5-4 Oil based power plants in southern grid**

| Oil based power plants in Andhra Pradesh | | |
|---|---|---|
| **S.No.** | **Name of the generating station** | **Installed Capacity MW** |
| 1 | LVS Power | 36.8 |
| **Oil based power plants in Karnataka** | | |
| 2 | Yelahanka diesel generating station | 127.92 |
| 3 | Rayalaseema alkalis and chemicals ltd, | 27 |
| 4 | TATA electric company | 81 |
| **Oil based power plants in Kerala** | | |
| 5 | Brahmapuram DPP | 106.60 MW |
| 6 | KDPP, Kozhikode | 128.00 MW |
| 7 | KPCL, Ksasaragode | 20.436 MW |

| Oil based power plants in Tamil Nadu | | |
|---|---|---|
| 8. | GMR Vasavi DPP | 196 |
| 9. | Samalpatti DPP | 105.66 |
| 10. | Samayanallur DPP | 106 |
| 11. | TPCL | 63.5 |
| 12. | HITEC | 14 |

| Table B. 5-5 Central sector thermal plants in southern grid | | | |
|---|---|---|---|
| **S.No.** | **Name of the generating station** | **Fuel** | **MW** |
| 1. | Neyveli Lignite Corporation | Coal | 2490 |
| 2. | NTPC, Ramagundam | Coal | 2600 |
| 3. | Simhadri | Coal | 1000 |
| 4. | Kayamkulam (N.T.P.C.) | Gas | 359.580 |

| Table B. 5-6. Central sector nuclear based power plants in southern grid | | |
|---|---|---|
| **S.No.** | **Name of the generating station** | **Installed Capacity MW** |
| 1 | Madras Atomic Power Station | 340 |
| 2 | Kaiga | 440 |

Calculation of the Operating Margin emission factor ($EF_{OM}$)

As per ACM0002, the operating margin emission factor is calculated by one of the following methods :

(a) Simple operating margin

(b) Simple adjusted operating margin

(c) Dispatch data analysis

(d) Average operating margin

Since data required for calculation of OM as per dispatch data analysis and simple adjusted OM are not publicly available, these methods are not adopted.

Hence, the other methods that are available are simple OM and average emission rate method. The simple OM method has to be used where (a) low –cost / must run resources constitute less than 50 % of total grid generation in (i) average of the five most recent years . or (ii) based on long term normals for hydroelectricity production. The average emission rate method has to be used only where low cost/must run resources constitute more than 50 % of total grid generation and detailed data to apply options (b) and (c) are not available.

Hence, the share of low cost /must run resources in the grid has to be calculated for the last five years and the average of this value has to be determined to select the method to estimate operating margin. The table B.5-7 gives the power generation mix of low cost and other resources.

**Table B-5-7 - Power generation mix of southern regional grid for five years**

| Energy Source | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
|---|---|---|---|---|---|
| Total power generation | 134,389 | 139,287 | 143,322 | 150,434 | 155,729 |
| Total thermal power generation | 87,400 | 91,829 | 116,072 | 113,122 | 108,217 |
| Total low cost power generation | 46,989 | 47,457 | 27,250 | 37,312 | 47,512 |
| Thermal % of total grid generation | 65.04 | 65.93 | 78.93 | 75.20 | 69.49 |
| Low cost % of total grid generation | **34.96** | **34.07** | **19.01** | **24.80** | **30.51** |
| **Average of the five most recent years of % of Low Cost generation out of total grid generation** | | | | | **28.67 %** |

***Since, the average of the most recent five years of low cost generation is 28.67%, which is less than 50 %, simple OM method shall be adopted.***

The $EF_{OM}$ is calculated as the generation weighted average emissions per electricity unit (t $CO_2$/MWh) of all generating sources serving the system, not including low –operating cost and must run power plants.

The generation details from various fuels for the year 2003-04, 2004-2005 and 2005-06 of southern regional grid are given in Tables below; the generation data of all the power plants in the southern regional grid are taken from publicly available data of Central Electricity Authority, Government of India.

**Table B.5-8 -Generation mix of southern regional grid for the years 2003-2004, 2004-2005 and 2005-06**

*All units in GWh*

| Table B.5-8-1-Generation in the southern regional grid for the year 2003 – 2004 [6] | | | | | | |
|---|---|---|---|---|---|---|
| **Fuel type** | **Andhra** | **Kerala** | **Karnataka** | **Tamil Nadu** | **Pondy** | **Total** |
| Thermal (coal)-state | 22229 | 0 | 11400 | 20424 | | 54053 |
| Thermal (coal)-Central | 24054 | 0 | 0 | 0 | | 24054 |
| Thermal (lignite) | 0 | 0 | 0 | 17791 | | 17791 |
| Thermal (gas) | 8239 | 3109 | 1631 | 2927 | 277 | 16183 |
| Thermal (oil) | 0 | 657 | 661 | 1907 | | 3225 |
| IPP - blast furnace gas | 0 | 0 | 766 | 0 | 0 | 766 |
| Hydro energy | 3210 | 3957 | 7459 | 2044 | | 16670 |
| Nuclear | 0 | 0 | 3123 | 1577 | | 4700 |
| Non -conventional energy | 3152.7 | 2.49 | 1034.31 | 1690 | | 5879.626 |
| **Total** | **60884.7** | **7725.49** | **26074.31** | **48,360.126** | **277** | **143321.63** |

| Table B.5-8-2- Generation in the southern regional grid for the year 2004-05 | | | | | | |
|---|---|---|---|---|---|---|
| **Fuel type** | **Andhra** | **Kerala** | **Karnataka** | **Tamil Nadu** | **Pondy** | **Total** |
| Thermal (coal)-state | 23356.6 | 0 | 10717.93 | 20002.89 | 0 | 54077.42 |
| Thermal (coal)-central | 25291.3 | 0 | 0 | 0 | 0 | 25291.3 |
| Thermal (lignite) | 0 | 0 | 0 | 18078.66 | 0 | 18078.66 |
| Thermal (gas) | 8174.29 | 732.33 | 629.55 | 2466.47 | 275.69 | 12278.33 |
| Thermal (oil) | 0 | 312.64 | 549.92 | 1501.57 | 0 | 2364.13 |
| IPP Blast furnace gas | 0 | 0 | 516.33 | 0 | 0 | 516.33 |
| Hydro energy | 5812.57 | 6144.02 | 8910.08 | 4413.11 | 0 | 25279.78 |
| Nuclear -Central | 0 | 0 | 2926.25 | 1480.48 | 0 | 4406.73 |
| Non -conventional energy | 3467.2 | 2.44 | 1505.65 | 2650 | 0 | 7625.29 |
| **Total** | **66,101.96** | **7191.48** | **25,755.75** | **50593.18** | **275.69** | **149917.97** |

[6] Source : *CEA report for annual generation www.cea.nic.in*

| Table B.5-8-3-Generation from various sources in the southern regional grid for the year 2005 - 2006 | | | | | | |
|---|---|---|---|---|---|---|
| **Fuel type** | **Andhra** | **Kerala** | **Karnataka** | **Tamil Nadu** | **Pondy** | **Total** |
| Thermal (coal)-state | 20741.83 | 0 | 9173.48 | 18794.79 | 0 | 48710.1 |
| Thermal (coal)-central | 27432.5 | 0 | 0 | 0 | 0 | 27432.5 |
| Thermal (lignite) | 0 | 0 | 0 | 17696.6 | 0 | 17696.6 |
| Thermal (gas) | 7422.17 | 395.65 | 241.49 | 2868.61 | 256.71 | 11184.63 |
| Thermal (oil) | 0 | 156.96 | 247.07 | 1406.56 | 0 | 1810.59 |
| IPP Blast furnace gas | 0 | 0 | 1382.95 | 0 | 0 | 1382.95 |
| Hydro energy | 8321.57 | 7538.55 | 11534.97 | 6110.47 | 0 | 33505.56 |
| Nuclear | 0 | 0 | 2859.58 | 1853.41 | 0 | 4712.99 |
| Non -conventional energy | 3813.92 | 2.5 | 2626.85 | 2850 | 0 | 9293.27 |
| **Total** | **67731.99** | **8093.66** | **28066.39** | **51580.44** | **256.71** | **155729.19** |

The total of generation of electricity from all sources in the southern regional grid is given in the table B.5-9 below

| Table B.5-9 Sector wise generation for southern regional grid | | | |
|---|---|---|---|
| **Sector wise generation** | **2003-04** | **2004-05** | **2005-06** |
| Thermal (coal)-state government | 54053 | 54077 | 48710 |
| Thermal (coal)-central government | 24054 | 25291 | 27433 |
| Thermal (lignite) | 17791 | 18079 | 17697 |
| Thermal (gas) –naphtha | 16949 | 12278 | 11185 |
| Oil based generation | 3225 | 2364 | 1811 |
| Blast furnace gas based generation | 766 | 516 | 1383 |
| Hydroelectric generation | 16670 | 25280 | 33506 |
| Nuclear based generation | 4700 | 4407 | 4713 |
| Non-conventional energy | 5880 | 7625 | 9293 |
| **Total** | **143322** | **149,918** | **155729** |
| **20 % of generation** | **28664.3** | **29983.6** | **31145.8** |
| Total generation excluding hydro, nuclear, non conventional energy and blast furnace gas based generation (as it is a CDM project) | 115306 | 112090 | 108634 |

Actual coal consumed by the power plants for the entire country including those that of southern regional grid are publicly available in CEA's website which is considered for estimation of emission factor for coal.

| Table B.5-9 - Coal Consumption | | | |
|---|---|---|---|
| | | | in '000 tonnes |
| **YEAR** | **2003-04** | **2004-05** | |
| **Andhra Pradesh** | | | |
| Kothagudem | 5928 | 6316 | 6009 |
| Ramagundam B | 312 | 317 | 280 |
| Vijayawada | 7161 | 6863 | 6808 |
| R-gundam STPS | 10167 | 10490 | 11700 |
| Nellore | 148 | 150 | 8 |
| Rayalseema | 2246 | 2149 | 1526 |
| Simhadri | 5231 | 5556 | 4633 |
| **Karnataka** | | | |
| Raichur | 6982 | 6936 | 6012 |
| **Tamilnadu** | | | |
| Ennore | 1186 | 1156 | 576 |
| Mettur | 4918 | 4852 | 3547 |
| Tuticorin | 5292 | 5563 | 5643 |
| North Chennai | 3086 | 2816 | 2121 |
| **Total** | **52657** | **53164** | **48863** |
| *Source : Performance review of TPS 2005-06, CEA Section 9)* | | | |

| **Table B.5-10 Estimation of Baseline Emission Factor** | | | |
|---|---|---|---|
| **Estimation of Simple Operating Margin** | | | |
| **Table B.5-10 –1 Estimation of $CO_2$ emission factor for the coal consumed in the southern regional grid in the three years** | | | |
| **Description** | **2003-04** | **2004-05** | **2005-06** |
| Calorific value of coal used ( TJ/ tonne) – IPCC value | 0.01998 | 0.01998 | 0.01998 |
| Coal consumption as per CEA Report (tons/yr) | 52657000 | 53164000 | 48863000 |
| Carbon emission factor for coal – IPCC value (t C/ TJ) | 26.2 | 26.2 | 26.2 |
| Mass conversion factor (t $CO_2$/TC) | 3.67 | 3.67 | 3.67 |
| Emission factor for coal-IPCC value (t $CO_2$/TJ) | 96.1 | 96.1 | 96.1 |
| Oxidation factor of coal-IPCC value | 0.98 | 0.98 | 0.98 |
| COEF of coal (tCO2/ton of coal) | 1.88 | 1.88 | 1.88 |

| Table B.5-10 –.2Estimation of Carbon emission factor of naphtha consumed in the southern regional grid in the three years | | | |
|---|---|---|---|
| **Description** | **2003-04** | **2004-05** | **2005-06** |
| Avg. efficiency of power generation with gas as a fuel, % | 45 | 45 | 45 |
| Calorific value of gas used – IPCC value – Both Naphtha and gas are used. Lower value of gas is used (TJl/ton) | 0.0433 | 0.0433 | 0.0433 |
| Estimated gas consumption (tons/yr) | 2989931 | 2286514 | 2066444 |
| Carbon Emission Factor for gas - IPCC value (t C/ TJ) | 15.3 | 15.3 | 15.3 |
| Mass conversion factor t $CO_2$/TC | 3.67 | 3.67 | 3.67 |
| Emission Factor for Gas- IPCC standard value(t $CO_2$/TJ) | 56.1 | 56.1 | 56.1 |
| Oxidation Factor of Gas-IPCC standard value | 0.995 | 0.995 | 0.995 |
| COEF of Gas(t$CO_2$/ton of gas) | 2.417 | 2.417 | 2.417 |

| Table B.5-10 –3 Estimation of Carbon emission factor of oil consumed in the southern regional grid in the three years | | | |
|---|---|---|---|
| **Description** | **2003-04** | **2004-05** | **2005-06** |
| Avg. efficiency of power generation with oil as a fuel,% | 41.7 | 41.7 | 41.7 |
| Calorific value of diesel oil used – IPCC value (TJ/ton) | 0.0433 | 0.0433 | 0.0433 |
| Estimated oil consumption (tons/yr) | 681463 | 499556 | 382589 |
| Carbon Emission Factor for oil - IPCC value (t C/ TJ) | 20.2 | 20.2 | 20.2 |
| Mass conversion factor t $CO_2$/TC | 3.67 | 3.67 | 3.67 |
| Emission Factor for oil - IPCC standard value (t $CO_2$/TJ) | 74.1 | 74.1 | 74.1 |
| Oxidation Factor of oil -IPCC standard value | 0.99 | 0.99 | 0.99 |
| COEF of oil (t $CO_2$/ton of oil) | 3.18 | 3.18 | 3.18 |

| Table B.5-10 –4- Estimation of Carbon emission factor of lignite consumed in the southern regional grid in the three years | | | |
|---|---|---|---|
| **Description** | **2003-04** | **2004-05** | **2005-06** |
| Calorific value of lignite – IPCC value for India (TJ/ton) | 0.0098 | 0.0098 | 0.0098 |
| Estimated lignite consumption (tons/yr) | 26236870 | 26661090 | 260976656 |
| Carbon Emission Factor for lignite- IPCC value (t / TJ) | 27.6 | 27.6 | 27.6 |
| Mass conversion factor t $CO_2$/TC | 3.67 | 3.67 | 3.67 |
| Emission Factor for lignite-IPCC standard value | 101.2 | 101.2 | 101.2 |

| | | | |
|---|---|---|---|
| ($tCO_2$/TJ) | | | |
| Oxidation Factor of lignite-IPCC value | 0.98 | 0.98 | 0.98 |
| COEF of lignite (t $CO_2$/ton of lignite) | 0.97 | 0.97 | 0.97 |

| **Table B.5-11- Estimation of Simple Operating Margin for southern regional grid** | | | |
|---|---|---|---|
| **Description** | **2003-04** | **2004-05** | **2005-06** |
| $CO_2$ emissions due to coal ( t $CO_2$/year) | 99049068 | 100002747 | 91912464 |
| $CO_2$ emissions due to naphtha/gas ( t $CO_2$/year) | 7226616 | 5482962 | 4994564 |
| $CO_2$ emissions due to diesel oil ( t $CO_2$/year) | 2041522 | 1496566 | 1146518 |
| $CO_2$ emissions due to lignite ( t $CO_2$/year) | 25500264 | 25912574 | 25364959 |
| Total $CO_2$ emissions ( t $CO_2$/year) | **133817471** | **132894849** | **123418144** |
| Electricity generation excluding low cost generation GWh | **115306** | **112090** | **106834** |
| Simple Operating Margin Emission factor ($EF_{OM\ Simple}$), ( $tCO_2$/GWh) | 1160.54 | 1185.61 | 1155.23 |
| Average $EF_{OM}$ , $tCO_2$/GWh | **1167.13** | | |
| Average $EF_{OM}$, $tCO_2$/MWh | **1.167** | | |
| Average $EF_{OM}$, kg $CO_2$ /kWh | **1.167** | | |

**Estimation of Build Margin emission factor**

The Build Margin emission factor is the generation weighted average emission factor ($tCO_2$/MWh) of sample group of power plants . The sample group m should consist of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20 % of the system generation (in MWh) that have been built most recently considering the sample group that comprises the larger annual generation shall be considered.

The generation of southern regional grid for the most recent year 2005-06 is 155,729 GWh and the 20 % of the generation is 31,145 GWh. The following table B.5.12 gives the list of most recent built plants. It may be seen that 20 % generation is larger than the annual generation from the 5 most recent built plants. Hence, the generation of most recent built units comprising 20 % generation is considered for estimation of Build Margin.

| Table 5.12- Power Plants built most recently in Southern Regional Grid | | | | | |
|---|---|---|---|---|---|
| Sr. No | Power Plant | Fuel | MW | Year of commissioning | Generation in 2005-06 in GWh |
| 1 | Nizam Sagar | Hydro | 10 | 2005-06 | 9.64 |
| 2 | Penna Ahobelam | Hydro | 20 | 2005-06 | 9.88 |
| 3 | Vemagiri CCPP | Gas | 233 | 2005-06 | 1.96 |
| 4 | Manadagere | Hydro | 3.5 | 2005-06 | 6.1 |
| 5 | Pykara ULT | Hydro | 150 | 2005-06 | 189.36 |
| 6 | KEPS GT | Gas | 119 | 2005-06 | 357.33 |
| 7 | Valantharvi | Gas | 38 | 2005-06 | 98.06 |
| 8 | Nagarjun Sagar | Hydro | 90 | 2004-05 | 273.94 |
| 9 | Nagarjun Sagar LBC | Hydro | 60 | 2004-05 | 120.97 |
| 10 | Chembukadavu | Hydro | 6.5 | 2004-05 | 10.59 |
| 11 | Urumi | Hydro | 6.2 | 2004-05 | 12.81 |
| 12 | Alamatti DPH | Hydro | 125 | 2004-05 | 598.62 |
| 13 | NLC - 2 FST Extn | Lignite | 210 | 2003-04 | 3082.33 |
| 14 | Kuttalam | Gas | 100 | 2003-04 | 674.23 |
| 15 | Raichur Unit VII | Coal | 210 | 2003-04 | 940.57 |
| 16 | NLC - 1 Expansion | Lignite | 210 | 2003-04 | 3990.28 |
| 17 | Srisailam LBPH | Hydel | 900 | 2003-04 | 2232.9 |
| 18 | Ramagundam STPS | Coal | 500 | 2003-04 | 3786.73 |
| 19 | Valuthur | Gas | 95 | 2003-04 | 697 |
| 20 | Pykara | Hydel | 70 | 2003-04 | 257 |
| 21 | Jegurupadu | Gas | 235 | 2002-03 | 668.17 |
| 22 | Neyveli ST-CMS | Lignite | 250 | 2002-03 | 1450.45 |
| 23 | BSES | Gas | 220 | 2002-03 | 37.15 |
| 24 | Samayanallur | Diesel | 106 | 2002-03 | 328.59 |
| 25 | Simhadri | Coal | 500 | 2002-03 | 4143 |
| 26 | Gerusoppa | Hydro | 60 | 2002-03 | 557.01 |
| 27 | Bellary | Diesel | 25.2 | 2002-03 | 17.25 |
| 28 | Peddapuram CCGT | Gas | 220 | 2001-02 | 842 |
| 29 | Non conventional energy | Wind,Cogen,biomass | | 2001-2006 | 5493 |
| 30 | Tanir Bawi | Gas | | | 241.49 |
| 31 | Tata Electric | Diesel | | | 133.12 |
| | **Total** | | | | **31263** |
| | **20% of the total generation** | | | | **31146** |
| | | | | **Coal based generation** | 8870.3 |
| | | | | **Lignite** | 8523 |
| | | | | **Diesel** | 479 |
| | | | | **Gas** | 3618 |
| | | | | **Hydro** | 4279 |
| | | | | **Non conventional energy** | 5493 |
| | **Total** | | | | **31262.63** |

**Table B.5-12 - Generation of most recent units comprising 20 % generation**

**Estimation of Carbon emission factor of various fuels**

| **Table B.5-13-1 Estimation of Carbon emission factor of coal consumed in sample group** | |
|---|---|
| **Description** | **2005-06** |
| Avg. efficiency of power generation with coal as a fuel, % | 32.5 |
| Calorific value of coal – IPCC value for India (TJ/ton) | 0.01998 |
| Estimated coal consumption (tons/yr) | 4917669 |
| Carbon emission factor for coal - IPCC value (t C/ TJ) | 26.2 |
| Mass conversion factor (t $CO_2$/TJ) | 3.67 |
| Emission factor for coal-IPCC value (t $CO_2$/TJ) | 96.1 |
| Oxidation factor of coal-IPCC value | 0.98 |
| COEF of coal (t$CO_2$/ton of coal) | 1.88 |
| $CO_2$ emissions from coal of sample plants ( t $CO_2$) | 9,250,309 |

| **Table B.5-13-2Estimation of Carbon emission factor of naphtha consumed in in sample group** | |
|---|---|
| **Description** | **2005-06** |
| Avg. efficiency of power generation with gas as a fuel, % | 45 |
| Avg. calorific value of naphtha/ gas used (TJ/ton) | 0.04333 |
| Estimated gas consumption (tons/yr) | 668012 |
| Carbon Emission Factor for gas - IPCC value (t C/ TJ) | 15.3 |
| Mass conversion factor t $CO_2$/TJ | 3.67 |
| Emission Factor for Gas- IPCC standard value(t $CO_2$/TJ) | 56.1 |
| Oxidation Factor of Gas-IPCC standard value | 0.995 |
| COEF of Gas(t$CO_2$/ton of gas) | 2.419 |
| $CO_2$ emissions from naphtha of sample plants ( t $CO_2$) | 1,615,693 |

| **Table B.5-13-.3 Estimation of carbon emission factor of oil consumed in sample group** | |
|---|---|
| **Description** | **2005-06** |
| Avg. efficiency of power generation with oil as fuel, % | 41.7 |
| Calorific value of oil – IPCC value (TJ/ton) | 0.04333 |

| | |
|---|---|
| Estimated oil consumption (tons/yr) | 95428 |
| Carbon Emission Factor for oil - IPCC value (t C/ TJ) | 20.2 |
| Mass conversion factor t $CO_2$/TJ | 3.7 |
| Emission Factor for oil-IPCC value (t $CO_2$/TJ) | 74.1 |
| Oxidation Factor of oil-IPCC standard value | 0.99 |
| COEF of oil (t $CO_2$/ton of oil) | 3.18 |
| $CO_2$ emissions from oil of sample plants ( t $CO_2$) | 303196 |

**Table B.5-13-.4Estimation of Carbon emission factor of lignite consumed in the southern regional grid in the three years**

| **Description** | **2005-06** |
|---|---|
| Efficiency of power generation with lignite as fuel, % | 25 |
| Calorific value of lignite – IPCC value for India (TJ/ton) | 0.0098 |
| Estimated lignite consumption (tons/yr) | 12523680 |
| Carbon Emission Factor for lignite- IPCC value (t C/ TJ) | 27.6 |
| Mass conversion factor t $CO_2$/TJ | 3.67 |
| Emission Factor for lignite-IPCC value (t $CO_2$/TJ) | 101.2 |
| Oxidation Factor of lignite-IPCC value | 0.98 |
| COEF of lignite (t $CO_2$/ton of lignite) | 0.98 |
| $CO_2$ emissions from lignite of sample plants ( t $CO_2$) | 12296280 |

$$\text{Build Margin } (EF_{BM}) = \frac{\text{Total emissions of all fuels consumed by sample plants } (tCO_2)}{\text{Total generation of sample plants (GWh)}}$$

$$= \frac{23465478 \text{ t } CO_2}{31263 \text{ GWh}}$$

$$= \mathbf{750.59\ tCO_2/GWh\ (=0.751t\ CO_2/MWh)}$$

As per ACM 0002 /Version 06, the baseline emission factor (EF) by the combined margin method is the weighted average of operating margin and build margin.

$$EF = W_{OM} * EF_{OM} + W_{BM} * EF_{BM}$$

where $W_{OM}$ and $W_{BM}$ are the weights for operating margin and build margin respectively.

*As per ACM 0002, for wind energy project, the default weights $W_{OM}$ = 0.75 and $W_{BM}$= 0.25 (owing to their intermittent and non dispatchable nature).*

Hence, Emission factor EF (t $CO_2$/MWh) = 0.75 * 1.167 (t $CO_2$/MWh) + 0.25 * 0.751 (t $CO_2$/MWh)

= **1.063 t $CO_2$ /MWh**

**B.5.2** Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

07/09/2006

**B.5.3** Name of person/entity determining the baseline:
Ecoinvest Carbon has assisted the project proponent in determining baseline and the contact information of Ecoinvest Carbon is given below :

**Contact information of entity determining baseline**

| | |
|---|---|
| Organization: | Ecoinvest Carbon S.A |
| Street/P.O.Box: | Plot C-22, G-Block |
| Building: | 7 th Floor, Bandra Kurla complex |
| City: | Bandra (E), Mumbai |
| State/Region: | Maharashtra |
| Postfix/ZIP: | 400 051 |
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| Telephone: | +91 22 40509500 |
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| E-Mail: | info@ecoinvestcarbon.com |
| URL: | www.ecoinvestcarbon.com |
| Represented by: | |
| Title: | Vice President |
| Salutation: | Mr. |
| Last Name: | Subramanian |
| Middle Name: | |
| First Name: | Nataraj |
| Department: | Financial Services Group |
| Mobile: | +91 98922 36912 |
| Direct FAX: | - |
| Direct tel: | + 91 22 40509503 |
| Personal E-Mail: | subramanian.nataraj@bunge.com |

The entity determining baseline is not a project participant.

**SECTION C. Duration of the project activity / Crediting period:**

**C.1. Duration of the small-scale project activity:**

>>

**C.1.1. Starting date of the small-scale project activity:**

27/10/2005

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

25y –0m

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

The project activity will use renewable crediting period

**C.2.1. Renewable crediting period:**

>>

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

The starting date of the first crediting period will be the date of registration, which is expected to be 01/01/2007.

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

7 y-0m

**C.2.2. Fixed crediting period:**

Not Applicable

**C.2.2.1. Starting date:**

>>

**C.2.2.2. Length:**

>>

## SECTION D. Application of a monitoring methodology and plan:

>>

### D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

Title of the approved monitoring methodology : Grid connected renewable electricity generation

Reference of the approved monitoring methodology : Paragraph 13 of the approved small scale methodology AMS I. D./Version 09 dated 28 July 2006.

### D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

As discussed elsewhere in the document and established in Section A.4.2, the project activity is in accordance with approved small scale methodology AMS I.D, and therefore, can use the monitoring methodology for I.D of 'Appendix B of the simplified M&P for small-scale CDM project activities-Version 9: 28 July 2006' – grid connected renewable electricity generation.

The monitoring methodology specified in paragraph 13 of the methodology requires that the project-monitoring plan to consist of metering the electricity generated by the renewable technology. Emission reductions of the project activity arise directly from the electricity exported to the grid. Since the baseline emission factor is estimated based on the combined margin of the southern regional grid and the same is used as the constant baseline for the project activity during the crediting period, monitoring of actual generation mix in the grid system is not required. Hence, the data to be monitored to estimate emission reductions of the project activity is only the electricity exported to the grid. Hence, the chosen methodology suits the project activity.

In order to monitor the mitigation of GHG due to the project activity, the total energy exported needs to be measured. The net energy supplied to the grid by the project activity in kWh multiplied by baseline emission factor for southern regional grid in kg $CO_2$/kWh, would form the baseline for the project activity.

**D.3 Data to be monitored:**

| ID Number | Data type | Data variable | Data unit | Measured (m), calculated I or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/paper) | For how long is archived data to be kept? | Comment |
|---|---|---|---|---|---|---|---|---|---|
| D.3.1 | Power | Net electricity exported to the grid | kWh | m | continuous | 100 % | Electronic | 2 years after the crediting period | Measured in the interconnection point |

**D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:**

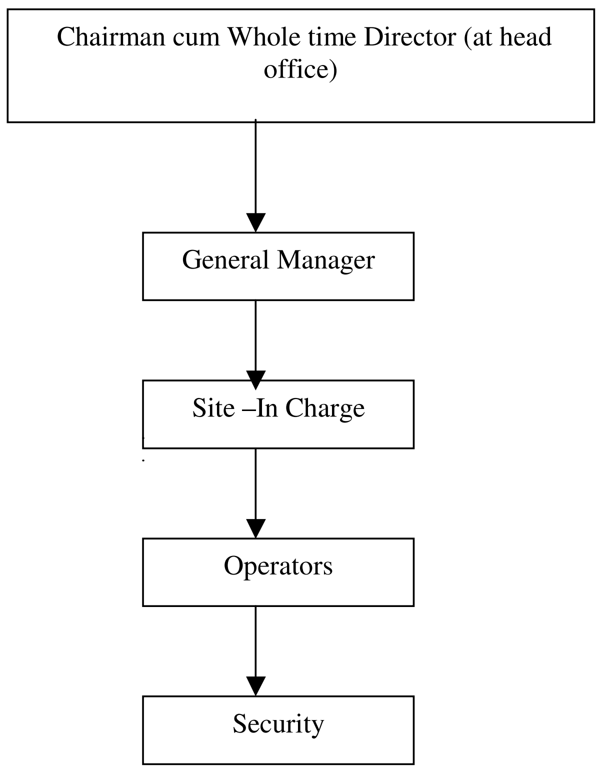
| Data | Uncertainty level of data (High/Medium/Low) | Are QA/QC procedures planned for these data? | Outline explanation why QA/QC procedures are or are not being planned. |
|---|---|---|---|
| D.3.1 | Low | Yes | This data will be used for calculation of emission reductions by project activity. Meter will be checked and calibrated as per specification and operating procedures of Tamil Nadu Electricity Board (TNEB) |

**D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:**

Operational and management structure

The Site In-charge would be responsible for operation and maintenance of wind turbine generators. The Site In-charge is a qualified electrical engineer with considerable experience in O & M of windmills. He would be assisted by operators in day today operations of wind farms. The management structure is given below:

**The Management Structure for monitoring emission reductions is as follows:**




The Operators would record the generation on a daily basis for each service connection. The operators would also maintain the records for training, maintenance, break down and calibration of meters.

The readings recorded by the operators would be verified by the Site –In charge. The Site In charge would report the cumulative generation to the head office at Melakandamangalam on a weekly basis. The site in charge would be responsible for maintaining the Generation & Maintenance log books, along with the history card for each and every WTG.

Internal Audits

General Manager at head office at Melakandamangalam would be the overall in charge of the operation of the wind farms. The General Manager would carry out internal audits once in six months and any corrective action to be taken would be recorded and carried out.

Monitoring

As emission reductions from the project are determined by the number of units connected to the grid, it is mandatory to have a monitoring system in place and ensure that the project activity produces and exports the rated power at the stipulated norms. The sole objective of having monitoring system is to have a constant watch on the emission reductions.

The project activity is designed and capable of synchronising within a frequency range of 47.5 to 51.5 Hz and a power factor between 0.85 lagging and 0.95 leading at the generator terminals.

The delivered energy shall be metered by TNEB at the high voltage side of the step up transformers. Metering is done either for two /three / more wind mills depending on the location of wind mills and service connection number. Metering equipment is electronic trivector meters of accuracy 0.2%. The metering equipment is maintained in accordance with electricity standards and have the capability of recording hourly and monthly readings. The monthly meter readings are taken at the interconnection point by TNEB on the twentieth day of the each month. Records of joint meter reading are maintained at site and a copy is maintained at the head office.

The meter (export and import) installed at the project would be of 0.2% accuracy class. The meter would be jointly inspected and sealed on behalf of Jayavilas and TNEB, in the presence of its authorised representatives. The meter would be tested for accuracy every calendar quarter with reference to a portable standard meter which shall be of an accuracy class of 0.1%. As the instruments are calibrated and marked at regular intervals, the accuracy of measurement can be assured at all times. Necessary records of calibration are maintained by Jayavilas.

Adequate fire fighting and safety equipment are installed as per the guidelines of the Directorate of Factories and Chief Electrical Inspector to Government . The Site In-charge is responsible for the upkeep of the safety and fire fighting and maintain necessary records.

**D.6. Name of person/entity determining the monitoring methodology:**

Ecoinvest Carbon S.A. have determined the monitoring methodology in consultation with the project proponents. Ecoinvest Carbon S.A is not a project participant.

## SECTION E.: Estimation of GHG emissions by sources:

### E.1.1 Selected formulae as provided in appendix B:

Approved small scale methodology AMS I.D does not indicate a specific formula to calculate the GHG emission reduction by sources.

### E.1.2 Description of formulae when not provided in appendix B:

#### E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

Since the project activity is a small scale wind energy project, there are no anthropogenic emissions by sources of greenhouse gases within the project boundary. Therefore no formula is applicable to estimate GHG emissions from sources.

#### E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

As per AMS I.D, Version 09dated 28 July 2006, leakage is to be considered only if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since this does not apply for the project activity, there are no leakage issues associated with the project activity and hence no formula is used to estimate leakage due to the project activity.

#### E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

The sum of E.1.2.1 and E.1.2.2 will give the sum of GHG emissions due to the project activity and leakage, which would be the net project emissions due to the project activity. Since there are no anthropogenic emissions and no leakage due to the project activity, the sum of E.1.2.1 and E.1.2.2 will be zero.

*The project emission of the project activity is zero.*

**E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:**

As per paragraph 9 of AMS I.D, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg $CO_2$ equ/ kWh).

Southern regional grid is considered for baseline analysis and calculation of anthropogenic emissions by fossil fuels during power generation.

The baseline emission factor of southern regional grid ($EF_y$) is estimated as per ACM0002

***Emission Reduction by project activity***

$$ERy = (TP_{\exp}, yxEFy) - PEy - ELy$$

Where,

$ER_y$ - Emission reductions of the year, "y" by project activity (tonnes $CO_2$ eq/year)

$TP_{exp,y}$ - Total power exported to grid in the year "y" in MWh

$EF_y$ - Baseline emission factor (t $CO_2$/MWh)

$PE_y$ - Project emissions in the year "y" [= 0]

$EL_y$ - Emissions due to leakage in the year "y" (tonnes of $CO_2$ eq/year) [= 0]

**Hence, $ER_y$ = $TP_{exp,y}$ X $EF_y$**

The detailed method of calculation of baseline emission factor has been explained in section B.5. and an excel sheet is also attached showing the calculations.

The baseline emission factor $EF_y$ estimated as per combined margin approach of ACM0002 (as prescribed in AMS I.D) which is **1.063 t $CO_2$/MWh (=1.063 kg $CO_2$/kWh)**

The net power that would be exported to the grid in each year during the crediting period, would be 15,089 MWh per year. Accordingly, the baseline emissions are estimated and are presented in the table E.1 below:

**Table E-1 – Baseline emissions of the project activity**

| S. No. | Year | Electricity supplied to the grid<br>*$TP_{exp}$ (MWh/year)* | Baseline emission factor<br>*$EF_b$ ($tCO_2$/MWh)* | Baseline emissions BE<br>*(ton $CO_2$eq/year)* |
|---|---|---|---|---|
| 1 | 2007 | 15,089 | 1.063 | 16,039 |
| 2 | 2008 | 15,089 | 1.063 | 16,039 |
| 3 | 2009 | 15,089 | 1.063 | 16,039 |
| 4 | 2010 | 15,089 | 1.063 | 16,039 |
| 5 | 2011 | 15,089 | 1.063 | 16,039 |
| 6 | 2012 | 15,089 | 1.063 | 16,039 |
| 7 | 2013 | 15,089 | 1.063 | 16,039 |
| **Total** | | **105,623** | **1.063** | **112,273** |

**E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:**

Following formula is used to determine emission reductions:

| | | | | |
|---|---|---|---|---|
| Emission reductions due to project activity | = | Baseline emissions | – | Project emissions |

The emission reductions due to the project activity during the crediting period are given in table E.2

**Table E.2 – Emission reductions**

| S. No. | Year | Baseline emissions<br>(ton $CO_2$) | Project emissions<br>(ton$CO_2$) | Emission reductions<br>(ton $CO_2$) |
|---|---|---|---|---|
| 1 | 2007 | 16,039 | 0 | 16,039 |
| 2 | 2008 | 16,039 | 0 | 16,039 |
| 3 | 2009 | 16,039 | 0 | 16,039 |
| 4 | 2010 | 16,039 | 0 | 16,039 |
| 5 | 2011 | 16,039 | 0 | 16,039 |

| | | | | |
|---|---|---|---|---|
| 6 | 2012 | 16,039 | 0 | 16,039 |
| 7 | 2013 | 16,039 | 0 | 16,039 |
| **Total for 2007 –2013** | | **112,273** | **0** | **112,273** |

## E.2 Table providing values obtained when applying formulae above:

The values obtained when applying above formula is reproduced below for the crediting period ;

| S.No. | Year | Emission reductions ($tCO_2$) |
|---|---|---|
| 1 | 2007 | 16,039 |
| 2 | 2008 | 16,039 |
| 3 | 2009 | 16,039 |
| 4 | 2010 | 16,039 |
| 5 | 2011 | 16,039 |
| 6 | 2012 | 16,039 |
| 7 | 2013 | 16,039 |
| **Total** | | **112,273** |

## SECTION F.: Environmental impacts:

### F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

Wind energy projects are exempted from environmental clearance.

However, a brief review of the environmental impacts project activity is discussed below ;

<u>During construction phase</u>

The construction phase involved erection of a WTG in particular location. Although movement of materials for erection produced some dust pollution, the impacts were negligible and do not have any significant impact on the environment.

<u>During operation phase</u>

*Impact on Air*

There are absolutely no negative impacts on air due to the project activity.

*Impact on water*

No water is consumed for the project activity and no effluent is discharged from the project activity and hence, there is no impact on water due to the project activity.

*Impact due to odour*

There is absolutely no odour issues due to the project activity.

*Impact due to noise*

There are no significant impacts on the environment due to noise.

*Impact on ecology*

There are no known endangered species in the vicinity of the project activity and hence no significant impact is effected on the ecology.

*Social and economy issues*

Land was purchased from the landowners. These lands are barren and largely unfertile. The farming operations were not very encouraging and land owners were in most cases more than willing to part off the land. They got a good price. The installation of the project activity has given job opportunities to the local community during construction and operation of the project activity. The project activity has contributed for improving the standard of living of the local community

## SECTION G. Stakeholders' comments:

### G.1. Brief description of how comments by local stakeholders have been invited and compiled:

The population in the villages of Pazhavoor , Levenjipuram Udayathur and Thankkarkulam villages are the most important local stakeholders of the project activity. The "Village Panchayat", which is a body elected by villagers, is the local government authority for the village. This Village Panchayat is the representative of the local community. Questionnaires were sent to the village panchayats of the villages of the project activity and to few other prominent members of the these villages. They were informed about the project activity and comments were invited from them regarding the effects of the project activity. Written comments were received from them in vernacular language (Tamil Language) which are compiled and the summary of the comments translated in English is given in G.2.

### G.2. Summary of the comments received:

Summary of questions sent to various village panchayats are tabulated below:

| **Question** | Reply from Mr. M. Subbiah,President, Pazahvoor Panchayat | Reply from Mr. M. Sivakumar, MSK Traders, South Karungulam | Reply from Mr. C.Ravi, Thanakarkulam, Valliyoor Union | Reply from Mrs. Janet Daisy, Headmistress, Thilakar Primary School, Peddarangapuram, Thanakkarkulam. |
|---|---|---|---|---|
| Effect of wind mills on environment | No impact on environment | Very good | Very good | Good |
| Has your normal life been affected in any way by wind mills | Not at all | No | No | No |
| Effect of windfarm on your living standard | Improved | Very much improved | Good improvement | Very much improved |
| Effect on local employment due to wind farm | Improved | Very good improvement | Good improvement | Very good improvement |
| Any effect due to noise created by wind mills | Nothing | Not at all | Nothing | Not at all |
| Effect on water due to windfarm | No effect on water | No | No effect on water | No |

| | | | | |
|---|---|---|---|---|
| Any vibrations due to windmills | No vibrations felt | No | No vibrations felt | No |
| Did you have any problem during construction of windfarm | Nothing | Not at all | Nothing | Nothing |
| Effects on birds due to windmills | No effect on birds | No. | No effect on birds | No effect on birds |
| Is there any problem for animals grazing ? | No | No | Nothing | Nothing |
| Has receiving signals in the televisions in the village has been affected due to windfarms | No | No | Not at all | Not at all |
| What are the benefits of wind mills for you? | Positive benefits | Very good benefits | Good benefits | Good benefits |
| Any other comments | There has been improvement in employment and economic activity due to windmills. | Uninterrupted power supply | There has been improvement in employment and economic activity due to windmills. | There has been improvement in employment and economic activity due to windmills. |

| .**Question** | **Reply from Mr. Masanam, Panchayat President, Udayathur** | **Reply from A.Abiraham, Resident of Udayathur** |
|---|---|---|
| Effect of wind mills on environment | No impact on environment | Very good |
| Has your normal life been affected in any way by wind mills | Not at all | No |
| Effect of windfarm on your living standard | Very much improved | Very much improved |
| Effect on local employment due to wind farm | Improved | Very good improvement |
| Any effect due to noise created by wind mills | Nothing | Not at all |
| Effect on water due to windfarm | No effect on water | No |
| Any vibrations due to windmills | No vibrations felt | No |

| | | |
|---|---|---|
| Did you have any problem during construction of windfarm | Nothing | Not at all |
| Effects on birds due to windmills | No effect on birds | No. |
| Is there any problem for animals grazing ? | No | No |
| Has receiving signals in the televisions in the village has been affected due to windfarms | No | No |
| What are the benefits of wind mills for you? | Positive benefits | Very good benefits |
| Any other comments | Requesting for more employment from skilled people from our village | The village has benefited by additional employment benefits and improvement in economic activity. |

## G.3. Report on how due account was taken of any comments received:

Since there was no comment which required any specific action from the project proponent, no action is taken.

## Annex 1

**CONTACT INFORMATION ON PARTICIPANTS IN THE SMALL SCALE PROJECT ACTIVITY**

| | |
|---|---|
| Organization: | Aruppukottai Sri Jayavilas Limited |
| Street/P.O.Box: | Tamilpadi Post |
| Building: | |
| City: | Melakandamangalam, Aruppukottai |
| State/Region: | Tamil Nadu |
| Postfix/ZIP: | 626129 |
| Country: | India |
| Telephone: | +91 4566 282376 |
| FAX: | +91 4566 282334 |
| E-Mail: | srijayavilas@vsnl.net |
| URL: | - |
| Represented by: | |
| Title: | General Manager |
| Salutation: | Mr. |
| Last Name: | Dinakaran |
| Middle Name: | |
| First Name: | Gopal |
| Department: | |
| Mobile: | +91 98429 13690 |
| Direct FAX: | |
| Direct tel: | +91 4566 282378 |
| Personal E-Mail: | sriayavilas@gmail.com |

## Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

No public funding as part of project financing from the Parties included in Annex I of the convention is involved in the project activity.

## Appendix 1 – Details of each wind turbine generator

| Table A-1-1 – Wind turbine generators in Pazhavoor village | | | | | |
|---|---|---|---|---|---|
| **S.No.** | **S.F.No** | **HTSC No** | **Make** | **Capacity kW** | **Date of Commissioning** |
| 1 | 756& 760 | 1611 | Pioneer Wincon | 250 | 23/03/2006 |
| 2 | 756 | 1611 | Pioneer Wincon | 250 | 18/03/2006 |
| 3 | 755 | 1611 | Pioneer Wincon | 250 | 18/03/2006 |
| 4 | 754/1 | 1655 | Pioneer Wincon | 250 | 18/03/2006 |
| 5 | 757 | 1799 | Pioneer Wincon | 250 | 31/03/2006 |
| 6 | 745/2C2 | 1718 | Pioneer Wincon | 250 | 29/03/2006 |
| 7. | 897,898,904/1 | 1719 | Gamesha | 850 kW | 29/03/2006 |
| **Total** | | | | **2.35 MW** | |

| Table A-1-2- Wind turbine generators in Levenjipuram village | | | | | |
|---|---|---|---|---|---|
| **S.No.** | **S.F.No** | **HTSC No** | **Make** | **Capacity kW** | **Date of Commissioning** |
| 8 | 1240/1B1 & 1B2 | 1800 | Pioneer Wincon | 250 | 31/03/2006 |
| 9 | 1239/1A3 | 1925 | Pioneer Wincon | 250 | 12/06/2006 |
| 10 | 1238/3A&4 | 1863 | Pioneer Wincon | 250 | 31/03/2006 |
| 11 | 1051/1 | 1656 | Pioneer Wincon | 250 | 23/03/2006 |
| 12 | 1278 | 1864 | Pioneer Wincon | 250 | 31/03/2006 |
| 13 | 1301 | 1865 | Pioneer Wincon | 250 | 31/03/2006 |
| 14 | 670/2,3,4,7 | 1805 | Gamesha | 850 | 31/03/2006 |
| **Total** | | | | **2.35 MW** | |

| Table A-1-3- Wind turbine generator in Thanakkarkulam village | | | | | |
|---|---|---|---|---|---|
| **S.No.** | **S.F.No** | **HTSC No** | **Make** | **Capacity kW** | **Date of commissioning** |
| 15 | 688/2B, 2E, 2K, 2F, 1B, 2A, 2B, 2L, 3A, 4, 1A, 2G, 1C, 2C, 687/2Q, 2O, 4D, | 1717 | Gamesha | 850 | 29/03/2006 |
| **Total** | | | | **0.85 MW** | |

| Table A-1-4- Wind turbine generator in Udayathur village | | | | | |
|---|---|---|---|---|---|
| **S.No.** | **S.F.No** | **HTSC No** | **Make** | **Capacity kW** | **Date of commissioning** |
| 16 | 849,440/2, | 1903 | Gamesha | 850 | 18/04/2006 |
| 17 | 444/2B2 | | Gamesha | 850 | 18/04/2006 |
| **Total** | | | | **1.7 MW** | |

## Appendix 2 –Abbreviations

| | |
|---|---|
| AMS | Approved small scale methodology |
| BM | Built Margin |
| CM | Combined Margin |
| CDM | Clean Development Mechanism |
| CEA | Central Electricity Authority |
| $CO_2e$ or $CO_2eq$ | Carbon di Oxide equivalent |
| FO | Fuel oil |
| GHG | Green house gases |
| GWh | Giga watt hour |
| HTSC | High Tension Service Connection |
| INR | Indian Rupees – the official currency of India, IUS$= INR45 |
| IPCC | Inter Governmental Panel on Climate Change |
| IRR | Internal rate of return |
| $kgCO_2$ eq/kWh | Kilogram carbon di oxide equivalent per kilowatt hour |
| KV | Kilo Volt |
| kW | Kilo watt |
| kWh | Kilo watt hour |
| m /s | meter per second |
| M&P | Modalities and Procedures |
| MNES | Ministry of Non conventional Energy Sources, Government of India |
| MoEF | Ministry of Environment &Forests, Government of India |
| MU | Million kilowatt hour |
| MW | Megawatt |
| MWh | Mega watt hour |
| NPC | Nuclear Power Corporation Limited |
| NTPC | National Thermal Power Corporation Limited |
| OM | Operating margin |
| INR | Indian Rupees, the official currency of India. (1 US $ = 45 Indian Rupees) – Although there are minor variations in the exchange rate, the indicated exchange rate is considered in this document |
| t $CO_2$/MWh | tonnes carbon di oxide per megawatt hour |
| $tCO_2e$ or $tCO_2eq$ | tonnes carbon di oxide equivalent |

| | |
|---|---|
| TNEB | Tamil Nadu Electricity Board |
| UNFCCC | United Nations Framework Convention on Climate Change |
| US$ | United States Dollars |
| WTG | Wind turbine generator |

## Appendix 3- List of References


| Sl. No. | Particulars of the references |
|---|---|
| 1. | United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int |
| 2. | UNFCCC document: Clean Development Mechanism, Simplified Project Design Document for Small Scale Project Activities (SSC-PDD), Version 02 |
| 3. | UNFCCC document: Simplified modalities and procedures for small–scale clean development mechanism project activities |
| 4. | UNFCCC document: Appendix B of the simplified modalities and procedures for small–scale CDM project activities - Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - Type I.D Grid connected renewable electricity generation Version 09:28 July, 2006 |
| 5. | Revised 1996 IPPC guidelines for National Greenhouse Gas Inventories: Workbook and Reference Manual |
| 6. | Ministry of Power (MoP), Govt. of India, www.powermin.nic.in |
| 7. | Ministry of Non conventional Energy Sources www.mnes.nic.in |
| 8. | Tamil Nadu Electricity Board www.tneb.org |
| 9. | Karnataka Power Transmission Corporation Ltd www.kptcl.com |
| 10. | Kerala State Electricity Board www.kseboard.com |
| 11. | Andhra Pradesh Power Generation Corporation Ltd. www.apgenco.com |
| 12. | Central Electricity Authority (CEA), Govt. of India, www.cea.nic.in |
| 13. | Ministry of Environment and Forest, http://envfor.nic.in |