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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Title: 50.4 MW Tata Wind Farm - in Maharashtra
Version: 10.0
Date of completion of PDD: 12/04/2013

A.2. Description of the project activity:

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Objective of the Project

"The Tata Power Company Limited" is the project sponsor. The objective is development, design, engineering, procurement, finance, construction, operation and maintenance of 50.4 MW Tata wind power project ("Project") in the Indian state of Maharashtra to provide reliable, renewable power to the Maharashtra state electricity grid which is part of the Western electricity grid. The Project will lead to reduced greenhouse gas emissions because it displaces electricity from fossil fuel based electricity generation plants.

Nature of Project

The aggregate 50.4 MW project activity comprises of total 63 numbers wind energy converters, with each machine having a capacity of 800 kW. Enercon (India) Ltd ("Enercon") will be the equipment supplier and the operations and maintenance contractor for the Project. The Project harnesses renewable resources in the region, and thereby displacing non-renewable natural resources and thus leading to sustainable economic and environmental development. "The Tata Power Company Limited" has sponsored the Project. Electricity generated by the project would be supplied to the Maharashtra state grid that forms part of the Western electricity grid of India and this power would be consumed by the Distribution business of The Tata Power Company Limited. The rate of purchase of this power by any distribution licensee (including Tata Power's distribution business) has been fixed and approved by the Maharashtra Electricity Regulatory Commission (MERC).

Contribution to Greenhouse Gas Emissions Reduction

The National CDM Authority (NCDNA) 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[1]. The contribution of this project activity towards in terms of these four indicators is provided below:

1. **Social well being:**

[1] http://cdmindia.nic.in/host_approval_criteria.htm

- ✓ The project activity has led to the development of supporting infrastructure such as road network etc., in the wind park location, which also provides access to the local population.
- ✓ The project activity leads 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 increased energy security.

2. **Environmental well being:**

- ✓ the project activity involves use of 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 contributing 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.
- ✓ The generated electricity will be fed into the Western 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.

A.3. Project participants:

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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)	1. The Tata Power Company Limited 2. Enercon (India) Limited	No
Sweden	3. Asian Development Bank, as trustee of Asia Pacific Carbon Fund	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:

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A.4.1.1. Host Party(ies):

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Government of India

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

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Western Region/ Maharashtra State.

A.4.1.3. City/Town/Community etc:

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The Project is spread across Agadgaon, Devegaon, Mehekari, and Ranjani villages in Khandke Taluka of Ahmednagar District of Maharashtra state in India.

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

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The Project consist of 63 numbers of E-48 WECs of 800 kW each. The details of the physical location are as follows:

Project Name	Total No. of WEC	Project Capacity (MW)	Name of Village	No. of WEG	Unique Identification of WECs
50.4 MW Tata Wind Farm - in Maharashtra	63	50.4	Agadgoan	21	TPCL-1,2,3,4,5,28,29,31,32,38,39,40,41,42,43,57,58,59,60,61,62
			Devegaon	23	TPCL-6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,44,45,46,47
			Mehekari	9	TPCL-48,49,50,51,52,53,54,55,56
			Ranjani	10	TPCL-25,26,27,30,33,34,35,36,37,63

The longitude and latitude details of each of the wind mill are given in the table below:

Unique identification Number	Longitude (Deg Min Sec)	Latitude (Deg Min Sec)

TPCL-1	N19 10 29.8	E74 50 59.8
TPCL-2	N19 10 37.9	E74 50 54.2
TPCL-3	N19 10 44.8	E74 50 50.7
TPCL-4	N19 10 41.0	E74 50 38.7
TPCL-5	N19 10 32.7	E74 50 38.7
TPCL-6	N19 10 24.5	E74 50 30.4
TPCL-7	N19 10 18.3	E74 50 24.7
TPCL-8	N19 09 41.6	E74 50 43.5
TPCL-9	N19 09 36.8	E74 51 03.9
TPCL-10	N19 10 07.1	E74 50 36.2
TPCL-11	N19 09 58.7	E74 50 39.9
TPCL-12	N19 09 49.8	E74 50 41.6
TPCL-13	N19 09 33.0	E74 50 46.9
TPCL-14	N19 09 22.4	E74 50 37.7
TPCL-15	N19 09 10.1	E74 50 41.0
TPCL-16	N19 09 01.1	E74 50 44.4
TPCL-17	N19 08 54.9	E74 50 43.9
TPCL-18	N19 09 56.7	E74 50 07.0
TPCL-19	N19 10 08.9	E74 50 14.8
TPCL-20	N19 11 07.7	E74 51 41.8
TPCL-21	N19 11 01.2	E74 51 48.0
TPCL-22	N19 10 54.1	E74 51 52.7
TPCL-23	N19 10 38.8	E74 51 43.3
TPCL-24	N19 10 31.6	E74 51 43.6
TPCL-25	N19 10 19.8	E74 51 41.5
TPCL-26	N19 08 51.1	E74 49 37.4
TPCL-27	N19 08 58.0	E74 49 39.9
TPCL-28	N19 09 04.4	E74 49 36.5
TPCL-29	N19 09 10.5	E74 49 34.8
TPCL-30	N19 09 37.2	E74 49 46.3
TPCL-31	N19 08 29.4	E74 49 55.1
TPCL-32	N19 08 21.5	E74 49 52.7
TPCL-33	N19 08 17.1	E74 49 51.7
TPCL-34	N19 08 06.1	E74 49 59.9
TPCL-35	N19 06 18.3	E74 53 30.7
TPCL-36	N19 06 30.0	E74 53 21.7
TPCL-37	N19 06 24.9	E74 53 27.0
TPCL-38	N19 06 35.0	E74 53 07.1
TPCL-39	N19 06 42.2	E74 53 06.4
TPCL-40	N19 06 49.8	E74 53 07.5
TPCL-41	N19 07 02.2	E74 53 02.2
TPCL-42	N19 07 08.1	E74 52 59.1
TPCL-43	N19 07 16.0	E74 52 59.1
TPCL-44	N19 09 37.8	E74 53 13.4
TPCL-45	N19 09 30.0	E74 53 13.9
TPCL-46	N19 10 11.5	E74 53 19.6
TPCL-47	N19 10 18.1	E74 53 06.8
TPCL-48	N19 10 15.5	E74 52 51.7
TPCL-49	N19 10 20.6	E74 53 19.1
TPCL-50	N19 10 25.2	E74 53 02.5
TPCL-51	N19 10 21.1	E74 52 44.9

TPCL-52	N19 10 04.2	E74 53 27.2
TPCL-53	N19 10 16.5	E74 53 32.5
TPCL-54	N19 10 24.6	E74 53 33.3
TPCL-55	N19 10 32.9	E74 53 33.5
TPCL-56	N19 09 59.9	E74 53 36.4
TPCL-57	N19 10 50.1	E74 52 23.4
TPCL-58	N19 10 43.9	E74 52 27.2
TPCL-59	N19 10 59.4	E74 52 21.1
TPCL-60	N19 10 35.6	E74 52 33.9
TPCL-61	N19 10 28.5	E74 52 41.4
TPCL-62	N19 10 38.6	E74 52 51.6
TPCL-63	N19 09 47.1	E74 53 18.3

The project area extends between latitude 19^0 06’ 18.3”to 19^0 11’ 07.7” North and longitude 74^0 49’ 34.8” to 74^0 53’ 36.4” East. The Project is connected to the EIL substation (to be owned by MSETCL) at Village Mehekari (near 33kV Mehekari S/S), Ahmednagar district. The project activity is located at a distance of 120 km from Pune by road. The nearest railway station is at Pune. A location map is attached at Appendix – 1.

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

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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:

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The Project involves 63-wind energy converters (WECs) of Enercon make (800 kW E-48) with internal electrical lines connecting the Project with local evacuation facility. The WECs generates 3-phase power at 400V, which is stepped up to 33 KV. The Project can operate in the frequency range of 47.5–51.5 Hz and in the voltage range of 400 V ± 12.5%. The other salient features of the state-of-art-technology are:

- Gearless Construction - Rotor & Generator Mounted on same shaft eliminating the Gearbox.
- Variable speed function – has the speed range of 18 to 33 RPM thereby ensuring optimum efficiency at all times.
- Variable Pitch functions ensuring maximum energy capture.
- Near Unity Power Factor at all times.
- Minimum drawal (less than 1% of kWh generated) of Reactive Power from the grid.
- No voltage peaks at any time.
- Operating range of the WEC with voltage fluctuation of -20 to +20%.
- Less Wear & Tear since the system eliminates mechanical brake, which are not needed due to low speed generator, which runs at maximum speed of 33 rpm and uses Air Brakes.
- Three Independent Braking Systems.
- Generator achieving rated output at only 33 rpm.

- Incorporates lightning protection system, which includes blades.
- Starts Generation of power at wind speed of 3 m/s.

Enercon (India) Ltd 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.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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The estimated emission reductions over the 10 year fixed crediting period would be 830,220 tCO2e as per details on annual emission reductions provided below:

Years	Annual estimation of emission reductions in tonnes of CO2e
1st year	83,022
2nd year	83,022
3rd year	83,022
4th year	83,022
5th year	83,022
6th year	83,022
7th year	83,022
8th year	83,022
9th year	83,022
10th year	83,022
Total estimated reductions (tonnes of CO2e)	830,220
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	83,022

*1st year begins from 01/05/2010 or date of registration whichever is later, and each year extends for 12 months. The crediting period will not start before the project registration with UNFCCC

A.4.5. Public funding of the project activity:

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There is no public funding involved in the Project.

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:

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Title: Consolidated baseline and monitoring methodology for “Grid-connected electricity generation from renewable sources”

Reference: Approved consolidated baseline methodology ACM0002 (Version 09, EB 36)

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

- Tool to calculate the emission factor for an electricity system – Version 01
- Tool for the demonstration and assessment of additionality – Version 5.2

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The Project is wind based renewable energy source, zero emission power project connected to the Maharashtra state grid, which forms part of the Western electricity grid. The Project 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 Western electricity grid.

This methodology is applicable to grid-connected renewable power generation project activities that involve electricity capacity additions.

The methodology is applicable under the following conditions:

- The project activity is the installation or modification/retrofit of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.
- In case of hydro power plants:
    - The project activity is implemented in an existing reservoir, with no change in the volume of reservoir.
    - The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2.
    - The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- Applies to grid connected electricity generation from landfill gas to the extent that it is combined with the approved "Consolidated baseline methodology for landfill gas project activities" (ACM0001); and
- 5 years of historical data (or 3 years in the case of non hydro project activities) have to be available for those project activities where modification/retrofit measures are implemented in an existing power plant.

The methodology is not applicable to the following:

- Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;
- Biomass fired power plants;
- Hydro power plants3 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^2.

In light of the above, the approved consolidated baseline and monitoring methodology ACM0002 Version 09 is the choice of the baseline and monitoring methodology and it is applicable because:

- the Project is grid connected renewable power generation project activity
- the Project represents electricity capacity additions from wind sources
- the Project does not involve switching from fossil fuel to renewable energy at the site of project activity since the Project is green-field electricity generation capacities from wind sources at sites where there was no electricity generation source prior to the Project, and
- the geographical and system boundaries of the Western electricity grid can be clearly identified and information on the characteristics of the grid is available.

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

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	Source	Gas	Included?	Justification/Explanation
Baseline	Grid-connected electricity generation	CO_2	Yes	In the baseline scenario the electricity would have been sourced from the Western grid which in turn would be connected to fossil fuel fired power plants which emit CO2.
		CH_4	No	No methane generation is expected to be emitted.
		N_2O	No	No nitrous oxide generation is expected to be emitted.
Project Activity	Greenfield wind energy conversion system	CO_2	No	The project activity does not emit any emissions.
		CH_4	No	No methane generation is expected to be emitted.
		N_2O	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:

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

Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described below.

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

Variable	Data Source
EG_y – Electricity generated	Records maintained by project proponents

Parameter	Data Source
$EF_{OM,y}$ = Operating Margin Emission Factor (tCO2/MWh)	CEA Data
$EF_{BM,y}$ = Build Margin Emission Factor (tCO2/MWh)	CEA Data
EFy – Grid Emission Factor	Calculated as the weighted average of the operating margin and build margin

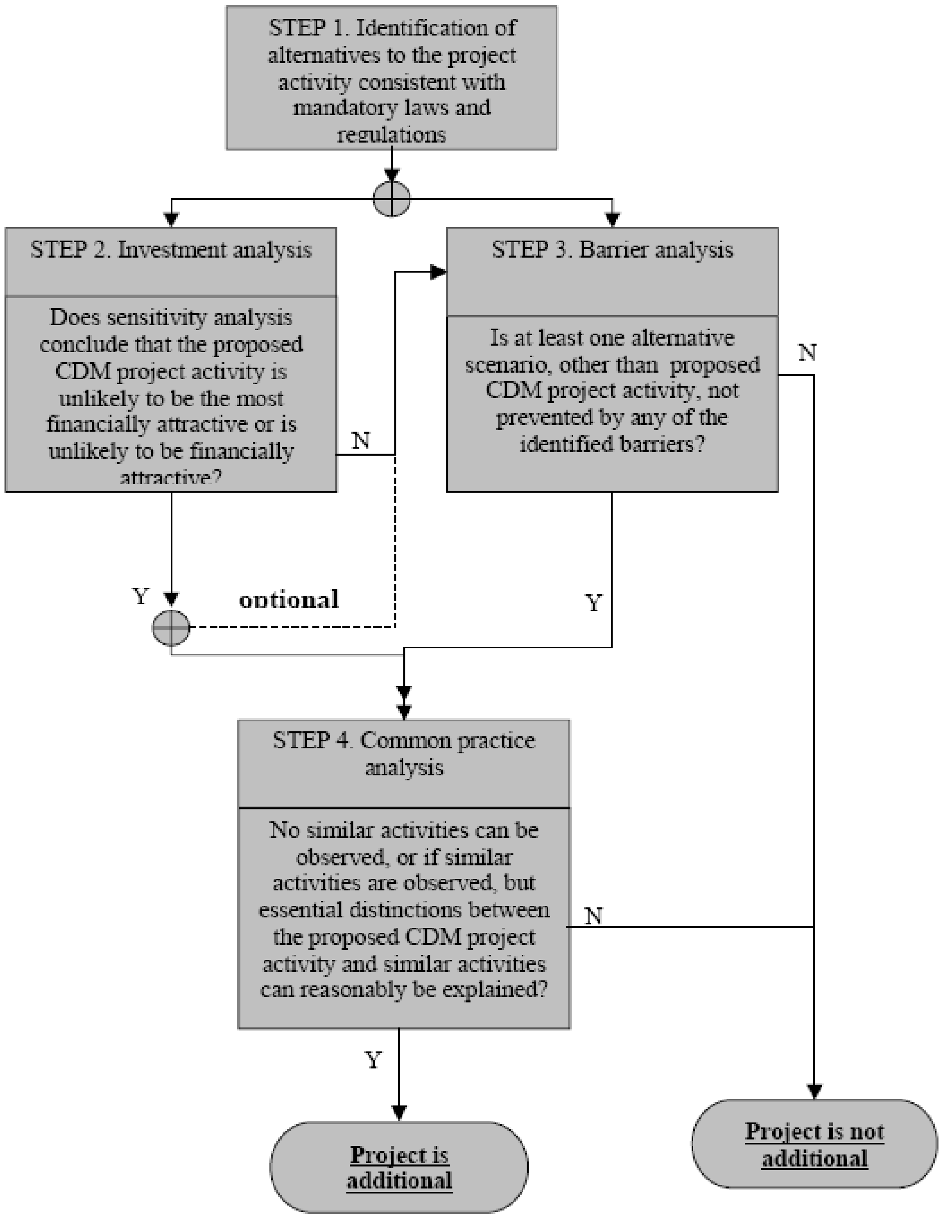
B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

The project activity has been conceived as a CDM project since its inception. The Tata Power Company Limited has considered the incentive from the CDM before the start of the project activity and the evidence for the same can be verified by the validator - Resolution passed by the Board of Directors of The Tata Power Company Limited on 29th May 2006 and confirmation from Asian Development Bank (ADB), lender to this project, vide their letter dated 13 February 2007. A detailed project report (DPR) for the project is also verified about serious consideration of CDM at the time of inception of the project.

Chronology of Events for 50.4 MW Tata Wind Farm in Maharashtra

S. No.	Activities	Date	Remarks
1	Detailed Project Report	3-Apr-06	Project feasibility study with the analysis for expected CDM revenue from the project.
2	Company Board Note	25-Apr-06	Investment decision has been taken along with seriously consideration of CDM revenue in the cash flow of the project.
3	Board Approval	29-May-06	Board approved the project activity with considering carbon credits benefits from the project.
4	LOI from The Tata Power Company Limited	23-Jun-06	Issued on the basis of offer received.
5	Purchase Order	16-Aug-06	About 8 Purchase Orders (PO) placed on Enercon India Limited (EIL) with consideration of CDM revenue in each PO. It is also mentioned in the POs that EIL would coordinate for development of this project as a CDM project and a separate agreement will be executed for the same between TPC and EIL.
6	Communication between The Tata Power Company Limited (TPC) and EIL	Sep 06-Nov 06	Mails/letters exchanged on account of the several commercial and legal formalities that are required to be taken care of for executing the agreement between TPC and EIL for carrying out CDM project activities.

7	Agreement between TPC for and EIL for carrying out CDM project activities	30-Nov-06	It defines the scope of work.
8	Agreement with DOE (M/s Det Norske Veritas AS)	Dec-06	Carrying out the Validation activities for the project.
9	Environment Impact Assessment Report (EIA) Study	Jan-07	M/s CARE Sustainability Pvt Ltd has been appointed for this purpose
10	Letter from project lender (Asian Development Bank)	13-Feb-07	It re-confirms that CDM was considered in the loan appraisal stage.
11	PDD web hosted under ACM 0002 Version 6	26 Apr 07 - 25 May 07	Period for receiving public comments under validation.
12	DNA Approval	25-Sep-07	Addressed to Enercon (India) Limited as Project Participant for the project activity.
13	Communications with DNA	26-Sep-07 to 17-Jan-08	Course of action taken for including the name of The Tata Power Company Limited as Project Participant for the project activity.
14	DNA Approval	18-Jan-08	Addressed to The Tata Power Company Limited as Project Participant with Enercon India Limited for the project activity.
15	PDD re-web hosted under ACM 0002 Version 7	03 Sep 08 - 02 Oct 08	Period for receiving public comments under validation.



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

Define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

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

1. Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity.

These alternatives are to include:

- The proposed project activity undertaken without being registered as a CDM project activity;
- Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver outputs services (e.g., cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology;
- If applicable, continuation of the current situation (no project activity or other alternatives\ undertaken).

The baseline alternative for the project activity is pre-defined in ACM0002 as 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 not undertaken as a CDM project activity.

(b) The project is not implemented, in which case equivalent amount of electricity would be 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:

2. The alternative(s) shall be in compliance with all mandatory applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This Sub-step does not consider national and local policies that do not have legally binding status.)

3. If an alternative does not comply with all mandatory applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that non compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration;

4. If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with mandatory regulations with which there is general compliance, then the proposed CDM project activity is not additional.

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

Determine whether the proposed project activity is not:

(a) The most economically or financially attractive; or

(b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

To conduct the investment analysis, use the following Sub-steps:

Sub-step 2a: Determine appropriate analysis method

1. Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (Sub-step 2b). If the CDM project activity and the alternatives identified in Step 1 generate no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

Sub-step 2b: Option I. Apply simple cost analysis

2. Document the costs associated with the CDM project activity and the alternatives identified in Step 1 and demonstrate that there is at least one alternative which is less costly than the project activity.

"*If it is concluded that the proposed CDM project activity is more costly than at least one alternative then proceed to Step 4 (Common practice analysis)*".

Sub-step 2b: Option II. Apply investment comparison analysis

1. Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision-making context.

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

2. Identify the financial/economic indicator, such as IRR, most suitable for the project type and decision context.
3. When applying Option II or Option III, the financial/economic analysis shall be based on parameters that are standard in the market, considering the specific characteristics of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer. Only in the particular case where the project activity can be implemented by the project participant, the specific financial/economic situation of the company undertaking the project activity can be considered.
4. Discount rates and benchmarks shall be derived from:
   (a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;
   (b) Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity

concerned), based on bankers views and private equity investors/funds' required return on comparable projects;

(c) A company internal benchmark (weighted average capital cost of the company), only in the particular case referred to above in paragraph 5. The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e. that project activities under similar conditions developed by the same company used the same benchmark;

(d) Government/official approved benchmark where such benchmarks are used for investment decisions;

(e) Any other indicators, if the project participants can demonstrate that the above Options are not applicable and their indicator is appropriately justified.

Option I – Simple cost analysis is not applicable as the project activity sells electricity to the Utility and obtains economic benefits in the form of electricity tariffs.

Paragraph 15, of the Guidance to Investment Analysis states that if the baseline alternative to the project activity is the supply of electricity from a grid, a benchmark approach is considered appropriate for Investment analysis. The baseline alternative for the project activity is that equivalent amount of electricity would have been supplied by the grid through existing grid connected power plants and addition of new generation sources, accordingly the **Option III – Benchmark Analysis** is used. The financial indicator that is identified is the project IRR.

We would like to submit that, while carrying out the investment analysis, we had initially considered the 16% post tax equity return benchmark that is considered by electricity regulatory commissions for determining the tariff applicable to wind power projects. Maharashtra Electricity Regulatory Commission (MERC) in its order passed on 24th November 2003 has also considered a 16% post tax equity return for determining the applicable tariff for wind power projects in Maharashtra. Subsequently, the Executive Board in EB 40 meeting ruled that the 16% post tax return considered by regulatory commissions is not a suitable benchmark. In the Guidance to Investment Analysis issued in EB 41 (Paragraph 6), the EB ruled that the investment analysis should be based on relevant information available at the time of investment decision and not information available at a later point in time.

In view of the above EB rulings, we have not used the earlier benchmark and have considered the weighted average cost of capital (WACC) applicable to the project type i.e. electricity generation projects as the suitable benchmark. This is in accordance with the Guidance to investment analysis issued in EB 41 (paragraph 11) as per which the WACC can be considered as appropriate benchmark for Project IRR.

The WACC has been determined using the Capital Asset Pricing Model (CAPM) considering Beta values of all listed power generating companies in India. The CAPM economic model is widely used to determine the required/expected return on equity based on potential risk of an investment. The CAPM framework is the Nobel award winning work of financial economist Dr. William Sharpe. In line with the requirements of the Guidance to Investment Analysis (paragraph 12), data and parameters used in calculation of cost of equity i.e. beta values of power generating companies in India, risk free rate of return, market risk premium etc. have been derived from publicly available data sources. The detailed calculations of WACC along with an elaboration of the approach are provided in Annex 6.

The benchmark WACC works out to 13.99%, i.e. if the project returns are lower than this benchmark then the project can be considered as additional. In addition, we have considered the 12% benchmark that IREDA considers for lending to renewable energy projects. The project's additionality is established by comparing the project IRR with the IREDA lending rate.

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

5. Calculate the suitable financial indicator for the proposed CDM project activity and, in the case of Option II above, for the other alternatives. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but possibly including *inter alia* subsidies/fiscal incentives, ODA, etc, where applicable), and, as appropriate, non-market cost and benefits in the case of public investors if this is standard practice for the selection of public investments in the host country.
6. Present the investment analysis in a transparent manner and provide all the relevant assumptions, preferably in the CDM-PDD, or in separate annexes to the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. Refer to all critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Justify and/or cite assumptions in a manner that can be validated by the DOE. In calculating the financial/economic indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions (e.g. insurance premiums can be used in the calculation to reflect specific risk equivalents).
7. Assumptions and input data for the investment analysis shall not differ across the project activity and its alternatives, unless differences can be well substantiated.
8. Present in the CDM-PDD submitted for validation a clear comparison of the financial indicator for the proposed CDM activity and:
   (a) The alternatives, if Option II (investment comparison analysis) is used. If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity can not be considered as the most financially attractive;
   (b) The financial benchmark, if Option III (benchmark analysis) is used. If the CDM project activity has a less favourable indicator (e.g. lower IRR) than the benchmark, then the CDM project activity cannot be considered as financially attractive.

For carrying out the investment analysis, the data and assumptions from the detailed project report (DPR) and other publicly available information sources have been considered. The project owner has availed loan from Asian Development Bank (ADB) and Indian Renewable Development Agency (IREDA) to finance the project activity. The debt structure for the project activity is set out below.

The key assumptions used for calculating the benchmark (post tax project IRR) are set out below:

Financial Assumptions

Project Capacity in MW	50.00	
Project Commissioning Date	1-Apr-07	
Project Cost per MW (Rs. In Millions)	50.0	Bid Comparison Document

Operations		
Plant Load Factor	20%	Max [MERC Order, Third

		party validated PLF]
Insurance Charges @ % of capital cost	0.18%	Normative
Operation & Maintanance Cost % of capital cost	1.00%	DPR Document/O&M Contract
Yearwise escalation on O & M charges from 4th year onword	5.0%	DPR Document/O&M Contract

Tariff		
Base year Tariff (2007-08) - Rs./kWh	3.50	MERC Order
Annual Escalation (Rs./kWh per Year)	0.15	MERC Order
Tariff applicable for year 13 (Rs/kWh)	5.30	MERC Order
Tariff applicable beyond year 13 (Rs/kWh)	Cost+16% ROE	MERC Order

Project Cost	Rs Million	
Land and Infrastructure, Generator & Electrical Equipments, Mechanical Equipments, Civil Works, Instrumentation & Control, Other Project Cost, Pre operative Expenses, etc.		
Total Project Cost	2,500.0	Bid Comparison

Means of Finance		Rs Million	
Own Source	30%	750	As per Assumptions in DPR
Term Loan	70%	1,750	
Total Source		2,500	
Terms of Loan			
Interest Rate	9.00%		As per Assumptions in DPR
Tenure	15	Years	As per Assumptions in DPR
Moratorium	6	Months	As per Assumptions in DPR

Income Tax Depreciation Rate (Written Down Value basis)		
on Wind Energy Generators	80%	IT Act
Book Depreciation Rate (Straight Line Method basis)		
On all assets	4.50%	Straight Line Depreciation Method Adopted

Book Depreciation up to (% of asset value)	90%	MERC Order

Income Tax		
Income Tax rate	30%	IT Act
Minimum Alternate Tax	10%	IT Act
Surcharge	10%	IT Act
Cess	2%	IT Act

Working capital		
Receivables (no of days)	45	CERC Order
O & M Exps (no of days)	30	CERC Order
Working capital interest rate	12%	DPR

Plant Load Factor: As per EB 48 annex 11, para 3(b) the plant load factor determined by a third party can be used in the investment analysis. The following sources were available for estimation of plant load factor to the PP.

1. MERC has considered the PLF of 20% in its order dated 24 November 2003 based on historical data submitted by various developers.
2. Historical PLF data from their own wind farm of 17 MW commissioned in 2001-02 in Ahmadnagar. The average observed annual PLF form 2002-2003 to 2005-06 for 17 MW project is 19.16%.
3. PLF data published by MEDA in 2004-05 for the commissioned projects in the district of Ahmednagar is 18.38% and 19.62% for Kedgaon and Supa sites respectively.
4. PLF validated by the third party independent consultant is 19.29%. (This is in agreement with EB guidance on PLF; source EB 48 annex 11, para 3(b))

The highest estimated PLF from the above sources is 20%. Therefore we have used 20% PLF in investment analysis for substantiating additionality.

Salvage Value: The project cost is depreciated upto 90% and therefore the remaining 10% of the asset value is added back in the final year in the cash flow statement.

The *post tax* project IRR for the Project without CDM revenues is 10.24 % i.e. less than the WACC benchmark of 13.99% and IREDA lending benchmark of 12%. The project IRR is lower than the IREDA lending rate; hence the project may be considered Additional.

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

9. Include a sensitivity analysis that shows whether the conclusion regarding the financial/economic attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially/economically attractive (as per Step 2c para 11a) or is unlikely to be financially/economically attractive (as per Step 2c para 11b).

Capital Cost

Capital cost for the project activity is derived from the detailed project report and board note that were provided to the board for approval. Therefore we have considered it appropriate to conduct sensitivity on capital cost. The sensitivity on project cost is done at a variation of 10% over the base case. The project IRR is 11.75% at capital cost of INR 2250 Million which is less than benchmark.

Capital Cost [in Million]	2250	2500	2750
Variation	10% decrease in base cost	Base case	10% increase in base cost
Post-tax Project IRR	11.75 %	10.24 %	8.99 %

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. The project activity is located in the district of Ahmednagar in Maharashtra. The observed historical PLF of the project activities at different sites that are operating in the district of Ahmednagar is 19.62% in 2004-05.

Tata have installed 17 MW in 2001-02 in the district of Ahmednagar that have an average PLF of 19.16% for the period of year 2002-03 to 2004-05.

Year	PLF in %
2002-03	20.76
2003-04	19.40
2004-05	18.88
2005-06	17.58
Average PLF	**19.16**

Maharashtra State Electricity Commission has set the 20% PLF for the state of Maharashtra. Historically, maximum observed PLF for wind power project of 17 MW commissioned by Tata power in the region of Ahmednagar is 20.76%. In addition to this, the historical PLF for year 2004-05 for the commissioned projects in the district of Ahmadnagar is 18.38% and 19.62% for Kedgaon and Supa sites respectively.

Plant Load Factor: As per EB 48 annex 11, para 3(b) the plant load factor determined by a third party can be used in the investment analysis. The PP has engaged third party independent consultant for estimation of PLF. The PLF estimated by third party independent consultant is 19.29% for the project activity.

Sensitivity analysis of the Project IRR is therefore carried out considering maximum of the highest observed PLF at different sites in the district of Ahmednagar, 10% increase over PLF estimated by an independent third party consultant and 10% increase over the PLF given by MERC in tariff order dated

23-Nov-2003 [Max(19.62%, 21.22%, 22%)]. The return that the project is expected to generate at PLF of 22% is 11.60%, which is less than the benchmark.

	PLF @ 18%	PLF @ 20% (base case)	PLF @ 22%
Post-tax Project IRR	8.86 %	10.24 %	11.60 %

The sensitivity analysis clearly shows even with a higher PLF, the project IRR remains lower than the WACC benchmark and the IREDA lending benchmark. It can therefore be concluded that the project activity is not attractive without CDM benefits.

Tariff

Maharashtra state electricity commission has fixed the tariff for the period of 13 years. The tariff schedule for the period of 13 years is as follows.

Years (**)												
1	2	3	4	5	6	7	8	9	10	11	12	13
3.50	3.65	3.80	3.95	4.10	4.25	4.40	4.55	4.70	4.85	5.00	5.15	5.30
*** the year commences from date of commissioning*												

The tariff is subject to change at the end of the term of PPA. The tariff order states that the consumer will be eligible for the lower tariff after the debt obligation of the project is fulfilled. The excerpts from the tariff order are as follows:

"The Commission notes that in Cost Plus Approach, which the Commission has adopted for tariff proposal, rate per unit charged by such projects during initial period of 10 years is bound to be higher as during this period the project has various debt related obligations. However, it is essential that the consumer is able to enjoy the benefit of cheaper power once all debt related obligations are paid off and project has virtually no variable costs"

The sale income needed and sale income approved by the commission have a differential amount of 6.317 Million which is required to be adjusted in the latter year to keep it consistent with the fixed return provided by the commission. Therefore to arrive at the tariff that may be applied by the commission at the end of the 13th year will be computed after adjusting the surplus provided by the commission. The tariff from the 13th year onwards therefore shall be adjusted for the surplus provided by the regulator in the initial years.

On computation the average tariff after 13th year onwards based on MERC assumptions works out to be INR 1.80 per unit. On the upside if MERC does not consider adjustment of the surplus gained which is extremely unrealistic, the average tariff will be INR 2.34 per Unit. MERC follows the cost+16% ROE approach to determine the tariff and hence it is very unlikely that the commission will approve the tariff of INR 2.34 per unit for the period beyond 13^{th} year. We have considered the base case tariff of INR 2.34 per unit which is on the higher side and very unlikely to be approved by the

commission. The Project IRR with tariff of INR 2.34 per unit is 9.66% which is lower than the benchmark.

Further, we have considered base case tariff based on the cost plus 16% ROE approach and using assumptions that are valid to the project activity. The project IRR even with this case which is not a likely scenario is 10.24% which is lower than the benchmark.

Outcome of Step 2: If after the sensitivity analysis it is concluded that: (1) the proposed CDM project activity is unlikely to be the most financially/economically attractive (as per Step 2c para 11a) or is unlikely to be financially/economically attractive (as per Step 2c para 11b), then proceed to Step 4 (Common practice analysis).

Step 3: Barrier analysis

Not Opted for.

Step 4: Common practice analysis

Unless the proposed project type has demonstrated to be first-of-its kind (according to Sub-step 3a), the above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a **credibility check** to complement the investment analysis (Step 2) or barrier analysis (Step 3). Identify and discuss the existing common practice through the following Sub-steps:

Sub-step 4a: Analyze other activities similar to the proposed project activity:

1. Provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis. Provide documented evidence and, where relevant, quantitative information. On the basis of that analysis, describe whether and to which extent similar activities have already diffused in the relevant region.

The investment decision for the project was taken in May 2006 and was commissioned in 2007-08. At the time of investment decision the total installed wind power capacity in Maharashtra was 1,001 MW[2] and at the time of commissioning the installed capacity in Maharashtra was 1756.38 MW. We want to submit that even at the time of commissioning our project was not part of the common practice. We present the following analysis to clarify this:

The table below presents the year wise capacity addition of wind installations in the state of Maharashtra.

[2] Total installed capacity in Maharashtra as on 31.03.2006- http://www.windpowerindia.com/statstate.html

S. No.	Year	Wind Project Installation (MW)
1	Upto 1992	1.10
2	During 1992-93	-
3	During 1993-94	-
4	During 1994-95	1.50
5	During 1995-96	-
6	During 1996-97	2.77
7	During 1997-98	0.23
8	During 1998-99	23.34
9	During 1999-00	50.35
10	During 2000-01	118.67
11	During 2001-02	196.54
12	During 2002-03	2.00
13	During 2003-04	6.30
14	During 2004-05	48.80
15	During 2005-06	545.10
16	During 2006-07	483.6
17	During 2007-08	276.075

(Source: *http://www.windpowerindia.com/statyear.html*).

Paragraph 4(a) above states that projects are considered similar they take place in a comparable environment. Till the year 2002-03, wind power developers in Maharashtra enjoyed sales tax benefits of Rs. 10 million per MW per year for a period of 5 years from the date of commissioning (Source: Maharashtra wind power policy 1998,), making investment in wind attractive on a stand alone basis. The sales tax benefits were withdrawn for projects commissioned after March-2003[3]. Therefore wind capacity additions before March 2003 have not been considered.

Paragraph 4(a) also states that projects can be considered similar if they rely on a broadly similar technology and are of a similar scale. Our project is of 50.4 MW capacity i.e. large scale CDM project activity (>15 MW). Therefore in accordance with Paragraph 4(a), we have analysed wind projects of more than 15 MW capacities. During the period 2003-2008 a total of 476 MW was added from wind projects with more than 15 MW size. We would like to submit that the entire 476 MW is under CDM. We have provided the spreadsheet with CDM links of all these projects to the DoE.

As can be seen, all comparable projects have come up only with the benefit of CDM. Hence our project is without CDM benefits is not a common practice.

[3] http://www.mercindia.org.in/Clarificatory%20Order-Wind%20Energy%20%5BCase%20Nos%207,%2015%20&%2016%20of%202004%5D_W.htm

Sub-steps 4a is satisfied and 4b is not required as no similar activities are observed.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The PDD for the project activity was webhosted on 27 April 2006 in version 6 of ACM0002. The latest available data that was available at the time of initial webhosting of the PDD was CEA database version 1.1 dated 21 December 2006. The project was re-webhosted on 03 September 2008 in version 7 of ACM0002. The project validation started with the initial webhosting of the PDD. Thus in accordance with the Tool to calculate emission factor of an electricity system, we have used the latest available database i.e. CEA database version 1.1 that was available at the commencement of the validation of the project activity.

According to the approved methodology ACM0002 (Version 09) Emission Reductions are calculated as

$$\mathbf{ER_y = BE_y - PE_y - L_y}$$

Where:

BE_y	Baseline Emissions in year *y* (t CO_2e/yr)
PE_y	Project Emissions in year *y* (t CO_2e/yr)
L_y	Leakage Emissions in year *y* (t CO_2e/yr)

Estimation of Baseline Emissions

Baseline emissions (BEy in tCO_2) due to displacement of grid-electricity is calculated as the product of the Baseline Emissions Factor (EFy in tCO_2/MWh) calculated as described below, times the electricity supplied by the project activity to the grid (EG_y – $EG_{baseline}$ in MWh), over the crediting period.

$$\mathbf{BE_y = (EG_y - EG_{baseline}) \times EF_y}$$

Where:

BE_y	Baseline emissions in year y (tCO_2/yr)
EG_y	Electricity supplied by the project activity to the grid (MWh)
$EG_{baseline}$	Baseline electricity supplied to the grid in the case of modified or retrofit facilities (MWh). For new power plants this value is taken as zero. As this is a new power plant this is zero for the project
EF_y	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”

According to the tool the baseline emission coefficient will be determined using the following steps:

STEP 1. Identifying the relevant electric power system

The Indian electricity system is divided into five regional grids, viz. Northern, Eastern, Western, Southern, and North-Eastern. 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. As the Project is connected to the Western regional electricity grid, the Western grid is the "project electricity system".

STEP 2. Select an operating margin (OM) method

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, 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 is considered.

	2000-01	2001-02	2002-03	2003-04	2004-05
North	25.9%	25.7%	26.1%	28.1%	26.8%
East	10.8%	13.4%	7.5%	10.3%	10.5%
South	28.1%	25.5%	18.3%	16.2%	21.6%
West	**8.2%**	**8.5%**	**8.2%**	**9.1%**	**8.8%**
North-East	42.3%	42.1%	45.8%	41.8%	55.4%
India	19.2%	18.9%	16.3%	17.1%	18.0%

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of five most recent years) for the Western 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 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 3. Calculate the operating margin emission factor according to the selected method
The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

- Based on data on fuel consumption and net electricity generation of each power plant / unit (Option A), or
- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit (Option B), or
- Based on data 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 C)

The Central Electricity Authority, Ministry of Power, Government of India has published a database of Carbon Dioxide Emission from the power sector in India based on detailed authenticated information obtained from all operating power stations in the country. This database i.e. The CO2 Baseline Database provides information about the Combined Margin Emission Factors of all the regional electricity grids in India. The Combined Margin in the CEA database is calculated ex ante using the guidelines provided by the UNFCCC in the “Tool to calculate the emission factor for an electricity system”. We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

The CEA database uses the option B i.e. data on net electricity generation, 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 electricity generation of each power unit and an emission factor for each power unit, as follows:

$$\mathbf{EF_{grid,Omsimple,y} = \Sigma\,(EG_{m,y} \times EF_{EL,m,y}) / \Sigma EG_{m,y}}$$

Where:

$EF_{grid,Omsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
y	Either the three most recent years for which data is available at the time of submission of the CDM PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

The emission factor of each power unit m has been determined using Option B1

$$\mathbf{EF_{EL,m,y} = (\Sigma\, FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,I,y}) / EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)

$FC_{i,m,y}$	Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO2,I,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
i	All fossil fuel types combusted in power unit m in year y
y	Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

STEP 4. Identify the cohort 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 5. 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:

$$\mathbf{EF_{grid,BM,y} = (\Sigma\ EG_{m,y} \times EF_{EL,m,}\ ) / \Sigma\ EG_{m,y}}$$

Where:

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

The CO2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the procedures given in step 3 (a) for the simple OM, using options B1 using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

STEP 6. Calculate the combined margin emissions factor

The emission factor *EFy* 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 *EFy* is given by:

$$Efy = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
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 940.22 tCO2e/GWh or 0.94022 tCO2e/MWh.

Details of Baseline data:

Data of Operating and Build Margin for the three financial years from 2002-03 to 2005-06 has been obtained from –

The CO2 Baseline Database for the Indian Power Sector
Ministry of Power: Central Electricity Authority (CEA)
Version 1.1
Key baseline information is reproduced in annexure 3.
The detailed excel sheet is available at:
http://cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

Estimation of Project Emissions
The project activity involves harnessing of wind energy and its conversion to electricity. Hence according to ACM0002 Version 09, there will be no project emissions in the project activity (PEy = 0).

Estimation of Leakage Emissions
As per ACM0002 Version 09, no leakage has been considered for the calculation of emission factor (LEy = 0).

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:

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Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO2e/MWh
Description:	Operating Margin Emission Factor of Western Electricity Grid
Source of data used:	“CO2 Baseline Database for Indian Power Sector” published by the Central Electricity Authority, Ministry of Power, Government of India.

	The "CO2 Baseline Database for Indian Power Sector" is available at http://cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value applied:	2002-03: 0.9814 2003-04: 0.9903 2004-05: 1.0119
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.

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO2e/MWh
Description:	Build Margin Emission Factor of Western Electricity Grid
Source of data used:	"CO2 Baseline Database for Indian Power Sector" published by the Central Electricity Authority, Ministry of Power, Government of India. The "CO2 Baseline Database for Indian Power Sector" is available at http://cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value applied:	2004 – 05: 0.7772
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.

B.6.3 Ex-ante calculation of emission reductions:

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Ex-ante calculation of emission reductions is equal to ex-ante calculation of baseline emissions as project emissions and leakage are nil.

Baseline Emission Factor (Combined Margin) (*EFy*): 940.22 tCO2e/GWh

Annual electricity supplied to the grid by the Project Activity *(EGy)*
= 50.4 MW (Capacity) x 20% (PLF) x 8,760 (hours) / 1,000 GWh
= 88.301 GWh

Annual Baseline Emissions Reduction: ERy = EFy * EGy
= 940.22 tCO2e/GWh x 88.301 GWh
= 83,022 tCO2e

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

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Year	Estimation of project activity emissions (tonnes of CO2e)	Estimation of baseline emissions (tonnes of CO2e)	Estimation of leakage (tonnes of CO2e)	Estimation of overall emission reductions (tonnes of CO2e)
*1st year	0	83,022	0	83,022
2nd year	0	83,022	0	83,022
3rd year	0	83,022	0	83,022
4th year	0	83,022	0	83,022
5th year	0	83,022	0	83,022
6th year	0	83,022	0	83,022
7th year	0	83,022	0	83,022
8th year	0	83,022	0	83,022
9th year	0	83,022	0	83,022
10th year	0	83,022	0	83,022
Total (tonnes of CO2e)	0	830,220	0	830,220

*1st year begins from the date of registration or 01/05/2010 whichever is later, and each year extends for 12 months. The crediting period will not start before the project registration with UNFCCC

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

>>

Data / Parameter:	EG_y
Data unit:	MWh (Mega-watt hour)
Description:	Net electricity supplied to the grid by the Project activity in year y.
Source of data to be used:	Summation of 'net export of electricity to the grid' as recorded in monthly 'JMR reports' along with the 'energy break-up reports'[4] for all the feeder meters at MSEDCL sub-station.. Where, $EG_y = \sum EG_{export} - \sum EG_{import}$ Net electricity supplied to the grid by the project activity is calculated as per

[4] For the feeders where there is sharing of meter by different developers, JMR reports are supported by breakup sheets prepared by the O&M contractor which is based on the monthly JMR reading and the controller meter reading, while for dedicated metering points JMR contains the value of export , import & net export of project activity WEGs. Each JMR contains the value of export, import & net electricity export to the grid

	formula (3) given in section B.7.2.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Annual net electricity supplied to the grid by the Project = 50.4 MW (Capacity) x 20% (PLF) x 8,760 (hours) = 88301 MWh (This value may vary depending on the actual PLF achieved and will be obtained from monitoring the electricity generated by the project activity during the particular year)
Description of measurement methods and procedures to be applied:	The net electricity supplied to grid is a calculated value and would be determined as the difference between the summation of electricity exported to the grid and the summation of electricity imported from the grid by the project activity and the same value would be reported in JMR report along with the break-up report, on monthly basis. Detailed procedure for calculating the net electricity supplied to the grid is given in section B.7.2. Refer Annex – 4 for an illustration of the provisions for measurement methods.
QA/QC procedures to be applied:	The value of net electricity supplied to the grid can be cross checked from the credit certificates (credit notes) provided by MSEDCL. QA/QC procedures will be as implemented by MSEDCL pursuant to the provisions of the power purchase agreement. Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.
Any comment:	The data will be archived for crediting period + 2 years.

Data / Parameter:	$\sum EG_{JMR,\ export}$
Data unit:	MWh (Mega-watt hour)
Description:	Summation of Electricity exported to the grid, as recorded by the main meter at each feeder meters at MSEDCL substation.
Source of data to be used:	The value of electricity exported to the grid will be taken from the monthly JMR reports.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter will be used for calculation of EGy and this will not be directly used for calculation of emission reduction.
Description of measurement methods and procedures to be applied:	The value of electricity export is jointly noted from the main meter installed at each feeder meter at pooling substation which is managed by Enercon under the jurisdiction of MSEDCL. -Frequency of recording data: Monthly. -Main and Check meters measure the electricity (export & the import) on continuous basis and recorded by state utility on monthly basis.
QA/QC procedures to be applied:	The meters will be calibrated once in a year by the state utility. Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.
Any comment:	The data will be archived for crediting period + 2 years.

Data / Parameter:	$\sum EG_{JMR,\ import}$

Data unit:	MWh (Mega-watt hour)
Description:	Summation of electricity imported from the grid, as recorded by the main meter at each feeder meter at MSEDCL substation.
Source of data to be used:	The value of electricity imported from the grid will be taken from the monthly JMR reports.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter will be used for calculation of EGy and this will not be directly used for calculation of emission reduction.
Description of measurement methods and procedures to be applied:	The value of electricity import is jointly noted from the main meter installed at each feeder meter at pooling substation which is managed by Enercon under the jurisdiction of MSEDCL. -Frequency of recording data: Monthly. -Main and Check meters measure the electricity (export & import) on continuous basis and recorded by state utility on monthly basis.
QA/QC procedures to be applied:	The meters will be calibrated once in a year by the state utility. Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.
Any comment:	The data will be archived for crediting period + 2 years.

Data / Parameter:	$\sum EG_{gross,y}$
Data unit:	MWh (Mega-watt hour)
Description:	Summation of total electricity generated from WEGs of the project proponent from individual meters (i.e. WEG controller panel meter) attached to the each feeder meter connected to MSEDCL substation
Source of data to be used:	Generation value from the WEG panel meter (Online SCADA system).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This parameter will be used for calculation of EGy and this will not be directly used for calculation of emission reduction.
Description of measurement methods and procedures to be applied:	Generation data will be archived from central monitoring station that collects data from the controller panel meter of each WEG through online SCADA system. -Frequency of recording data: Monthly. -Panel meter (LCS controller) measures the net electricity generation (Gross Export) on continuous basis and daily/monthly data can be sourced/recorded from online SCADA system.
QA/QC procedures to be applied:	The controller panel meters do not require calibration as the energy readings of electricity generated at the controller meter is cross verified by the energy calculated by inverting system installed in the WEGs. Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.
Any comment:	The data will be archived for crediting period + 2 years.

Data / Parameter:	$\sum EG_{export}$
Data unit:	MWh (Mega-watt hour)
Description:	Summation of Electricity exported by the project activity to the grid as recorded at JMR at each feeder at MSEDCL substation
Source of data to be used:	The value of electricity exported by the project activity to the grid for each feeder meter will be taken from monthly JMR reports along with the break-up reports.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$\sum EG_{export}$ is summation of electricity export values of all the feeder meters at MSEDCL sub-station. For the common feeder meter EG_{export} will be calculated as per equation no. (1) given under section B.7.2, while in case of dedicated feeder meters $EG_{export} = EG_{JMR,export}$.
Description of measurement methods and procedures to be applied:	For the common feeder meter EG_{export} will be calculated as per equation no. (1) given in section B.7.2, while in case of dedicated feeder meters $EG_{export} = EG_{JMR,export}$ -Frequency of recording data: Monthly.
QA/QC procedures to be applied:	Electricity exported by the project activity to the grid can be cross checked from the credit certificates provided by MSEDCL. Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.
Any comment:	The data will be archived for crediting period + 2 years.

Data / Parameter:	$\sum EG_{import}$
Data unit:	MWh (Mega-watt hour)
Description:	Summation of electricity imported by the project activity from the grid as recorded at JMR at each feeder at MSEDCL substation
Source of data to be used:	The value of electricity imported by the project activity from the grid for each feeder meter will be taken from monthly JMR reports along with the break-up reports.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$\sum EG_{import}$ is summation of electricity import values of all the feeder meters at MSEDCL sub-station. For the common feeder meter EG_{import} will be calculated as per equation no. (2) given under section B.7.2, while in case of dedicated feeder meters $EG_{import} = EG_{JMR,import}$
Description of measurement methods and procedures to be applied:	For the common feeder meter EG_{import} will be calculated as per equation no. (2) given in section B.7.2, while in case of dedicated feeder meters $EG_{import} = EG_{JMR,import}$ -Frequency of recording data : Monthly
QA/QC procedures to be applied:	Electricity imported by the project activity from the grid can be cross checked from the credit certificates provided by MSEDCL. Refer Annex – 4 for an illustration of the provisions for QA/QC procedures.
Any comment:	The data will be archived for crediting period + 2 years.

The data will be maintained in soft and hard format for crediting period + 2 years.

B.7.2 Description of the monitoring plan:

>>

Approved monitoring methodology ACM0002 Version 09 Sectoral Scope: 1, "Consolidated 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.

This approved monitoring methodology requires monitoring of the electricity generation from the project activity.

Emission factor for the project activity as mentioned in registered PDD was determined ex-ante, which is fixed throughout the crediting period of project activity. 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.

Procedure for Computing Net Electricity Supplied to the Grid by the Project Activity:

Line diagrams of the project activity showing all relevant monitoring points has been presented below. There are total three metering points for the project activity.

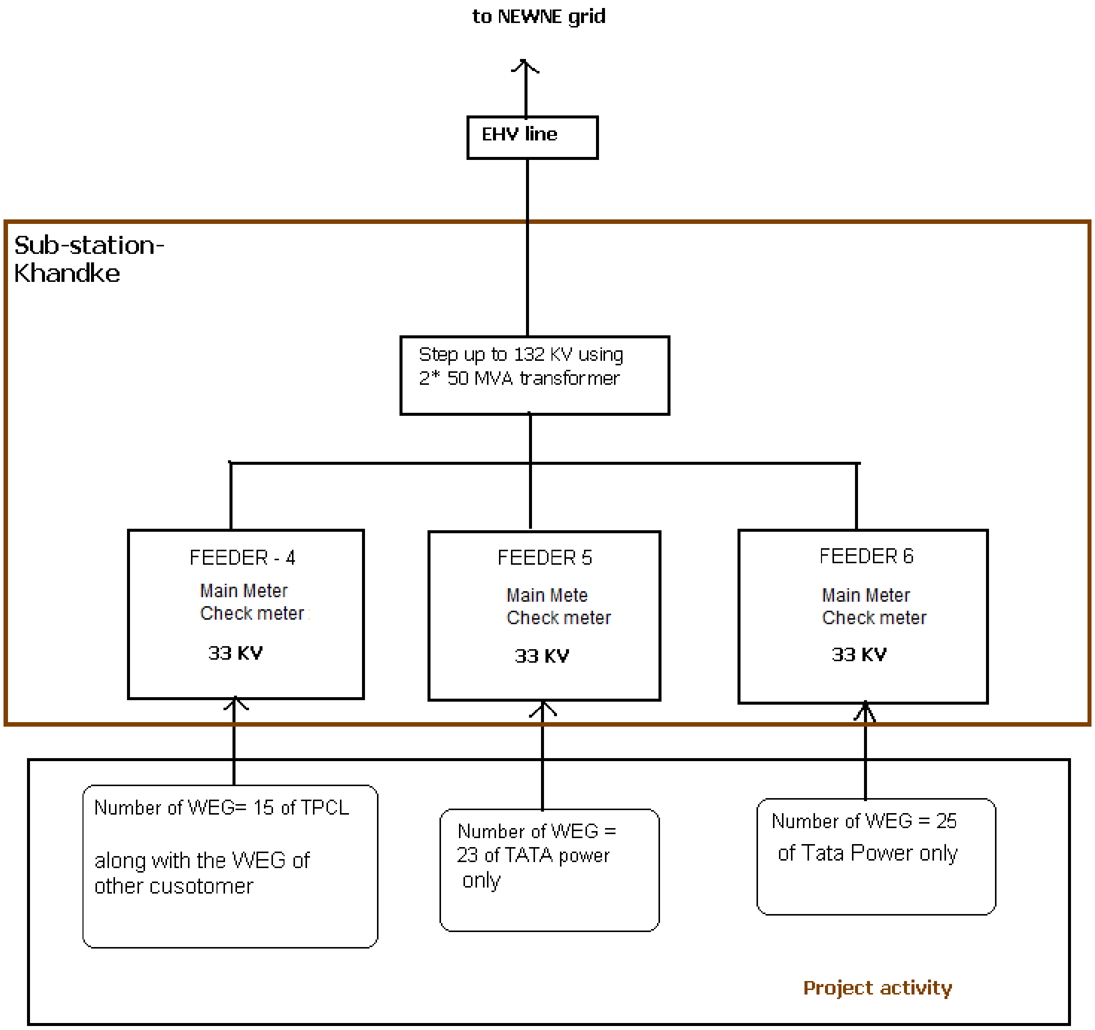


Figure: Line diagram of the project activity in current situation.

As shown in the above line diagram, the project activity is connected to feeder 4, 5 and 6. Each feeder has one set of main & check meter. The main and check meters that are connected to feeder 5 and 6 are dedicated meters for the project activity i.e. no WEGs of other customer(s) are connected to these meters. Feeder 5 is dedicated to 23 WEGs of the project activity while Feeder 6 dedicated to 25 WEGs of the project activity. However the main and check meters for feeder 4 is connected to 15 WEGs of the project activity and 09 WEGs of the non-project activity.

The sharing of any feeder among WEGs is being done by the state utility, based on the load carrying capacity of that particular feeder and also based on the load profile at connected substation. Each feeder has one set of main & check meter. In the actual project scenario, the main and check meters at feeder 5 and feeder 6 are connected to 23 and 25 WEGs respectively which are dedicated to the project activity. In other words, no other WEGs of different customer(s) are being connected to feeder 5 and

feeder 6 considering the present load carrying capacity of these feeders. As there are no WTGs of other customers(s) are connected to the meters at feeder 5 and feeder 6, the apportioning procedure to arrive at electricity generated by WTGs with respect to their customer(s), has not been applied here. However the main and check meters for feeder 4 are connected to 15 WEGs of the project activity and 09 WEGs of the non-project activity, considering the load carrying capacity of this feeder. Therefore for feeder 4, the apportioning procedure is applied to compute the electricity that can be allocated to 15 WEGs of the project activity. The apportioning procedure is done by Enercon and certified by MSEDCL, where the customers do not have any control. These apportioning calculations are as per the standard procedures & guidelines of MSEDCL, who authorises JMR reports and issuing the same to the customers. Based on the apportioning, the apportioned values of electricity export and import by WEGs connected to feeder 4 are noted in the credit certificate (credit notes) which is being issued to the individual customers with respect to their WEGs connected to the feeder 4.

Further, the above mentioned configuration of any feeder may change in future depending upon the load carrying capacity of the feeder and also the load profile at connected sub-station. The same apportioning procedure, as explained below, will be followed for all the feeders if required (in the case where the common metering is done for the WTGs of project activity and non-project activity, for any of the feeder).

Procedure of apportioning in case of common metering (both project activity & non project activity WEGs are connected to same feeder meter):-

The generated electricity is measured through a two-step procedure, wherein the first metering is carried out at the controller of each WEG at the project site. The monitoring of all these WEGs is done from a common monitoring station as a part of central monitoring system (CMS). $EG_{gross,y}$ is the electricity generated from an individual WEG measured through its controller panel meter and connected to common feeder meter . The summation of total Electricity generated from WEGs of the project proponent from individual meters (controller panel meter) in MWh is presented as:

$$\sum_{y=0}^{n} EG_{gross,y}$$

where n = No of WEGs of project proponent connected at common MSEDCL meter at feeder

and the summation of total Electricity generated (controller panel meter) from the other WEGs (total number of WEGs = m) attached to the common MSEDCL feeder meter connected to substation in MWh is presented as:

$$\sum_{y=0}^{m} EG_{gross,y}$$

where m = No of WEGs of other customers connected at common MSEDCL meter at feeder (this value is not under the control of project proponent and cannot be monitored by project proponent).

The second metering is carried out at grid interconnection point (i.e. substation) wherein the Joint Meter Reading (JMR) is carried out on first day of every month in presence of the representatives of

the project proponent & the state electricity utility (MSEDCL). JMRs for all the feeders include electricity exported and imported by the project activity (along with WEGs of non-project activity, if any). The JMR report gives both the "export" ($EG_{JMR,export}$) and "import" ($EG_{JMR,import}$) of the electricity to/from the NEWNE grid based on common MSEDCL meter readings. This JMR is used for calculation of the amount of net electricity supplied to the grid. MSEDCL also provides the credit certificate to the project proponent that provides data on electricity export and import.

The apportioning of electricity generated from the various WEGs which are connected to one feeder meter, is done by Enercon based on the power generation from the individual WEGs connected to this MSEDCL feeder meter. Operation and maintenance personnel from Enercon prepare a monthly report on generation and consumption. This report (named as 'Energy Break-up Report') contains the details of power exported/imported to/from the grid by WEG(s) of connected. This apportioned value is then submitted to MSEDCL and on the basis of this Break-up Report and JMR, MSEDCL issues the credit certificates to the individual customers with respect to their WEG(s) connected to the feeder.

EG_{export} the electricity export to the grid by the project activity WEGs connected at common MSEDCL feeder meter is calculated as follows:

$$EG_{export} = \frac{EG_{JMR,\,export} \times \sum_{y=0}^{n} EG_{gross,y}}{\sum_{y=0}^{n} EG_{gross,y} + \sum_{y=0}^{m} EG_{gross,y}} \quad \ldots\ldots\ldots\ldots(1)$$

EG_{import} the electricity import from the grid by the project activity WEGs connected at common MSEDCL meter is calculated as follows:

$$EG_{import} = \frac{EG_{JMR,\,import} \times \sum_{y=0}^{n} EG_{gross,y}}{\sum_{y=0}^{n} EG_{gross,y} + \sum_{y=0}^{m} EG_{gross,y}} \quad \ldots\ldots\ldots\ldots(2)$$

Where,

$\mathbf{E_{JMR,Export}}$ is electricity exported, as recorded by the main meter at common MSEDCL feeder meter at substation.
$\mathbf{E_{JMR,Import}}$ is electricity imported, as recorded by the main meter at common MSEDCL feeder meter at substation.

The above method of apportioning is as per the standard procedures & guidelines of MSEDCL and authorised by the MSEDCL.

Further formula (1) & (2) will be used to calculate the electricity export & import of project activity connected at common feeder at MSEDCL sub-station.

While in case of dedicated feeder meters $EG_{export} = EG_{JMR,export}$ & $EG_{import} = EG_{JMR,import}$.

EG_y, the net electricity supplied to the grid by the project activity WEGs connected to all the feeders (common as well as dedicated feeder meter) at MSEDCL substation, is calculated as follows:

$$EG_y = \sum EG_{export} - \sum EG_{import} \quad \text{……………….. (3)}$$

Where,

$\sum EG_{export}$ is summation of electricity export values of project activity as recorded at all the feeders at MSEDCL sub-station (sourced from monthly JMR reports along with the break-up reports).

$\sum EG_{import}$ is summation of electricity import values of project activity as recorded at all the feeders at MSEDCL sub-station (sourced from monthly JMR reports along with the break-up reports).

The apportioning procedure is described in details only to provide the clear description of entire procedure by relevant authority. Further the apportioning procedure requires the generation data of other project proponents as mentioned in above formula. Since project participant is not authorise to access the generation data of other project proponents, the value of electricity export & import will be sourced directly from JMR/credit note as provided by the state utility and the apportioning procedure will be done by Enercon officials only where the project proponent has no control.

Following parameters are to be monitored by the project proponent:-

S. No.	Parameter	Description	Source of Data
1	$\sum EG_{JMR, export}$	Summation of Electricity exported to the grid, as recorded by the main meter at each feeder at MSEDCL substation.	Joint Meter Reading
2	$\sum EG_{JMR, import}$	Summation of electricity imported from the grid, as recorded by the main meter at each feeder at MSEDCL substation.	Joint Meter Reading
3	$\sum EG_{gross,y}$	The summation of total electricity generated from WEGs of the project proponent from individual meters (i.e. WEG controller panel meter) attached to the each feeder connected to MSEDCL substation	WEG controller panel meter (Online SCADA system)
4	$\sum EG_{export}$	Summation of Electricity exported by the project activity to the grid as recorded at JMR at each feeder at MSEDCL substation.	Joint Meter Reading along with the Energy Break-up Report
5	$\sum EG_{import}$	Summation of electricity imported by the project activity from the grid as recorded at JMR at each feeder at MSEDCL substation	Joint Meter Reading along with the Energy Break-up Report
6	EG_y	Net electricity supplied to the grid by the project activity.	Joint Meter Reading along with the Energy Break-up Report

Following parameter is not under the control of project proponent and recorded by Enercon only:-

S. No.	Parameter	Description
1.	$\sum_{y=0}^{m} EG_{gross,y}$	The summation of total Electricity generated (recorded at controller panel meter) from the non-project activity WEGs (total number of WEGs = m) attached to the each feeder connected to MSEDCL substation

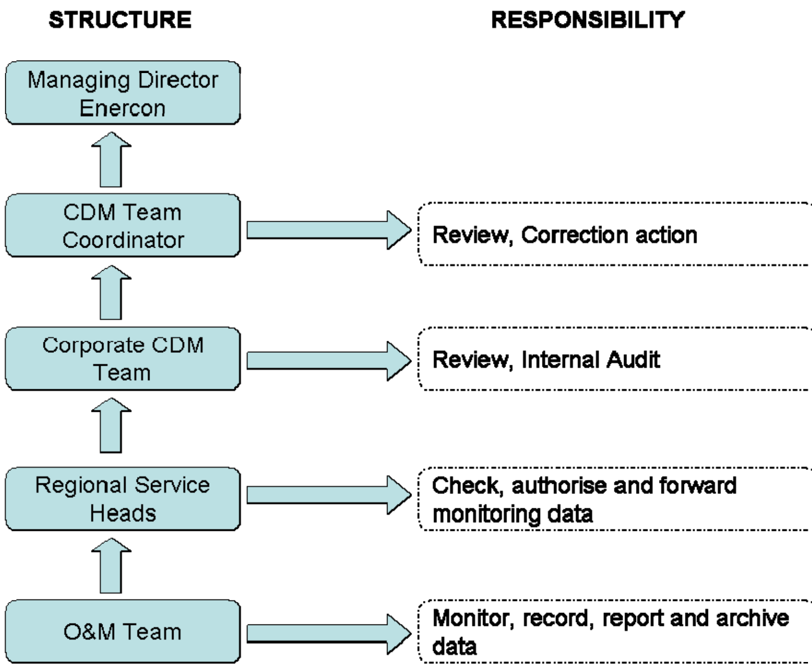
The net electricity supplied to the grid which is the summation of net electricity supplied by project activity as recorded at all the feeder meters and will be sourced from JMRs along with Energy Break-up Report, which can be cross checked from the credit notes provided by the MSEDCL..

The Project is operated and managed by Enercon (India) Ltd. Enercon India Limited is an ISO 9001:2008 certified Quality Management system. Enercon India Limited 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.

The accuracy of monitoring parameter is ensured by adhering to the calibration and testing procedure. The project will adhere to all the mandatory regulatory and statutory requirements at the state as well as national level.

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 Wind Energy Converters (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 by Enercon is as follows:



Procedure for data uncertainty:-

The metering equipment will be tested by State Utility on annual basis. The main and check meters are tested annually by state utility. Procedure to deal with metering equipment failure:-

If during the meter test checking,

- The main meter is found to be within the permissible limit of error and the corresponding check meter is beyond the permissible limits, then the meter reading will be as per the main meter as usual. The check meter shall, however, be calibrated immediately.

- The main meter is found to be beyond permissible limits of error, but the corresponding check meter is found to be within permissible of error, then the meter reading for the month up to the date and time of such test shall be as per the check meter. The main meter shall be calibrated immediately and meter reading for the period thereafter till the next monthly meter reading shall be as per the calibrated main meter.

- Both the main meter and the corresponding check meter are found to be beyond the permissible limits of error, both the main meter & check meter shall be immediately calibrated and the correction applied to the reading registered by the main meter to arrive the correct reading of energy supplied for metering electricity supplied to the grid for the period from the last month's meter reading up to the current test. Meter reading for the period thereafter till the next monthly reading shall be as per the calibrated main meter.

- If during any of the monthly meter readings, the variation between the main meter and the check meter is more than the permissible limit for meters of 0.2% accuracy class, all the meters shall be re-tested and calibrated immediately

- The controller meters do not require calibration as the energy readings of electricity generated at the controller meter is cross verified by the energy calculated by inverting system installed in the WEGs. In case there is any mismatch in the energy values recorded by the controller 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 attend to the problem immediately in order to identify the error and correction factor will be determined

  If during any of the monthly meter readings, the variation between the main meter and the check meter is more than the permissible limit for meters of 0.2% accuracy class, all the meters shall be re-tested and calibrated immediately.

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)

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Date of completion: 15/02/2008

Name of responsible person/entity: The Tata Power Company Limited and Enercon India Limited.

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:

>>

16/08/2006 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:

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
1/05/2010 or date of registration of the Project whichever is later. The crediting period will start after date of registration of the project with UNFCCC.

C.2.2.2. Length:

>>
10 Years

SECTION D. Environmental impacts

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

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The Tata Power Company Limited gave the responsibility to Enercon for conducting EIA for its projects. Enercon appointed Care Sustainability to conduct rapid environmental impact assessment study for the wind power project of The Tata Power Company Limited to assess the impact of the project on the local environment.

Environmental Impact Assessment (EIA) of this project is not an essential regulatory requirement, as it is not covered under the categories as described in EIA Notification of 1994 or the Amended Notification of 2006. However, the project proponents conducted the EIA to study impacts on the environment resulting from the project activity.

The EIA study included identification, prediction and evaluation of potential impacts of the CDM activities on air, water, noise, land, biological and socio-economic environment within the study area. The ambient air concentrations of Suspended Particulate Matter, Respirable Particulate Matter, Oxides of Nitrogen, Sulphur dioxide and Carbon Monoxide were monitored and were found under limits as specified by CPCB. The noise levels were observed through out the study period and were found to be in the permissible range as specified by the state pollution control board and National Ambient Air Quality Standards. Water quality monitoring studies were carried out for determination of physico-chemical characteristics of bore wells. The ph level of water was found to be under the specified limits.

The project area does not have any housing structures/dwelling units hence Rehabilitation and Resettlement would not be an issue. The project has provided job opportunities by way of casual labour, skilled labour and office staff not only in the construction and operation of project activity. Adverse impact on the health and culture of local residents is not anticipated. The site does not involve any sensitive archaeological monuments as per the Archaeological Survey of India. No Historical and Cultural Monuments have been affected due to project location. The project site and immediate neighbourhood areas with pleasing architectural design that blends with the landscape does have a positive impact on the aesthetics of the present surrounding of the site.

The operation of the Tata Wind Farms has brought certain changes in the socio-economic and cultural environment by providing certain employment and livelihood opportunities improved the quality of life of the people in the surrounding habitations and also by providing cleaner environment and better

health conditions to the people in the neighbouring villages. The generation of electricity from such clean process would contribute towards meeting the states deficit in electricity requirements.

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:

>>

EIA demonstrated that there is no major impact on the environment due to the installation and operation of the windmills. The ecology is not likely to get impacted by this type of project activity. The local population confirmed that there is no noise or dust nuisance due to windmills. The EIA also ruled out any adverse impacts due to the project activity.

SECTION E. Stakeholders' comments

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

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The comments from local stakeholders were invited through a local stakeholder meeting conducted in Ahmednagar District on 15 November-2006. The Tata Power Company Limited identified local communities, farmers, officials of Gram Panchayat and O & M contractor Enercon India Limited as the most important stakeholders with an interest in the CDM activities. A local newspaper advertisement was placed in Sarvmat on 29 October 2006 inviting the local stakeholders for the meeting. The minutes of the meeting are set out in Appendix 2.

E.2. Summary of the comments received:

>>

The comments from local villagers included:

- Effect on the rainfall
- Noise Disturbance
- The nature of benefits that local stakeholders will get
- Impact on the grazing of local cattle
- Effect on the yield of grains

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

>>

Enercon as a project developer and O & M contractor provided the following responses in relation to the comments received from the local stakeholders:

- There is no relation between Wind Energy Machine and rainfall. Rain is natural phenomenon and is not affected.
- There is no noise because of the wind turbines on the account of the gearless technology of Enercon.
- The benefits to the local stakeholders will be through employment opportunities provided by the project in terms of construction workers. It will also lead to better connectivity to nearby towns.

- The project does not affect the grazing by the cattle. Enercon does not use any kind for boundary wall to protect their machines and hence the accessibility of cattle to areas for grazing and drinking water is not affected.
- There is no impact on the yield of the food grains due to the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

For Project Sponsor:

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project activity does not involve any public funding.

Annex 3

BASELINE INFORMATION

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

Simple Operating Margin

	Western Grid (tCO2e/MWh)
Simple Operating Margin – 2002-03	0.9814
Simple Operating Margin – 2003-04	0.9903
Simple Operating Margin – 2004-05	1.0119
Average Operating Margin of last three years	0.99455

Build Margin

	Western Grid (tCO2e/MWh)
Build Margin- 2004-05	0.77722

Combined Margin Calculations

	Weights	Western Grid (tCO2e/MWh)
Operating Margin	0.75	0.99455
Build Margin	0.25	0.77722
Combined Margin		0.94022

Detailed information on calculation of Operating Margin Emission Factor and Build Margin Emission Factor is available at http://cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm.

Annex 4

MONITORING INFORMATION

- **Metering:** Electricity supplied to the grid is metered by the Parties (MSEDCL, Project Participants).

- **Metering Equipment:** Metering system for the project activity consists of one main and one check meter at each feeder. Therefore in total there are three main and three check meters. All the feeder meters are two-way tri-vector meters capable of recording import and export of electricity. Metering equipment is maintained in accordance with electricity standards prevalent in Maharashtra.

  In addition to feeder meters there is individual controller panel meter (LCS meter) installed inside each WEG of the project activity. The LCS meter readings are archived electronically on continuous basis.

- **Meter Readings:** The net electricity supplied to the grid is recorded by taking a Joint Meter Reading (JMR) in the presence of officials from MSEDCL and Enercon as O&M contractor, on behalf of project sponsor. The Joint meter reading contains the value of energy imported and exported and the net export to the grid during the recording period. This Joint meter reading is certified by the Executive engineer of MSEDCL and by Enercon Officials. QA/QC of the Joint Meter Readings would be established through the calibration report of the Joint Meter.

- **Inspection of Energy Meters:** All main and check energy meters (export and import) and all associated instruments, transformers installed at the Project are of 0.2% accuracy class. Each meter is jointly inspected and sealed on behalf of the Parties and is not to be interfered with by either Party except in the presence of the other Party or its accredited representatives.

- **Meter Test Checking:** There is a separate main and check meter for each 33 kV feeder. The Main and Check Meters are close to each other and will be tested for accuracy, with a portable standard meter, by the MSEDCL/MSETCL Testing Division, The MSEDCL/MSETCL will carry out the calibration, periodical testing, sealing and maintenance of meters. All the meters will be tested at the Metering Point. The MSEDCL/MSETCL will provide a copy of the test reports. If during any of the monthly meter readings, the variation between the main meter and the check meter is more than 0.2%, all the meters will be re-tested and calibrated immediately by MSEDCL/MSETCL.

- The controller panel meters do not require calibration as the energy readings of electricity generated at the controller meter is cross verified by the energy calculated by inverting system installed in the WEGs. In case there is any mismatch in the energy values recorded by the controller 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 attend to the problem immediately in order to identify the error and correction factor will be determined.

Annex 5 – WACC Calculation

Weighted Average Cost of Capital:

Weighted average cost of capital (WACC) is calculated as the sum of weighted average cost of equity and cost of debt as illustrated below

WACC = [D/ (D+E)]*[Cost of Debt] + [E/ (D+E)]*[Cost of Equity]

Cost of Debt:

Cost of debt is defined as the rate at which lenders agree to lend money to a project. The additionality tool and the guidance to investment analysis clarify that for projects that benchmark for project with more than one potential developer should not be based on project specific parameters but should represent the standard in the market. Accordingly, the bank prime lending prevailing at the time of project start date has been considered as the cost of debt. The prime lending rate at the time of investment was in the range of 10.75% - 11.50% [Source: Reserve Bank of India, http://rbidocs.rbi.org.in/rdocs/Wss/DOCs/72074.xls, the average PLR of 11.125% has been considered.

Interest costs are tax deductible, therefore in order to arrive at the post tax cost of debt, the cost of debt is multiplied with marginal tax rate. The marginal tax rate of 11.33% is applicable for the project activity.

The post tax cost of debt therefore works out to: 11.125% * (1-11.33%) = 9.86%

Calculation of Cost of Equity:

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM)[5] considering Beta values of all power generating companies in India that were listed at the time of this investment. The CAPM economic model is used widely used to determine the required/expected return on equity based on potential risk of an investment. The CAPM framework is the Nobel award winning work of financial economist Dr. William Sharpe.

Ke = Rf + B x (Rm - Rf)

where:

Ke = Rate of return on equity capital;

Rf = Risk-free rate of return;

B = Beta;

Rm – Rf = Market risk premium;

[5] The Capital Asset Pricing Model (CAPM) was published in 1964 by William Sharpe, for his work on CAPM Sharpe received the Nobel Prize in 1990. http://www.investopedia.com/articles/06/CAPM.asp

Risk free rate:

The risk free rate is understood as the rate of return on an asset that is theoretically free of any risks, therefore the rate of interest on government bonds are considered as risk free rates. Page 191 of text book on "Corporate Finance Theory and Practice" by Dr. Aswath Damodaran[6] of Stern School of Business, New York University (attached as Appendix 5) describes that the long term government bond rates are suitable indicators of risk free rates when the time horizon for the investment is long term.

Accordingly the risk free rate has been taken from long dated Indian government bond rates at the project start date (which is August 2006) which has been considered as it was in the year of investment (i.e in that year, the company had the alternative of this long term risk free investment). The data on government bond rates is published by Reserve Bank of India. (Web-link: http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/80303.pdf)

The applicable risk free rate is 7.34%.

Risk Premium:

The most common approach for estimating the risk premium is to base it on historical data, in the CAPM, the premium is estimated by looking at the difference between average return on stocks and average return on government securities over an extended period of history [page 190, Corporate Finance Theory and Practice, Dr. Aswath Damodaran. Attached as appendix 6]. It is preferred to use long term premimums, i.e over a period of 25 years, since considering shorter time periods can lead to large standard errors because volatility in stock returns [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran. Attached as appendix 7]. It is also preferred to calculate the risk premium based on geometric mean of the returns since arithmatic mean overstates the risk premium. Geometric mean is defined as the compounded annual return over the same period [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran. Attached as appendix 7].

Therefore the risk premium has been calculated as the difference in compounded annual return bewteen the BSE-Sensex and the Government bond rates. The detailed calculations are presented in the attached excel sheet.

Source: BSE Stock Exchange (www.bseindia.com)

The applicable risk premium is 11.32%.

Beta:

Beta (B) indicates the sensitivity of the company to market risk factors. For companies that are not publicly listed, the beta is determined by referring beta values of publicly listed companies that are engaged in similar types of business. The project activity type is wind power generation; the approach therefore should be to base the beta for the project on the beta values of listed wind power generation companies in India. In the absence of adequate data on companies which are exclusively into the

[6] Dr. Damodaran is one of the foremost authorities in the world in the field of Investment Analysis

exactly same type of business (i.e wind power projects), the next best option for assessing the risk of these projects is to consider the data available on companies which are involved in similar businesses.

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

The applicable Beta value has been determined on the basis of the Beta values of all power generating companies in India which were listed on the stock exchange at the time of this investment. Beta values of individual companies have been sourced from Bloomberg and screenshots are available in appendix 3.

The table below summarises the beta values:

RELIANCE ENERGY	1.03
GUJARAT INDS	1.33
TATA POWER CO	1.53
NEYVELI LIGNITE	1.42
CESC LTD	1.88
Average	**1.44**
Source:Bloomberg[7]	

WACC = [D/ (D+E)]*[Cost of Debt] + [E/ (D+E)]*[Cost of Equity]

For calculation of WACC, a debt : equity ratio of 70:30 has been considered, as typical for the project type[8].

WACC = 70%* 11.125% (1-11.33%) + 30%*(7.34% +1.44* 11.32%)

Therefore, WACC = 70% * 9.86% + 30% * 23.6% = **13.99%**

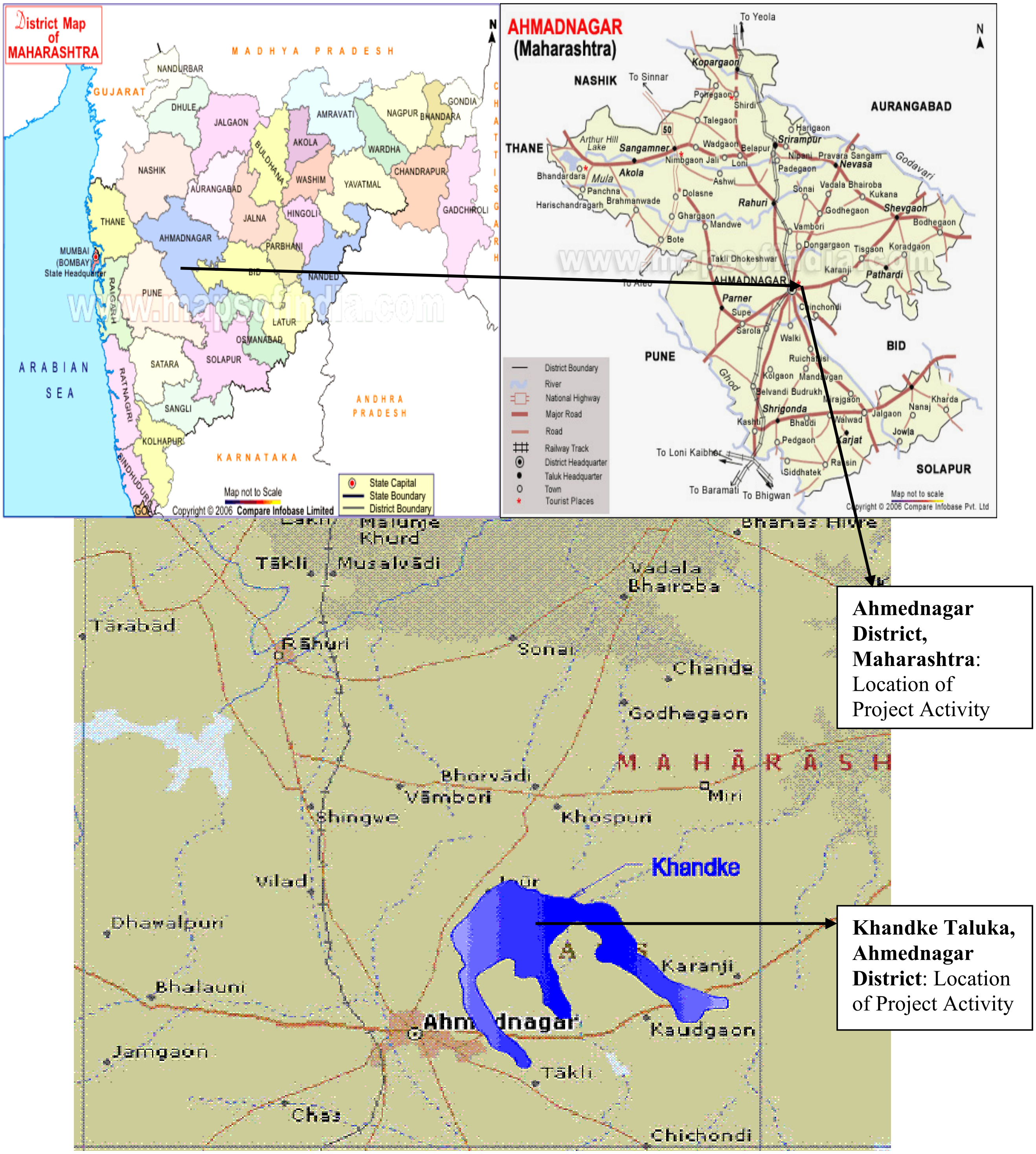
[7] The beta value used, are the regression betas calculated by Bloomberg based on periodic stock returns. Bloomberg also provides an adjusted beta value after making the following adjustments:

Adjusted Beta=Regression Beta (denoted as Raw beta) *(0.67) +1.00*(0.33)

Bloomberg states that this is a default adjustment on the assumption that in future, over a period of time all betas may tend towards the average beta i.e. one. The approach outlined in corporate finance states: the conventional approach to estimate the beta of an investment is a regression of return on investment against returns on a market index (please see attached page no. 196 from "Corporate Finance Theory and Practice by Aswath Damodaran as Annexure 8). Accordingly, the regression beta (and not the adjusted beta) value has been considered.

[8] Several regulations and orders refer this as the normative debt equity ratio for wind power projects.

Appendix 1 – Location Map



Appendix 2- Minutes of Local Stakeholder Consultation Meeting

Public Stake holder's Meeting of Clean Development Mechanism Project of The Tata Power Company Limited – Ahmednagar District, Maharashtra State

Venue: Ahmednagar, Enercon Site Office
Date: 15.11.06
Time: 2 pm to 4 pm

Participants of the Meeting:

A meeting and discussions were held in connection with Environment/Renewable Energy Projects on 15.11.06 in the afternoon from 2 to 4 pm at Enercon Site office, Sata Colony, Ahmednagar. More than 20 persons from nearby villages were present to attend the meeting. Enercon India Ltd was represented by Shri Mahesh Bag (Admin), Mr. Vivek Sen (Corporate) Mumbai, Mr. Sandeep Bhinde Enercon Ahmednagar, Mr. Shridhar Golambe Enercon Ahmednagar.

Stakeholders present for the meeting:

1. *Bhausaheb Gade*
2. *Kashikale Khumaji Karale*
3. *Gangadhar Sakat*
4. *Ramdas Keshav Shinde*
5. *Shivaji Mohan Shinde*
6. *Gayn Dev Laxman Vaman*
7. *Ashok Mohan Shinde*
8. *Tukaram Vitthal Karale*
9. *Bhausaheb Gangadhar Sakat*
10. *Adinath Laxman Shinde*
11. *Mohan Laxman Shinde*
12. *Radhaji Gundu Shinde*
13. *Thakaji Khumaji Karale*
14. *Popat Ambadas Karale*
15. *Jagannath Namdev Gayakwad*
16. *Ramesh Bhakuji Karale*
17. *Hanmant Karbhari Karale*
18. *Balasaheb Ranganath Gayakawad*
19. *S. G. Kulkarni*

20. *Shivaji Punja Karale*
21. *Tukaram Baburao Vagule*

Welcome Address:

The meeting began at the stipulated time and Mr. Mahesh Bag on behalf of Enercon India Limited welcomed all Villagers from Ahmednagar and nearby villages who devoted their time and effort to attend the meeting.
The main objective of this meeting was to discuss the doubts related to Wind Energy and its effects on the Environment. Several points were discussed in details between the participants of the meeting were discussed and cleared to villagers of Ahmednagar.

Proceedings:

Mr. Vivek Sen from Enercon explained regarding development of Wind Energy and Advantages of Renewable Energy and Clean Development Mechanism and answered the questions asked by Villagers to their satisfaction.

Address By the Chief Guests:

Chief Guest Shri. Tukaramji Vaghule, Sarpanch of Ratalgaon Village explained the advantages of Wind Energy to the participants. He continued by emphasizing on the need for development of alternative and clean sources of energy due to shortage of energy in the future and development of villages due to the installation of wind energy. Shri. Shivajirao Karale, Sarpanch of Aagadgaon also in his speech explained about the Wind Energy and its advantages and answered the question asked by villagers to their satisfaction.

Shri. Sanddeep Bhinde, Vivek Sen, Shridhar Golambe were present during the meting and discussions.

QUESTIONS ASKED BY VILLAGERS:

1. Does Wind Energy Machines affects the rainfall?

   Ans. Enercon official stated that there is lot of difference between the height of installed Wind Energy Machines and Clouds. There is no relation between Wind Energy Machine and rainfall. Rain is natural phenomenon and is not affected or stopped by windmills.

2. Does the blades of Wind Energy Machines and its sound disturbs animals or people?

   Ans. The blades will not make any noise and they are at 56 m height and it will not disturb animals or people while crossing the Project Area.

OTHER QUESTIONS (QUESTIONS ASKED TO THE VILLAGERS):

1. What developments took place due to Wind Energy projects?
   Ans. There are number of developments like Road, Transportation, Employment, running of State Buses etc.,

2. Should we promote such Projects?
   Ans. Yes. We should promote wind energy projects, which will develop roads, transportation, employment etc.,

3. As per your views, how does this project affect Environment?
   Ans. This project will not have any impact on the rainfall as the project does not change the natural conditions.

4. While developing Wind Energy Project what kind of help can we (Enercon India Ltd) expect from the villagers?
   Ans. We can provide the project persons with Drinking water, Eatables etc., on time.

5. Do you maintain good relation with personnel and authorities of this project?
   Ans. Yes, we do have very good relations with competent authorities of this project.

6. Does this project have employment opportunities?
   Ans. Yes, the employment opportunities has improved as the result of the project activity

7. Does this project has developed Transportation / road developments etc.,
   Ans. Yes, Road and Transportation has developed and hence the accessibility has also improved to the near by areas.

8. How do projects relate to your life?
   Ans. We use the roads constructed at the site. Also we do take our domestic animals near the constructed site area where our domestic animals eat the grass.

9. Does sound of blades disturbs your lives?
   Ans. No.

10. If the field / land got damaged due to water drainage caused by the construction of the project?
    Ans. No such nuisance has occurred.

11. Is there any difficulty (prohibition by the project officials) to take the domestic animals for grazing?
    Ans. No, there is no difficulty in taking the domestic animals to the site.

12. Is there any affect on the yield of the grains from your fields?
    Ans. No.

13. Did you find the Project officials cutting the trees on the forestland?
    Ans. No. We haven’t found any project officer cutting down forest trees.

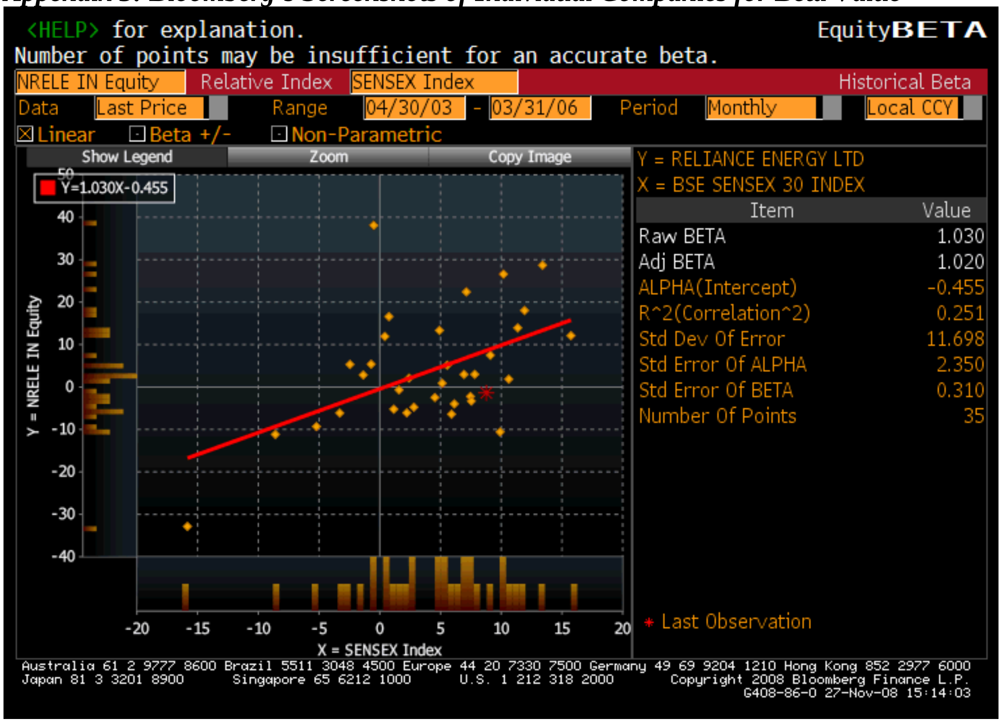
14. Is there any dust related problem from the project? If any dust arises, how does it affect?

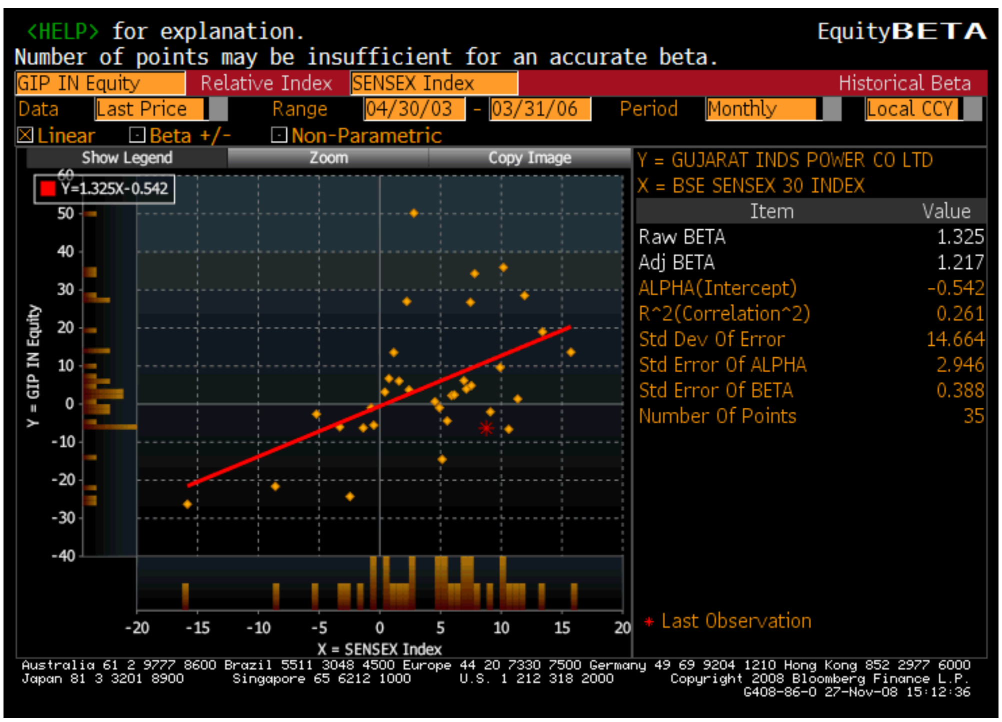
Ans. No, there is no problem related to the dust from the project activity.

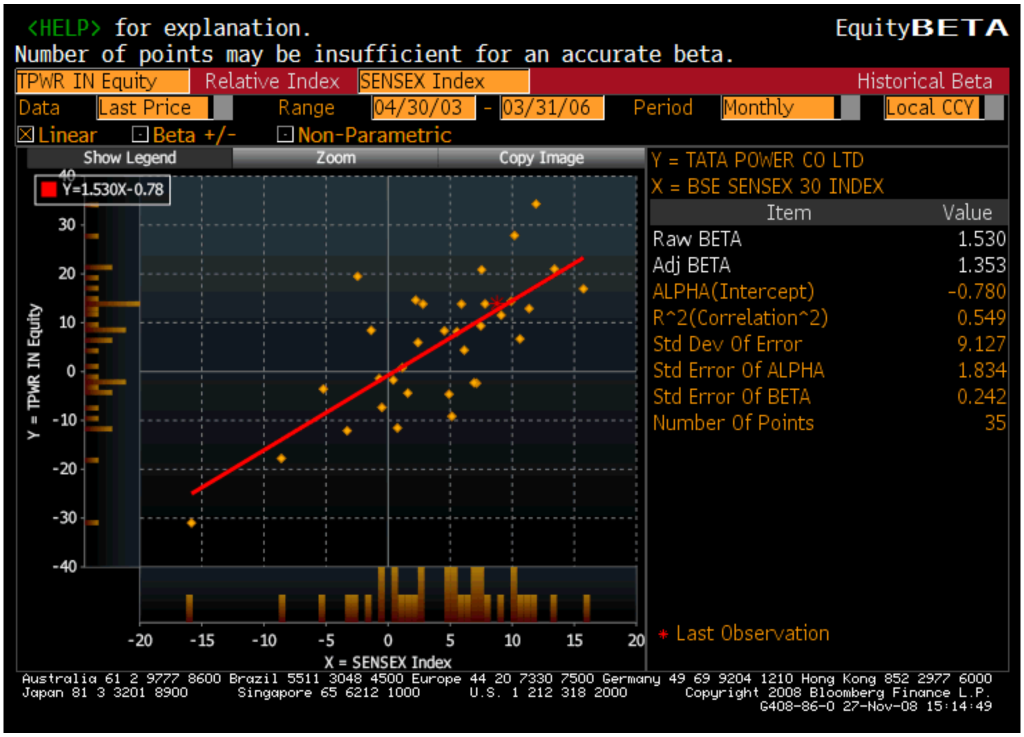
Ending Note:

The meeting ended on a positive note with Mr. Mahesh Bag thanking all the participants who devoted their time and effort to make this meeting possible. The villagers expressed their satisfaction and gratitude for making them a part of the project.

Appendix 3: Bloomberg's Screenshots of Individual Companies for Beta Value






<HELP> for explanation.
EquityBETA
Number of points may be insufficient for an accurate beta.
TPWR IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
04/30/03 - 03/31/06
Period
Monthly
Local CCY
Linear
Beta +/-
Non-Parametric
Show Legend
Zoom
Copy Image
Y=1.530X-0.78
Y = TPWR IN Equity
X = SENSEX Index
Y = TATA POWER CO LTD
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 1.530
Adj BETA 1.353
ALPHA(Intercept) -0.780
R^2(Correlation^2) 0.549
Std Dev Of Error 9.127
Std Error Of ALPHA 1.834
Std Error Of BETA 0.242
Number Of Points 35
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2008 Bloomberg Finance L.P.
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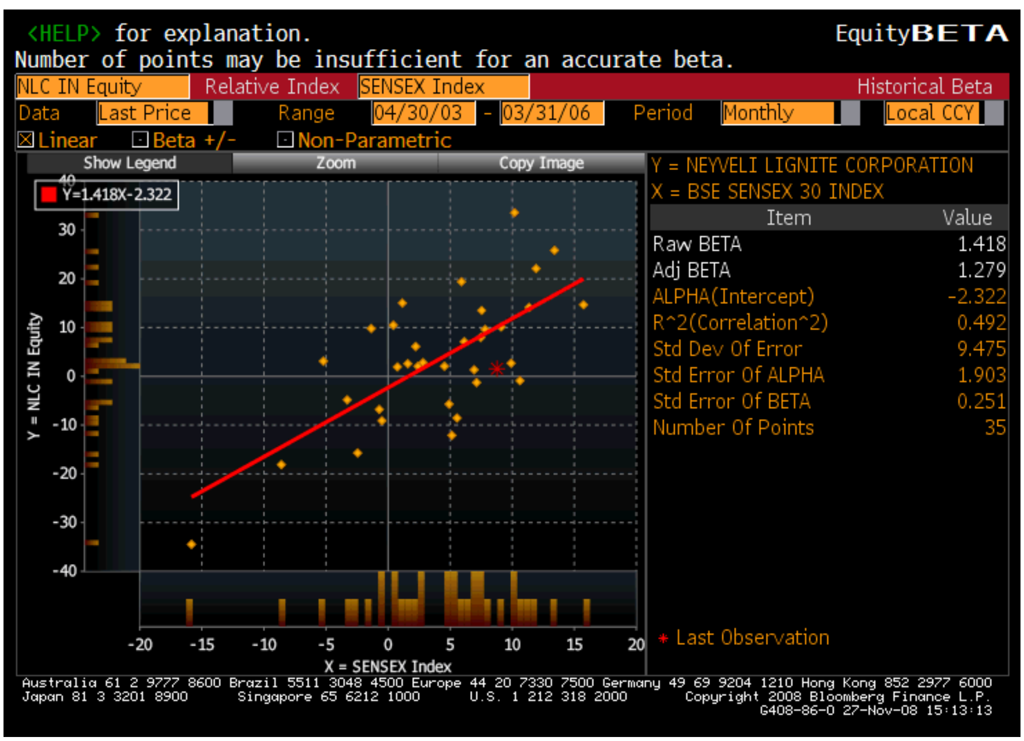
<HELP> for explanation.
EquityBETA
Number of points may be insufficient for an accurate beta.
NLC IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
04/30/03 - 03/31/06
Period
Monthly
Local CCY
Linear
Beta +/-
Non-Parametric
Show Legend
Zoom
Copy Image
Y=1.418X-2.322
Y = NLC IN Equity
X = SENSEX Index
Y = NEYVELI LIGNITE CORPORATION
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 1.418
Adj BETA 1.279
ALPHA(Intercept) -2.322
R^2(Correlation^2) 0.492
Std Dev Of Error 9.475
Std Error Of ALPHA 1.903
Std Error Of BETA 0.251
Number Of Points 35
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2008 Bloomberg Finance L.P.
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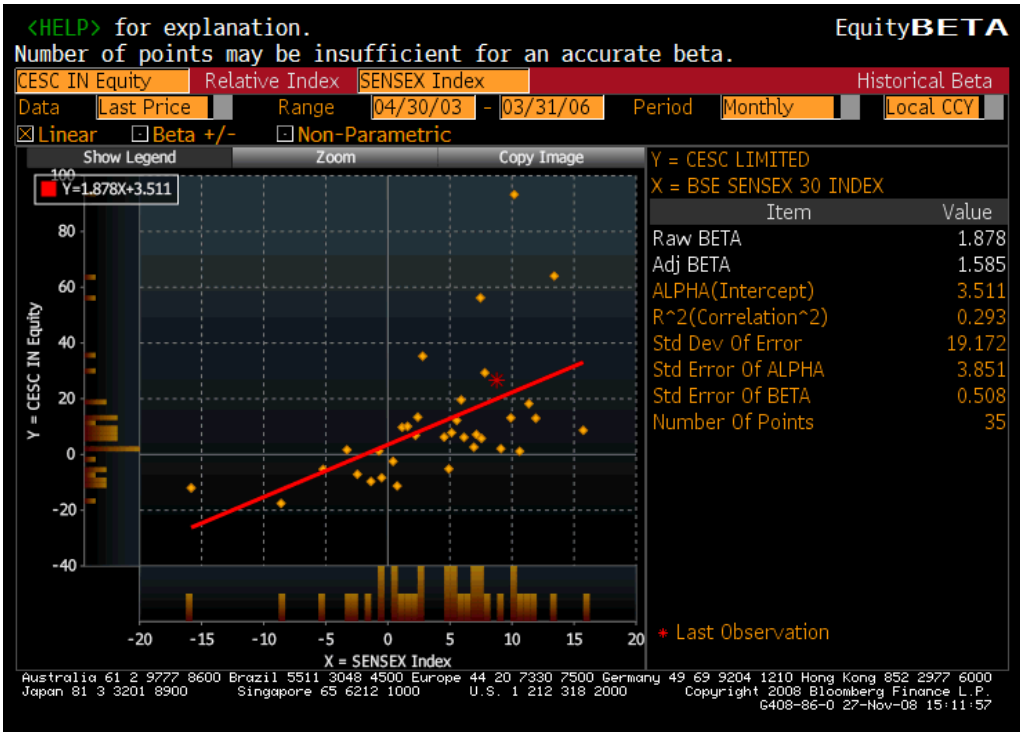
<HELP> for explanation.
EquityBETA
Number of points may be insufficient for an accurate beta.
CESC IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
04/30/03 - 03/31/06
Period
Monthly
Local CCY
Linear
Beta +/-
Non-Parametric
Show Legend
Zoom
Copy Image
Y=1.878X+3.511
Y = CESC IN Equity
X = SENSEX Index
Y = CESC LIMITED
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 1.878
Adj BETA 1.585
ALPHA(Intercept) 3.511
R^2(Correlation^2) 0.293
Std Dev Of Error 19.172
Std Error Of ALPHA 3.851
Std Error Of BETA 0.508
Number Of Points 35
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2008 Bloomberg Finance L.P.
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Appendix 4: Page 185 of text book on "Corporate Finance Theory and Practice"

PART TWO

Investment Analysis

First Principles of Corporate Finance

Invest in projects that *yield a return greater* than the ***minimum accepable hurdle rate.***
- The hurdle rate should be ***higher for riskier projects*** and should reflect the ***financing mix*** used — either owners' funds (equity) or borrowed money (debt).
- Returns on projects should be measured on the basis of *cash flows* generated and the *timing* of these cash flows; they should also take into account both *positive and negative side effects* of these projects.

↓

Choose a *financing mix* that *maximizes the value of the firm* and *matches the assets* being financed.

↓

If there are not enough investments that earn the hurdle rate, *return the cash* to the owners of the firm. The *form of returns* — dividends and stock buybacks — will depend on the *stockholders' characteristics*.

↓

Objective: Maximize the Value of the Firm.

185

Appendix 5: Page 186-187 of text book on "Corporate Finance Theory and Practice"

CHAPTER 7

Estimating Hurdle Rates for Firms

WHEN ANALYZING firms, we would like to know the cost of raising funds from equity investors (cost of equity), the interest rates they have to pay when they borrow (cost of debt), and their overall cost of financing their operations (cost of capital). Why? Knowing that Boeing's cost of equity is 10.38% and that its cost of capital is 9.17% is a necessary input to value the equity in the firm or the firm itself. In addition, Boeing cannot assess the quality of its existing investments or how much to pay in dividends without knowing how much it costs it to raise funds.

How do we estimate the cost of raising funds from equity investors? In the last chapter, we laid the groundwork for this process. We argued that only that portion of a firm's risk that cannot be diversified away should be considered to be the equity risk in the firm, and that the expected return on an equity investment should reflect this risk. The risk and return models developed in the last chapter provide ways of measuring this risk, and we use these risk measures to come up with expected returns. Although they might vary in the details, these models all require three inputs — a riskless rate, a beta or betas, and a risk premium or premiums. In this chapter, we consider the best ways to estimate these inputs and use them to estimate the expected return on an equity investment. Since investors in equity in a firm require this return to compensate for equity risk, the expected return is also the cost of equity to the firm.

To estimate the cost of debt, we draw on our description of default risk from the last chapter. We consider approaches that can be used to assess the default risk in a firm and how these measures of default risk can be used to compute a cost of debt for the firm.

Because firms use both debt and equity to finance their investments, we examine how much of each the firm uses, yielding an overall cost of financing, that is a weighted average of the costs of equity and debt. This overall cost of financing is the cost of capital to the firm.

The Cost of Equity and Capital

Firms raise money from both equity investors and lenders to fund investments. Both groups of investors make their investments expecting to make a return. In the last chapter, we stated that the expected return for equity investors would include a premium for the equity risk in the investment. We label this expected return the **cost of equity.** Similarly, the expected return that lenders hope to make on their

investments includes a premium for default risk, and we call that expected return the **cost of debt.** If we consider all of the financing that the firm takes on, the composite cost of financing will be a weighted average of the costs of equity and debt, and this weighted cost is the **cost of capital.**

In this chapter, we use the models that we introduced in the last chapter to estimate the costs of equity and capital for firms. In particular, we look at Boeing, The Home Depot, and InfoSoft and evaluate what it costs them to raise equity, debt, and capital. We begin by estimating the equity risk in each of these firms and using the equity risk to estimate the cost of equity, and we follow up by measuring the default risk to estimate a cost of debt. We conclude the chapter by determining the weights we should attach to each of these costs to arrive at a cost of capital.

Why Do We Need Hurdle Rates for Firms?

Why do firms need to know their costs of equity and capital? One of the fundamental decisions that every business needs to make is to assess where to invest its funds and to reevaluate, at regular intervals, the quality of its existing investments. The investment principle, stated in Chapter 1, specifies that firms should invest in assets only if they expect them to earn more than their hurdle rates. The costs of equity and capital for a firm represent what the firm needs to make *collectively on all its investments* in order for them to be good investments. For instance, if The Home Depot's cost of capital is 9.51%, it has to make at least 9.51% on the capital it has invested in all its existing investments. Alternatively, considering the equity investors' perspective alone, The Home Depot with a cost of equity of 9.78% has to earn at least 9.78% on the equity it has invested in all its existing investments for these to be considered good investments. It is worth emphasizing, however, that this does not imply that every project The Home Depot takes will be measured against these criteria, since projects within a firm can have varying degrees of risk. We consider project-specific costs of equity and capital in the next chapter.

Knowing a firm's cost of equity and capital also allows us to compare different ways of financing its operations. We can change the mix of debt and equity at Boeing, for instance, and examine the effects, if any, on the cost of capital for the firm. Increasing the proportion of debt at the firm may allow us to lower the cost of capital from its existing level of 9.17%, letting the firm accept more investments.

In Chapter 5, we noted that the value of a business is computed by discounting the expected cash flows from the business at the cost of capital. We also measured the value of equity by discounting the expected cash flows to equity investors at the cost of equity. Given that our objective in making decisions is to maximize the value of the business, and by extension, the value of the stock (equity), the costs of equity and capital become fundamental inputs into the decision process.

CT 7.1: As long as firms are growing rapidly, they do not need to know their costs of equity or capital. Is this statement true? Why or why not?

Cost of Equity

The cost of equity is the rate of return investors require on an equity investment in a firm. The risk and return models described in the previous chapter need a riskless rate

Appendix 6: Page 190 of text book on "Corporate Finance Theory and Practice"

- If no such securities exist in the market in which you are attempting to estimate a real riskless rate, it can be approximated by the long-term real growth rate of the economy. Thus, the real riskless rate in China may be set equal to 6% because that is what you expect the long-term real growth rate in the Chinese economy to be. It will be much lower (2–3%) for more mature, slower growth economies.

Risk Premium

The risk premium is a significant input in all the asset pricing models. In the following section, we begin by examining the fundamental determinants of risk premiums and then look at practical approaches to estimating these premiums.

What Is the Risk Premium Supposed to Measure? The risk premium measures the "extra return" that would be demanded by investors for shifting their money from a riskless investment to an average risk investment. It should be a function of how risk-averse investors are and how risky they perceive stocks (and other risky investments) to be, relative to a riskless investment. Because each investor in a market is likely to have a different assessment of an acceptable premium, the premium will be a weighted average of these individual premiums, where the weights will be based on the wealth the investor brings to the market. Investors with more wealth, like Warren Buffett, will therefore have their risk premiums weighted more than investors with less wealth.

✔ ***CQ 7.1:* Assume that stocks are the only risky assets and that you are offered two investment options. One is a riskless investment on which you can make 6.7%, and the other is a stock mutual fund. How much more than 6.7% would you need to be offered, on an expected basis, to pick the latter? Would you ever settle for less than 6.7%?**

Estimating Risk Premiums We look now at two ways to estimate the risk premium in the capital asset pricing model. One is to look at the past and estimate the premium earned by risky investments (stocks) over riskless investments (government bonds); this is called the **historical premium.** The other is to use the premium extracted by looking at how markets price risky assets today; this is called an **implied premium.**

Historical Risk Premiums. The most common approach to estimating the risk premium is to base it on historical data. In the arbitrage pricing model and multifactor models, the raw data on which the premiums are based are historical data on asset prices over very long time periods. In the CAPM, the premium is estimated by looking at the difference between average returns on stocks and average returns on riskless securities over an extended period of history.

In most cases, we follow these steps to find historical risk premiums. First, we define a time period for the estimation, which can range as far back as 1926 for U.S. data.[4] Then, we calculate the average returns on stocks and average returns on a riskless security over the period. Finally, we calculate the difference between the returns

[4] The most widely used database, from Ibbotson Associates, has returns going back to 1926. Jeremy Siegel at Wharton recently presented data going back to the early 1800s.

Appendix 7: Page 191 of text book on "Corporate Finance Theory and Practice"

on stocks and the riskless return and use it as a risk premium to predict future returns. When we use historical premiums, we implicitly assume that the risk aversion of investors has not changed across time and that the relative riskiness of the risky portfolio (stocks) has not changed over time either.

In calculating the average returns over past periods, a measurement question arises: Should we use arithmetic or geometric averages to compute the risk premium? The arithmetic mean is the average of the annual returns for the period under consideration, whereas the geometric mean is the compounded annual return over the same period. The following example demonstrates the difference.

Year	*Price*	*Return*
0	\$50	
1	100	100%
2	60	–40%

The arithmetic average return over the two years is 30%, while the geometric average is only 9.54% ($1.2^{0.5} - 1 = 1.0954$). Those who use the arithmetic average premium argue that it is much more consistent with the framework[5] of the CAPM and a better predictor of the risk premium in the next period. The geometric mean is justified on the grounds that it takes into account compounding and that it is a better predictor of the average premium in the long term. There can be substantial differences in risk premiums based on the choices made at this stage, as illustrated in Table 7.1. The data in the table are based on historical data on stock, treasury bill, and treasury bond returns and provide estimates of historical risk premiums. As you can see, the historical premiums can vary widely depending on whether we go back to 1926, 1962, or 1981, whether we use T. Bills or T. Bonds as the riskless rate, and whether we use arithmetic or geometric average premiums.[6] Although it is impossible to prove one premium right and the others wrong, we are biased toward

- *Longer term premiums,* since stock returns are volatile and shorter time periods can provide premiums with large standard errors. For instance, the premium extracted from 25 years of data will have a standard error[7] of about 4 to 5%.
- *Long-term bond rates as riskless rates,* since our time horizons in corporate financial analysis tend to be long term, and we use the treasury bond rate as our riskless rate.
- *Geometric average premiums,* since arithmetic average premiums overstate the expected returns over long periods.[8] The geometric mean yields lower premium

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[5] The CAPM is built on the premise of expected returns being averages and risk being measured with variance. Since the variance is estimated around the arithmetic average, and not the geometric average, it may seem logical to stay with arithmetic averages to estimate risk premiums.

[6] Booth (1999) examines both nominal and real equity risk premiums from 1871 to 1997. Although the nominal equity returns have changed over time, he concludes that the real equity return has been about 9% over this period. He suggests adding the expected inflation rate to this number to estimate the expected return on equity.

[7] Assuming that returns in individual years are independent, the standard error of a 25-year estimate can be calculated by dividing the annual standard deviation in stock prices in the United States (about 25%) by the square root of the number of years ($\sqrt{25} = 5$), yielding a standard error of 5% (25%/5) in the estimate.

[8] When we look at markets like the United States that have survived for 70 years without significant breaks, we are looking at the exception. To provide a contrast, consider the other stock markets in which one could have invested in 1926; many of these markets did not survive, and an investor would have lost much of his or her wealth.

Appendix 8: Page 196 of text book on "Corporate Finance Theory and Practice"

Betas

The second set of inputs that we need to put risk and return models into practice are the betas for investments. In the CAPM, the beta of an investment is the risk that the investment adds to a market portfolio. In the APM and multifactor model, the betas of the investment relative to each factor have to be measured. Three approaches are available for estimating these parameters. One is to use historical data on market prices for individual investments; the second is to estimate the betas from the fundamental characteristics of the investment; and the third is to use accounting data. We describe all three approaches in this section.

Historical Market Betas The conventional approach to estimating the beta of an investment is a regression of returns on the investment against returns on a market index. For firms that have been publicly traded for a length of time, it is relatively straightforward to estimate returns that an investor would have made by investing in the firm's stock each interval (such as a week or a month) over that period. In theory, these stock returns on the assets should be related to returns on a market portfolio, that is, a portfolio that includes all traded assets, to estimate the betas of the assets. In practice, we tend to use a stock index, such as the S&P 500, as a proxy for the market portfolio, and we estimate betas for stocks against the index.

The standard procedure for estimating betas is to regress stock returns (R_j) against market returns (R_m).

$$R_j = a + bR_m$$

where

a = Intercept from the regression

$$b = \text{Slope of the regression} = \frac{\text{Covariance } (R_j, R_m)}{\sigma^2_m}$$

The *slope* of the regression corresponds to the beta of the stock and measures the riskiness of the stock.

The *intercept* of the regression provides a simple measure of performance of the investment during the period of the regression, when returns are measured against the expected returns from the capital asset pricing model. To see why, consider the following rearrangement of the capital asset pricing model:

$$R_j = R_f + \beta\,(R_m - R_f)$$
$$= R_f(1 - \beta) + \beta\,R_m$$

Compare this formulation of the return on an investment to the return equation from the regression:

$$R_j = a + bR_m$$

Thus, a comparison of the intercept (a) to $R_f(1 - \beta)$ should provide a measure of the stock's performance, at least relative to the capital asset pricing model.[14] In summary, then:

[14] The regression is sometimes calculated using returns in excess of the riskless rate, for both the stock and the market. In that case, the intercept of the regression should be zero if the actual returns equal the expected returns from the CAPM, greater than zero if the stock does better than expected, and less than zero if it does worse than expected.