



Voluntary Carbon Standard 2007.1
Project Description Template

[Date of the VCS PD: 03-November-2009, Version -02]

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1 Description of Project:

1.1 Project title

15 MW bundled grid connected renewable energy project in Maharashtra, India.

1.2 Type/Category of the project

The project generates 15 MW of electricity from wind power and supplies the generated electricity to Maharashtra state electricity grid which is part of the Northern, Eastern, Western and North Eastern (NEWNE) regional electricity grid of India. The project is part of the UNFCCC Clean Development Mechanism program, which is a GHG program that has been approved by the VCS Board. Accordingly, under the VCS program, as per the modalities and procedures for small-scale CDM project activities, the type and category of the project is as under

Sectoral Scope: 1, Energy industries (renewable/ non renewable sources)

Project Type: Renewable energy projects

Project Category: D, Grid connected renewable electricity generation (version 14)

The project comprises of 12 Wind Electric Generators (WEGs), each with a generation capacity of 1.25 MW. The project is a bundled project with four investors, details of investor wise WEGs have been provided in section 1.4 of the PD.

Since the annual range of emission reductions falls between 5,000 – 1,000,000 tCO₂e, this project falls in the group “Projects” as per VCS guidelines.

1.3 Estimated amount of emission reductions over the crediting period including project size:

The crediting period for the project shall be the from 01-April-2006 to 31-March-2016¹ which can be renewed. The total emission reductions from the project over the first 10 years are expected to be 222,034 tCO₂e. Since the annual range of emission reductions falls between 5,000 – 1,000,000 tCO₂e, this project falls in the group “Projects”. The expected vintage-wise emission reductions from the project are presented in the table below:

Period	VERs(tonnes of CO ₂ e)
1st April 2006 to 31st March 2007	19,364
1st April 2007 to 31st March 2008	17,667
1st April 2008 to 31st March 2009	16,934
1st April 2009 to 31st March 2010	25,185
1st April 2010 to 31st March 2011	23,814
1st April 2011 to 31st March 2012	23,814
1st April 2012 to 31st March 2013	23,814
1st April 2013 to 31st March 2014	23,814
1st April 2014 to 31st March 2015	23,814
1st April 2015 to 31st March 2016	23,814

¹ In case of registration of project with UNFCCC before 31st Marchy 2016, a day before the CDM registration date shall be the last date of the VCS crediting period, else the VCS crediting period will be as mentioned in section 1.3.

Period	VERs(tonnes of CO ₂ e)
Total	222,034

1.4 A brief description of the project:

The project involves implementation of WEGs as a voluntary measure to strengthen the regional grid of India through environmentally benign energy generation source available to India. The project is implemented in four villages namely, Tisangi, Ghtnandre, Jarandi and Titane in Sangli and Dhule districts of Maharashtra. The generated electricity shall be exported to the regional grid through the locally available evacuation facility provided by the state utility (MSEDCL – Maharashtra State Electricity Distribution Company Limited).

This project generates electricity using wind energy, which does not result in any greenhouse gas (GHG) emissions. Thus, this project will lead to a reduction in GHG emissions that would otherwise have occurred when using electricity generated from conventional fossil fuel based sources in the NEWNE regional grid.

The project has been undertaken to produce 15 MW power through the installation of WEGs. The project has been developed by C. Mahendra Exports Limited (hereinafter referred to as 'C. Mahendra'). The project is a bundled project involving 4 investors, detail of which is given in the table below. However, C. Mahendra is responsible for the VCS development of the project.

Table 1: List of Investors in the bundled project

S.No.	WEG Number	Installed Capacity (MW)	Name of Investor	Date of Commissioning
1	G – 320	1.25	C. Mahendra Exports Ltd.	31-Mar-2006
2	G – 52	1.25	C. Mahendra Exports Ltd.	25-Mar-2006
3	G – 53	1.25	C. Mahendra Exports Ltd.	25-Mar-2006
4	G – 54	1.25	C. Mahendra Exports Ltd.	25-Mar-2006
5	G – 55	1.25	C. Mahendra Exports Ltd.	20-Feb-2006
6	G – 56	1.25	C. Mahendra Exports Ltd.	20-Feb-2006
7	G – 57	1.25	C. Mahendra Exports Ltd.	25-Mar-2006
8	G – 38	1.25	C. Mahendra Exports Ltd.	14-Feb-2006
9	G – 311	1.25	Ratnakala Exports	20-Feb-2006
10	G – 319	1.25	Ratnakala Exports	31-Mar-2006
11	K – 139	1.25	Ambika Diamonds	11-Jul-2005
12	K – 123	1.25	Rindiam Export	01-Sep-2005

The Engineering, Procurement and Construction (EPC) contractor for the project is Suzlon Energy Limited (hereinafter referred to as 'Suzlon'). The project scenario therefore

- Provides additional generation from a clean source of energy;
- Strengthens the regional grid (NEWNE grid of India); and
- Increases availability of electricity to the rural feeder lines / facilities.

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

The project spreads across two districts in Maharashtra, both of which are well connected by railways and national highways. The villages are well interconnected by metalled and un-metalled roads. The WEGs can be well identified with the respective WEG numbers. The nearest international airport is Mumbai. Dhule also has a distinction of having railway terminus, which is connected to nearest railway junction at Chalisgaon. The location detail of the WEGs is given in the table below.

District: Dhule (Latitude: 20° 58' N, Longitude: 74° 47' E)

District: Sangli (Latitude: 16° 52' N, Longitude: 74° 36' E)

Table 2: Location details of the WEGs

S.No.	WEG Number	Date of Commissioning	Village	Taluka	Land Survey Number	Latitude	Longitude
1	G – 320	31-Mar-2006	Tisangi	Kawathe Mahakal	474	N 17 09 23.7	E 74 50 51.8
2	G – 52	25-Mar-2006	Ghatnandre	Kawathe Mahakal	388	N 17 11 40.6	E 74 51 11.5
3	G – 53	25-Mar-2006	Ghatnandre	Kawathe Mahakal	435	N 17 11 58.2	E 74 51 24.3
4	G – 54	25-Mar-2006	Ghatnandre	Kawathe Mahakal	453	N 17 12 23.5	E 74 51 44.7
5	G – 55	20-Feb-2006	Ghatnandre	Kawathe Mahakal	479	N 17 12 20.0	E 74 52 12.0
6	G – 56	20-Feb-2006	Ghatnandre	Kawathe Mahakal	478	N 17 12 33.2	E 74 52 07.5
7	G – 57	25-Mar-2006	Ghatnandre	Kawathe Mahakal	456	N 17 12 36.0	E 74 51 49.3
8	G – 38	14-Feb-2006	Ghatnandre	Kawathe Mahakal	851	N 17 11 31.7	E 74 53 16.3
9	G – 311	20-Feb-2006	Jarandi	Tasgaon	843	N 17 09 52.2	E 74 50 05.4
10	G – 319	31-Mar-2006	Tisangi	Kawathe Mahakal	491	N 17 09 50.5	E 74 50 33.9
11	K – 139	11-Jul-2005	Titane	Sakri	198	N 21 12 05.1	E 74 18 29.9
12	K – 123	01-Sep-2005	Titane	Sakri	142	N 21 11 32.7	E 74 17 39.2

Also, the location map of the districts where the project is located has been provided in Annexure – 1.

1.6 Duration of the project activity/crediting period:

Project start date: The start date of the project is 11-July-2005, being the date of commissioning of first WEG in complete project. The lifetime of the WEGs is 20 years.

Crediting Period: The crediting period for the project shall be the period from 01-April-2006 to 31-March-2016, which can be renewed. .

1.7 Conditions prior to project initiation:

The project activity is located in the NEWNE grid which is dominated by fossil fuel fired thermal power stations. The grid has power deficit and hence the addition of new generating source would have taken place by a fossil fuel based power plant. This project displaces this new capacity add-on by a renewable wind energy generation will help in the sustaining and catering to the power demand

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

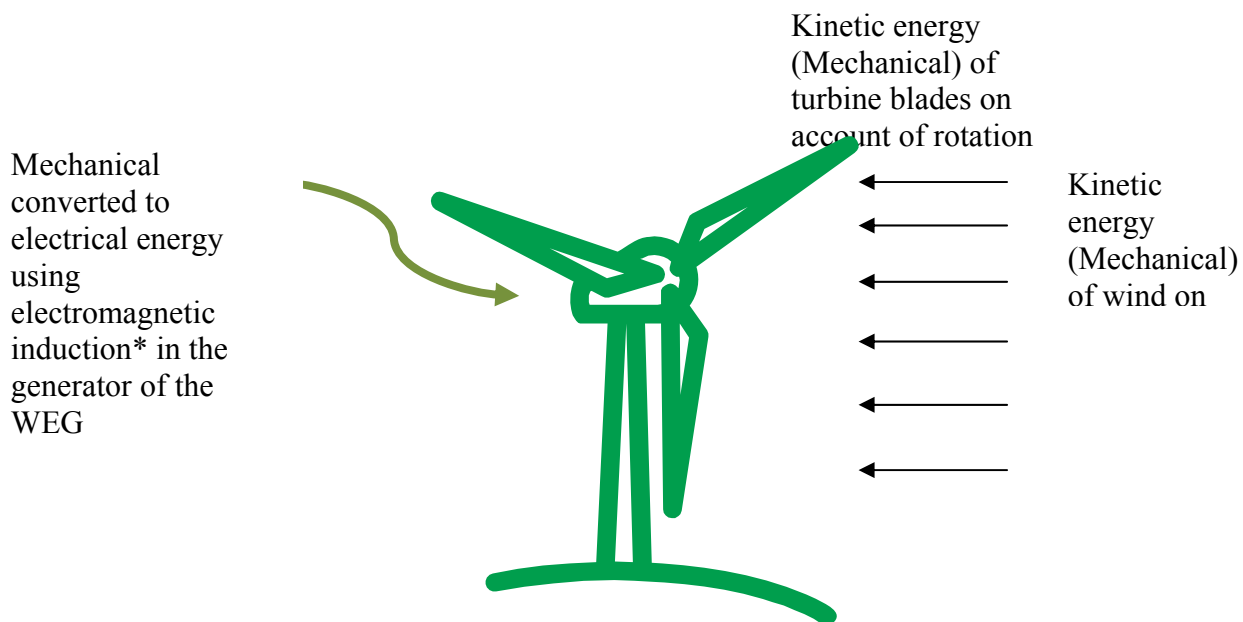
The project harnesses wind energy to generate and supply electricity to the regional electricity grid (NEWNE) of India. The project displaces conventional / fossil fuel based electricity generation that would have otherwise been produced by the operation and expansion of the fossil fuel based power plants in NEWNE electricity grid, thereby leading to reduction in emission of GHG associated with fossil fuel based electricity generation.

1.9 Project technologies, products, services and the expected level of activity:

The project involves installation of a total of 12 no. of WEGs, each with a generation capacity of 1.25 MW. The WEGs are of Suzlon make and of type S-70 and the total generation is expected to be 26280 MWh per annum (the detailed calculations have been provided in section 4.2).

Wind has considerable kinetic energy by virtue of its motion at high speeds. When wind passes over the blades of the wind turbine, the kinetic energy is converted into mechanical energy through the rotation of the turbine blades. The generator converts this mechanical energy of rotation into electricity. This technology is a clean technology since there are no GHG emissions associated with the electricity generation. The energy conversion diagram is presented in the figure below:

Figure 1: Energy Conversion Diagram



1.10 Compliance with relevant local laws and regulations related to the project:

Renewable energy projects are not mandated in India by any enforced law or other regulatory framework. However, for guidance on voluntary wind energy based electricity generation, there are policies introduced/incentives declared by the state governments. These policies have been considered for the project and are available at <http://www.windpowerindia.com/govtinc.html>.

For the implementation of the project, the project proponent has obtained land lease deeds/sale deeds and has secured nodal agency clearance for commissioning of the WEGs in the state of Maharashtra. The project proponent has entered into the power purchase agreement with the distribution utility for sale of power. All the clearances, approvals and licenses obtained for the project activity has been provided to the DOE for verification.

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements

The risks that may affect the project's GHG emission reductions are given below:

- A. Wind electricity generation is risky and unpredictable due to the variability involved in wind resources as well as its forecasting. This variability is due to the variability in the wind speed and wind pattern, which in turn depends on weather cycle, climatic conditions, etc.
- B. The project is dependent on the utility provider for grid availability. If there is a grid failure, the project will be unable to supply the generated electricity to the grid.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The project is primarily a renewable power generation facility which does not produce any GHG emissions. The project has not been implemented to create GHG emissions for the purpose of the subsequent removal or destruction of GHG emissions.

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

The project has not created another form of environmental credit in the given crediting period (from 1-April-2006 to 31-March-2016). An undertaking to this effect dated 20th October 2009 has been submitted to the DOE.

1.14 Project rejected under other GHG programs (if applicable):

Project is not rejected under any other GHG program.

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants

C. Mahendra is the project proponent for this activity and has been duly authorized by the individual investors to take up the said project activity for VCS development. C. Mahendra will be responsible for all the communications and actions in relation to the project being validated in accordance with the VCS standard.

The contact information of the project proponent is provided below:

Organization:	C. Mahendra Exports Limited
Street/P.O.Box:	1204 Panchratna
Building:	12 th Floor, Opera House
City:	Mumbai
State/Region:	Maharashtra
Postfix/ZIP:	400 004
Country:	India
Telephone:	+91 22-2382 6998
FAX:	+91 22-2380 2847
E-Mail:	infonagindas@cmahendra.com
URL:	www.cmahendra.com
Represented by:	Mr. Mahendra C. Shah
Title:	
Salutation:	Mr.
Last Name:	Shah
Middle Name:	C
First Name:	Mahendra
Department:	
Mobile:	
Direct FAX:	
Direct tel:	+91 0261-307 2444
Personal E-Mail:	mahendra@cmahendra.com

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.

The project is eligible according to:

- Legislative: the project attends all legal requirements;
- Technical: alterations/maintenance required are technically feasible;
- Economic: reduces supply-demand gap of southern grid upto some extent;
- Sectoral: incentive of good practices to the sector;
- Social: the project has opened up employment opportunities for the local people not only during the erection and commissioning of the WEGs but also for the operation and maintenance of the WEGs which has definitely improved the standard of living of the local people;
- Environmental: the project attends all legal requirements and no environmental impacts are predicted;
- Geographic/site specific: WEGs can be uniquely geographically identified with no barriers regarding logistic;
- Temporal information: the project will not double count the GHG emissions during the ten years renewable crediting period.

1.17 List of commercially sensitive information (if applicable):

There is no commercially sensitive information in the Project Description, such as trade secrets, financial, commercial, scientific, technical or other information whose disclosure

could reasonably be expected to result in a material financial loss or gain, prejudice the outcome of contractual or other negotiations or otherwise damage or enrich the person or entity to which the information relates.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

Sectoral Scope : 1, Energy industries (renewable/ non-renewable sources)

Project Category : AMS-I.D., Version 14 “Grid connected renewable electricity generation”.

The tools referenced in this methodology are:

- Tool to calculate the emission factor for an electricity system, version 01.1 (<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v1.1.pdf>)

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

The approved baseline and monitoring methodology AMS I.D., Version 14 is the choice of the baseline and monitoring methodology and it is applicable because:

S. No.	Applicability Criteria	Project Case
1	This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	The project comprises power generation using wind power based renewable energy.
2	If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM/VCS project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.	There is neither non-renewable component added, nor co-firing is required for the proposed project. The renewable project capacity is not exceeding the limit of 15 MW.
3	Combined heat and power (co-generation) systems are not eligible under this category.	Not applicable, as the project does not involve co-generation system.
4	Project activities that involve the addition of renewable energy units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not applicable, all the windmills are new and this project is not capacity enhancement or up gradation project.

S. No.	Applicability Criteria	Project Case
5	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	Not applicable, this project is not a retrofit or modification of existing facility.

The details above justify the applicability of AMS I.D. for this project.

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

	Source	Gas	Included?	Justification/Explanation
Baseline	Grid-connected electricity generation	CO ₂	Yes	The fossil fuel based power plants that is displaced due to the project activity (baseline scenario) emits CO ₂ .
		CH ₄	No	Negligible quantity of methane is expected to be emitted.
		N ₂ O	No	Negligible quantity of nitrous oxide is expected to be emitted.
Project Activity	Greenfield wind energy conversion system	CO ₂	No	The project does not emit any emissions.
		CH ₄	No	No methane generation is expected to be emitted.
		N ₂ O	No	No nitrous oxide generation is expected to be emitted.

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

The baseline for the candidate VCS project has been developed in line with the approved methodology AMS I.D. (Version 14) wherein it has been stated that the baseline scenario in case of installation of a new grid-connected renewable power plant/unit is:

“the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor.

$$BE_y = EG_{BL,y} * EF_{CO_2}$$

Where:

BE_y : Baseline emissions in year y; tCO₂

$EG_{BL,y}$: Energy baseline in year y; kWh

EF_{CO_2} : CO₂ Emission Factor in year y; tCO₂e/kWh

The Emission Factor can be calculated in a transparent and conservative manner as follows:

- a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the ‘Tool to calculate the emission factor for an electricity system’.

OR

- b) The weighted average emissions (in kg CO₂e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available) and made publicly available”.

The Combined Margin (CM) approach has been employed for calculation of the Emission Factor. The calculations will be based on data available from the Central Electric Authority and publicly available on their website <http://cea.nic.in>

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality):

As per VCS guidelines, for proving additionality, if a project uses the CDM methodology, the additionality requirement should be those set out in the methodology. Thus, as per AMS I.D. (version 14), the project participant uses the “*Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities*” to prove additionality.

“*Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities*” states that the project participant shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers: Investment Barrier, Technological Barrier, Barrier due to prevailing practice and Other barriers.

The project participant uses the investment barrier to prove additionality.

The investment barrier has been substantiated below using the Investment Analysis as per the “Guidance on Assessment of Investment Analysis, EB 41 Annex 45” in accordance with Para 1(a) of “Non-binding best practice examples to demonstrate additionality for SSC project activities” EB 35, Annex 34. The financial indicator identified for carrying out the investment analysis is the IRR

As per Guidance on assessment of investment analysis issued in EB 41 (paragraph 11) the Weighted Average Cost of Capital (WACC) can be considered as appropriate benchmark for project IRR. It is also worthwhile to note that the captioned project is a greenfield wind power generation project that generates and supplies electricity to the state grid, therefore the project has more than one possible project developer. The guidance under Para 13 of “*Guidance on assessment of investment analysis issued in EB 41*” also states that in cases where the project has more than one potential developer, the benchmark can not be based on internal cost of equity or WACC and shall be based on publicly available data sources which can be clearly validated by the DOE. According to the EB’s guidance under the additionality tool, we have not used company or project specific parameters for the calculation of the benchmark (such as company WACC, project and company specific interest rates, etc.). Accordingly, the weighted average cost of capital has been calculated based on parameters that are standard in

the market, considering the specific characteristics of the project type. The WACC has been derived based on the cost of capital of all listed power generating companies.

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

$$\text{WACC} = [D / (D+E)] * [\text{Cost of Debt}] + [E / (D+E)] * [\text{Cost of Equity}]$$

where:

D: Percentage of Debt used in the Project

E: Percentage of Equity used in the Project

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 10.25 – 10.75 % [Source: Reserve Bank of India, <http://www.rbi.org.in/scripts/WSSViewDetail.aspx?TYPE=Section&PARAM1=4>] average PLR of 10.5 % 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 loan tenure of the typical power project is 10 years, it may be noted that for the first 10 years, all power projects in India are required to pay tax @ 7.87% (as per section 80 IA of Income Tax Act). Accordingly the marginal tax rate has been considered as 7.87%.

The post tax cost of debt therefore works out to

$$\text{Cost of Debt} = \text{Average PLR} \times (1 - \text{Marginal taxrate})$$

Cost of Equity:

The cost of equity has been determined using the Capital Asset Pricing Model (CAPM) considering Beta values of all power generating companies in India that were listed at the time of this investment. Detailed calculations of cost of equity and calculation of

has been provided in Annexure-3.

As can be seen, the WACC works for different start dates works out to be:

Dates	WACC
March 2005 (Earliest Investment decision date)	13.46%
May 2005 (PO date for Rindiam Exports and Ambika Diamonds)	13.25%
July 2005 (PO date for Ratnakala Exports)	13.24%
August 2005 (PO date for C. Mahendra Exporst)	13.20%

To be on the conservative side, the project WACC has been taken as the minimum of all these WACCs.

The benchmark WACC for the project is 13.20%

A financial analysis for calculating the post-tax project IRR has been carried out based upon the values available at the time of investment decision and the highest project IRR in the bundled project without consideration of VCS benefits is determined to be 9.10%. Key assumptions, made for the project, are set out below:

Operations	
Capacity Utilization Factor ²	20.0%
Capital Cost	As per the Budgetary offers (Copy of the budgetary offer is being provided to the DOE)
Operation & Maintenance Cost base year	Budgetary Offer
% of escalation per annum on O & M Charges	Budgetary Offer

Tariff	
Base year Tariff (Rs./kWh)	3.5
Annual Escalation (Rs./kWh per Year)	0.15
Tariff applicable after 13 years (Rs/kWh)	3.5

Income Tax Depreciation Rate (Written Down Value basis) on Wind Energy Generators	80%
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Income Tax	
Income Tax rate	33.66%
Minimum Alternate Tax	7.87%

Working capital	
Receivables (no of days)	45
O & M expenses (no of days)	30
Working capital interest rate	0%

The project IRR for the project without VER revenues for all the investors included in the bundle is less than the benchmark IRR of 13.20% in all cases. Refer table below for results:

Table 3: Post tax project IRR for all the investors

Name of Investor	Project IRR at base PLF
C. Mahendra Exports Limited	9.09%

² The electricity generation of the project has been considered on the basis of actual performance of 444 wind turbines, belonging to 95 different wind turbine developers, over a period of four years from 1999-00 to 2002-03. The average PLF of these wind turbines over a four year period works out to 20% and the same has been considered by MERC for setting the tariff of wind farms in Maharashtra.

Rindiam Exports	7.81%
Ratnakala Exports	7.95%
Ambika Diamonds	8.01%

Thus it can be seen that the proposed project is not financially the most attractive and requires the additional flow of revenue in the form of VER incentives in order to stabilize the finances.

Sensitivity Analysis:

To further demonstrate additionality, a sensitivity analysis has been carried out, to assess the sensitivity of the IRR to variations in the most critical parameter of the project subject to deviations from the assumed values; the Capacity Utilization Factor (CUF) Since the revenue to be earned from sale of electricity generated depends entirely on the Capacity Utilization Factor of the WEGs, it is of paramount importance to evaluate the impact of CUF on the project IRR of the project. CUF is the key variable encompassing variation in wind profile and variation in off-take (including grid availability) including machine downtime.

It is expected that there could be a possible 10% generation difference (both on the higher as well as lower side) during the normal operational life of the project. The financial model has been developed on the basis of 20% base CUF.

Sensitivity analysis carried out for the project without CDM revenue at $\pm 10\%$ gives the following result:

Table 4: Project IRR with variation in CUF

Indicator	Project IRR		
Name of Investor	PLF @ 18%	PLF @ 20%	PLF @ 22%
C. Mahendra Exports Limited	7.26%	9.09%	10.76%
Rindiam Exports	5.83%	7.81%	9.61%
Ratnakala Exports	6.13%	7.95%	9.61%
Ambika Diamonds	5.99%	8.01%	9.83%

Table 5 Project IRR with variation in Capital Cost

Indicator	Project IRR		
Name of Investor	Capital Cost (-10%)	Capital Cost (Base case)	Capital Cost (+ 10%)
C. Mahendra Exports Limited	11.25%	9.09%	7.25%
Rindiam Exports	10.05%	7.81%	5.90%
Ratnakala Exports	10.05%	7.95%	6.15%
Ambika Diamonds	10.29%	8.01%	6.06%

It is clearly evident that the project returns even at maximum achievable CUF are below the WACC benchmark reinstating the support through VER revenue as a necessary requirement for the project.

Thus, investment as set out above demonstrates in a conservative and transparent manner that the project is financially unattractive. The project thus satisfies the Additionality conditions and qualifies as a VER project.

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

Sectoral Scope: 1, Energy industries (renewable/ non-renewable sources)
 Project Category: AMS-I.D., Version 14, “Grid connected renewable electricity generation”.

The approved consolidated baseline and monitoring methodology AMS I.D. is the choice of the baseline and monitoring methodology because:

- The project represents electricity capacity additions from wind sources;
- The project is a green-field electricity generation from wind sources;
- The geographical and system boundaries of the grid can be clearly identified and information on the characteristics of the grid is available.

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches:

- **Purpose of monitoring**

The purpose of monitoring is to measure the electricity generated and to verify the emission reductions from the project.

- **Types of data and information to be reported, including units of measurement**

The approved monitoring methodology requires monitoring of the electricity generated from the project. The monitoring methodology and unit of measurement are described in Sections 3.3 and 3.4.

- **Origin of the data**

The Project is operated and managed by Suzlon Energy Limited, which follow the documentation practices to ensure the reliability and availability of the data for operation of the wind power project. The monitored data can be found from the monthly JMR reports issued by MSEDCL to the project participants.

- **Monitoring, including estimation, modelling, measurement or calculation approaches**

The monitoring approach, including modelling, measurement and calculation approached for individual parameters are described in Sections 3.3 and 3.4.

- **Monitoring times and periods, considering the needs of intended users**

Monitoring will be done as:

- **Metering:** Electricity supplied to the grid is metered by MSEDCL at the high voltage side of the step up transformer installed at the respective feeders. The names of all feeders that the project WEGs are connected to, have been provided in Annexure - 4.
- **Metering Equipment:** Metering equipment at the feeders is electronic tri-vector meters of accuracy class 0.5% (both main and check meters). The meters are two-way and record both electricity import and export values. Both meters are owned, installed and maintained by MSEDCL.
- **Data Measurement Arrangement:** The generated electricity is measured through a two step procedure:
 - i) The first measurement of electricity is carried out at the controller of the WEG (EG_{WEG}) with integrated meters. Each WEG is equipped with a micro-processor based intelligent controller, specially designed for control of WEG and recording of various parameters. The controllers are connected to the Central Monitoring Station (CMS) of the entire wind farm through a wireless Radio Frequency (RF) network. The generation data of individual WEG can be monitored as a real-time entity at CMS. The snapshot of generation on the last day of every calendar month is kept as a record in electronic form.
 - ii) The second measurement of electricity is carried out at the grid interconnection point (MSEDCL feeder) wherein the Joint Meter Reading (JMR) is carried out on first week of every month in presence of the representatives of the project proponents & the state electricity utility (MSEDCL). The JMR report gives the cumulative net electricity supplied by all WEGs connected to the feeder (which includes WEGs not included in the project as well).

The apportioning of electricity generated from individual WEGs is done by the EPC contractor, based on the power generation recorded from individual WEGs at the Controller point and the cumulative net electricity recorded at the MSEDCL meter. Based on the information compiled by the EPC Contractor, MSEDCL generates monthly credit reports for each investor. Invoices are raised on these reports thereafter, by the investors which are sent back to MSEDCL.

- **Apportioning Details:**

$EG_{n,y}$ is the electricity generated from an individual WEG measured through its controller meter. The summation of Total electricity generated from the 12 WEGs of the project proponent from individual wind turbine meters in MWh is presented as:

$$\sum EG_{n,y}$$

Whereas, the summation of Total electricity generated from the other WEGs in the wind farm attached to the common MSEDCL meter at the sub-station in MWh is presented as:

$$\sum EG_{m,y}$$

A ratio based on these two set of measured values would be used for apportioning the net electricity supplied to the MSEDCL grid by the project activity.

EG_y the total net electricity supplied to the grid by the project activity is calculated as follows:

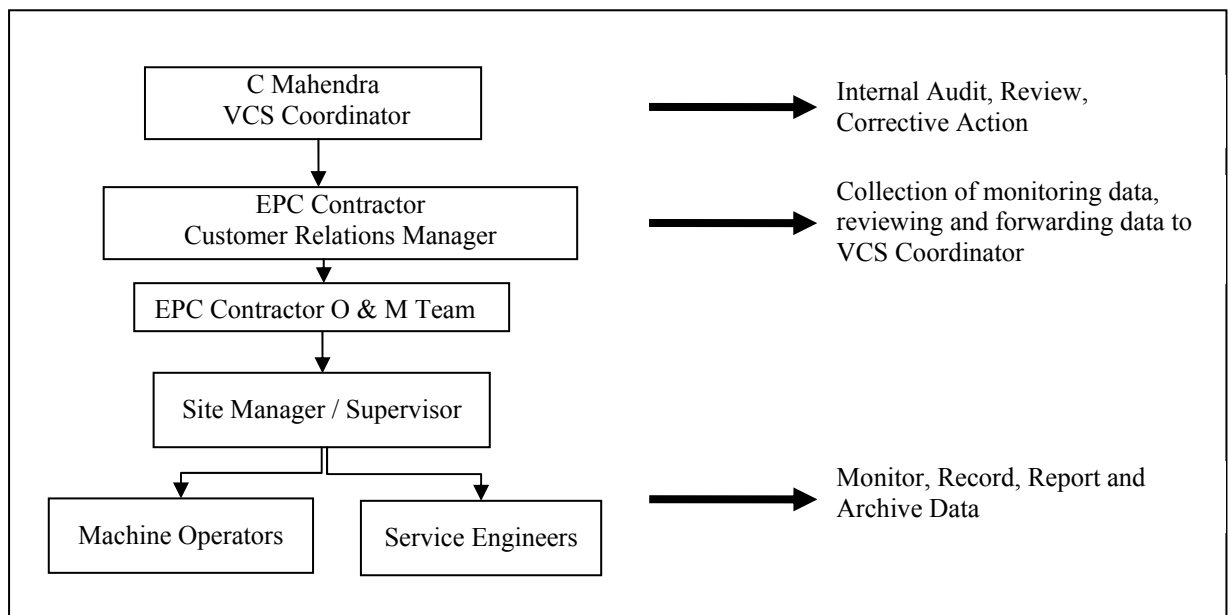
$$EG_y = EG_{y\ JMR} * \frac{\sum EG_{n,y}}{(\sum EG_{n,y} + \sum EG_{m,y})}$$

- **Data Archiving** – All records related to the project are systematically archived. Monthly credit notes and WEG controller level generation records are available with the EPC contractor, in printed format. These are maintained at the project site itself. In addition, the monthly JMR report carrying readings of net electricity delivered to each feeder can also be made available, upon request.
- **Frequency:** Frequency: The meter reading will be taken in the first week of every month.
- **Recording:** The recording of the meter reading will be done in the hard copy format once a month and subsequently credit notes will be issued to the power producer, against which the invoicing will be done.
- **Meter Test Checking:** The main and check meters are tested for accuracy with reference to a portable standard meter. The portable standard meter is owned by MSEDCL. The main and check meters shall be deemed to be working satisfactorily if the errors are within specifications for meters of 0.5% accuracy class. The frequency of meter testing is annual. The responsibility of meter testing lies with the MSEDCL.

The Authority and Responsibility for project management, registration and monitoring over the crediting period is – Mr. Kirtikumar N. Shah – Head, Administration.

• **Monitoring roles and responsibilities**

The operational and management structure implemented by C Mahendra and other project participants of the bundle and EPC contractor is as follows:



The authority and responsibility of project overall project coordination in relation to the VCS validation would be with Project participants. EPC Contractor is responsible for apportioning of the electricity generated.

- **Managing data quality**

The accuracy of monitoring parameter is ensured by adhering to the calibration and testing procedure as described in the QA/QC procedures described for each parameter in Section 3.3 below. The project will adhere to all the mandatory regulatory and statutory requirements at the state as well as national level. The data will be archived for a period of 2 years after the end of the crediting period in the hard copy format.

The daily generation report is sent to PPs by SEL. The daily generation report contains data on grid availability, machine availability and generation of electricity. PPs review the machine availability from the generation report and initiate the forward corrective action request to SEL in case the performance is not as per agreed O&M terms.

- **Method followed for any un-certainties and during emergency situation:** In case the meters are found to operate outside the permissible limits, the meters will be either replaced immediately or calibrated. Error correction will be applied to the meter reading. Whenever a main meter goes defective, the consumption recorded by the Check meter will be referred. The details of the malfunctioning along with date and time and snapshot parameters along with load survey will be retrieved from the main meter. The exact nature of the malfunctioning will be determined after analysing the data so retrieved and the consumption recorded by the main meter will be assessed accordingly.
- In case both main and the check meters are found beyond the permissible limit of error both the meters shall be calibrated immediately and correction applicable to the main meter shall be applied to the energy registered by the main meter at the correct energy for the purpose of energy account/ billing for the actual period during which inaccurate measurements were made, if such period can be determined or, if not readily determinable, shall be the shorter of:
 - The period since the immediately preceding test of the relevant main meter, or
 - One hundred and eighty days immediately preceding the test at which the relevant main meter was determined to be defective or inaccurate

3.3 Data and parameters monitored / Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Data / Parameter:	EG _v
Data unit:	kWh (kilo-Watt hour)
Description:	Total net electricity supplied to the grid by the project.
Source of data to be used:	MSEDCL certificates / Invoices
Value of data applied for the purpose of calculating expected emission reductions	26280000

Description of measurement methods and procedures to be applied:	This is a calculated data and not directly measured. Net electricity delivered to the grid is calculated based on measured values of 'export' and 'import' on the MSEDCL meter at the connected grid substation, where joint meter reading (JMR) is taken by MSEDCL officials & Suzlon representatives. At the conclusion of the reading, a JMR report is prepared, certified by MSEDCL officials. Further, this meter is common to project activity and other wind turbines in the wind farm hence the apportioning of net electricity would be carried out on the basis of electricity generated from individual wind turbines at the controller point. The apportioning is carried out by the EPC contractor and is described in section 3.2 above.
QA/QC procedures to be applied:	Net electricity supplied will be cross-verified from the invoice raised on MSEDCL by individual investors
Any comment:	The data will be archived for a period of 2 years after the end of crediting period.

Data / Parameter:	$\sum_0^n EG_{n,y}$
Data unit:	kWh
Description:	Total Electricity supplied to the MSEDCL grid substation by project activity at WEG Controller point
Source of data to be used:	Monthly generation records of the EPC contractor, of each WEG in project activity
Value of data applied for the purpose of calculating expected emission reduction	This value will not be directly used for estimation of emission reduction.
Description of measurement methods and procedures to be applied:	<ul style="list-style-type: none"> - The electricity is measured through integrated meters at the WEG Control panel. - The data is measured continuously and records are available in electronic & printed format - 100% of the data is monitored
QA/QC procedures to be applied:	This value is used for apportioning of net electricity supplied to MSEDCL by the project activity. Calibration of these meters is not possible as these are micro-processor based intelligent controllers, specially designed for control of WEG and display instantaneous values of electricity generated.
Any comment:	The data shall be archived for the entire crediting period + 2 years

Data / Parameter:	$\sum_0^m EG_{m,y}$
Data unit:	MWh/kWh
Description:	Total Electricity supplied to the MSEDCL grid substation from all other wind turbines in the wind farm, at the WEG controller point.
Source of data to be used:	Records of the EPC contractor

Value of data applied for the purpose of calculating expected emission reductions	This value will not be directly used for estimation of emission reduction.
Description of measurement methods and procedures to be applied:	This value is not monitored/ measured as part of the project activity during its crediting period, and is used for apportioning of net electricity supplied to MSEDCL by the project activity.
QA/QC procedures to be applied:	-
Any comment:	The data will be archived for crediting period + 2 years.

Data / Parameter:	EG_{v,JMR}
Data unit:	MWh/kWh
Description:	Net Electricity supplied to the MSEDCL grid substation from entire wind farm
Source of data to be used:	Monthly Joint Meter Readings (JMR) taken by the MSEDCL and Suzlon representatives.
Value of data applied for the purpose of calculating expected emission reduction	This value will not be directly used for estimation of emission reduction.
Description of measurement methods and procedures to be applied:	<ul style="list-style-type: none"> - This is a measured value and electricity is measured with the help of two-way (import & export) electronic meters at the wind farm substation. - Net electricity is arrived at by calculating 'Import minus Export' - The data is measured hourly and recorded monthly - The value is used for apportioning of net electricity supplied to MSEDCL by the project activity.
QA/QC procedures to be applied:	-
Any comment:	The data will be archived for crediting period + 2 years.

The monitoring of the above mentioned parameter is recorded each month

3.4 Description of the monitoring plan

The details of monitoring have been provided in section 3.2 above. The meter where the meter reading is taken is sealed, maintained and calibrated by the state electricity utility. The data shall be archived and documented for a minimum period of two years beyond the end of the crediting period.

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

According to the approved methodology AMS I.D., Emission Reductions are calculated as per the “Tool to calculate the emission factor for an electricity system Version 01.1”.

$$ER_y = BE_y - PE_y - L_y$$

where:

BE_y	Baseline Emissions in year y (t CO ₂ e/yr)
PE_y	Project Emissions in year y (t CO ₂ e/yr)
L_y	Leakage Emissions in year y (t CO ₂ e/yr)

Estimation of Baseline Emissions

Baseline emissions (BE_y in tCO₂) due to displacement of grid-electricity is calculated as the product of the Baseline Emissions Factor (EF_y in tCO₂/kWh) calculated as described below and the electricity supplied by the project to the grid ($EG_y - EG_{baseline}$ in kWh), over the crediting period.

$$BE_y = (EG_y - EG_{baseline}) * EF_y$$

where:

BE_y	: Baseline emissions in year y (tCO ₂ /yr)
EG_y	: Electricity supplied by the project to the grid (kWh)
$EG_{baseline}$: Baseline electricity supplied to the grid in the case of modified or retrofit facilities (kWh). 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.

According to the above referenced tool (“Tool to calculate the emission factor for an electricity system Version 01.1”), 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 two regional grids, viz. NEWNE and Southern grid. Each grid covers several states. The regional grids are interconnected; there is inter-state and inter-regional exchange. A small power exchange also takes place with neighbouring countries like Bhutan and Nepal. Power generation and supply within the regional grid is managed by Regional Load Dispatch Centre (RLDC). 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 (National Thermal Power Corporation) and NHPC (National Hydroelectric Power Corporation), 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 NEWNE regional electricity grid, the NEWNE 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 in the last five years is as follows:

	2003-04	2004-05	2005-06	2006-07	2007-08
North	28.1%	26.8%	28.1%	27.1%	-
East	10.3%	10.5%	7.2%	9.0%	-
South	16.2%	21.6%	27.0%	28.3%	27.1%
West	9.1%	8.8%	12.0%	13.9%	-
North-East	41.9%	55.5%	52.7%	44.1%	-
NEWNE	-	-	18.0%	18.5%	19.0%
India	17.1%	18.0%	20.1%	20.9%	21.0%

Source: CO₂ Baseline Database Version 04 (For 2005-06, 2006-07 and 2007-08 data for NEWNE and South grid) and Version 03 (For 2003-04 to 2006-07 data for North, East, South and West grids) for the Indian Power Sector – Central Electricity Authority

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of five most recent years) for NEWNE regional grid is less than 50% of the total generation. Hence the Simple OM method can be used to calculate the Operating Margin Emission factor.

The 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 VCS-PD 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/kWh) 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. 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:

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

where:

- $EF_{\text{grid,OMsimple,y}}$: Simple operating margin CO2 emission factor in year y (tCO₂/kWh)
- $EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (kWh)
- $EF_{\text{EL,m,y}}$: CO2 emission factor of power unit m in year y (tCO₂/kWh)
- 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 VCS PDD to the Validator (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage.

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

$$EF_{\text{EL,m,y}} = \Sigma (FC_{i,m,y} \times NCV_{i,y} \times EF_{\text{CO}_2,i,y} / EG_{m,y})$$

where:

- $EF_{\text{EL,m,y}}$: CO2 emission factor of power unit m in year y (tCO₂/kWh)
- $FC_{i,m,y}$: 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)
- $EF_{\text{CO}_2,i,y}$: CO2 emission factor of fossil fuel type i in year y (tCO₂/GJ)
- $EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (kWh)
- 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 VCS-PD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage.

The average operating margin of the last three years is calculated to be 1.009003 tCO₂e/MWh. The Operating Margin calculations have been provided in Annexure-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 kWh) 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 VCS-PD 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:

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

Where:

- EF_{grid,BM,y}: Build margin CO₂ emission factor in year y (tCO₂/kWh)
- EG_{m,y}: Net quantity of electricity generated and delivered to the grid by power unit m in year y (kWh)
- EF_{EL,m,y}: CO₂ emission factor of power unit m in year y (tCO₂/kWh)
- 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.

The build margin is determined to be 0.597712 tCO₂e/MWh from CEA Database version 4. For the calculation, please refer Annexure-2.

STEP 6. Calculate the combined margin emissions factor

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

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

where:

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

$EF_{grid,OM,y}$: Operating margin CO₂ emission factor in year y (tCO₂/kWh)

w_{OM} : Weighting of operating margin emissions factor (%)

w_{BM} : Weighting of build margin emissions factor (%) (where $w_{OM} + w_{BM} = 1$).

According to AMS I.D., 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 is calculated as shown in the table below:

	Weights	tCO ₂ e/MWh
Operating Margin	0.75	0.75675
Build Margin	0.25	0.14942
Combined Margin	= 0.90617	

Details of Baseline data:

Data of Operating and Build Margin for the three financial years from 2005-06 to 2007-08 has been obtained from - The CO₂ Baseline Database for the Indian Power Sector, Ministry of Power: Central Electricity Authority (CEA), Version 4, dated: 25th September 2008.

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

As per the approved methodology AMS I.D. (Version 14), baseline emissions (BE_y in tCO₂) are calculated as follows:

$$BE_y = EG_y * EF_y$$

where:

BE_y: Baseline emissions in year y (tCO₂/yr)

EG_y: Electricity supplied by the project to the grid (kWh)

EF_y: Combined Margin CO₂ emission factor for grid connected power generation in year y calculated.

The baseline emissions are calculated as follows:

1. Baseline emission factor = 0.90617t CO₂e/MWh

2. Baseline Emission Calculations has been calculated as the product of annual electricity supplied to the grid (GWh) from the project and baseline emission factor. The calculations have been presented below:

Annual electricity supplied to the grid (GWh) from the project has been calculated as below:

$$= \text{Capacity (MW)} \times \text{CUF (\%)} \times 8760 \text{ (hours)}$$

$$= 15 \times 20\% \times 8760 \text{ MWh}$$

$$= 26,280 \text{ MWh.}$$

An annual baseline emission (tCO₂e) for subsequent years has been calculated as:

$$= 0.90617 \text{ tCO}_2\text{e/MWh} \times 26,280 \text{ (MWh)}$$

$$= 23,814 \text{ t CO}_2\text{e.}$$

4.3 Quantifying GHG emissions and/or removals for the project

There are no direct GHG emissions or removals for the project.

Estimation of Project Emissions

The project uses wind power to generate electricity and hence the emissions from the project are taken as nil.

$$PE_y = 0$$

Estimation of Leakage Emissions

The project is a green field power wind power generation facility and the energy generating equipment used in the project has not been transferred from any other activity. In accordance with AMS I.D., version 14, leakage on account of this project is negligible and is ignored. Thus, $L_y = 0$

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

The project reduces carbon dioxide through displacement of grid electricity generation with fossil fuel based power plants by renewable-wind electricity. The emission reduction ER_y due to project during a given year y is calculated as the difference between baseline emissions (BE_y), project emissions (PE_y) and emissions due to leakage (LE_y) as per the formula given below:

$$ER_y = BE_y - PE_y - LE_y$$

As described in Section 4.3, the project emissions and leakage emissions for this project are nil. Hence, ex-ante calculation of emission reductions is equal to ex-ante calculation of baseline emissions as project emissions and leakage are nil.

$$\text{Hence, } ER_y = BE_y$$

As calculated in Section 4.2, baseline emissions are calculated as follows:

$$BE_y = EGY * EF_y$$

The VERs throughout the crediting period has been summarized in the table below.

Period	VERs(tonnes of CO2e)
1st April 2006 to 31st March 2007	19,364
1st April 2007 to 31st March 2008	17,667
1st April 2008 to 31st March 2009	16,934
1st April 2009 to 31st March 2010	25,185
1st April 2010 to 31st March 2011	23,814
1st April 2011 to 31st March 2012	23,814
1st April 2012 to 31st March 2013	23,814
1st April 2013 to 31st March 2014	23,814
1st April 2014 to 31st March 2015	23,814
1st April 2015 to 31st March 2016	23,814
Total	222,034

5 Environmental Impact:

As per the Schedule 1 of the EIA notification dated 14th September 2006 (<http://envfor.nic.in/legis/eia/eia-2006.htm>), given by the Ministry of Environment and Forests (Government of India) under the Environment (Protection) Act 1986, EIA is not a regulatory requirement in India for wind energy projects.

Thus the project doesn't fall under the list of activities requiring EIA. The project will not involve any negative environmental impacts, as the WEGs are installed for generation of power using wind which is a clean source of energy.

6 Stakeholders comments:

The players included in the stakeholders for the proposed project are as follows:

1. Maharashtra Energy Development Agency
2. Maharashtra State Electricity Distribution Corporation Limited
3. Gram Panchayat (representative body for Local Government in the Village)
4. Local Villagers

The land area falling under the wind farm is primarily barren or fallow. The owners of the land were contacted and transfer of land was transacted under the proper legal system. The villagers were well aware about the project activity and the land was procured at mutually agreeable terms. The villagers were not deprived of their rights and they were assigned full freedom to use their land. In addition to receiving revenue for the land, local stakeholders have received the benefits of improved infrastructure and employment opportunities at the wind farm location.

Method of inviting comments:

The stakeholders of each village of the project were contacted before the starting of the project and were briefed about the activity, its associated positive impacts to the environment and the direct benefits to their livelihood. Discussions were held on the many aspects of the lives of the villagers that may have been negatively or positively impacted by the project. They were interviewed and encouraged to provide comments and suggestions regarding the activity.

No Objection Certificates (NOC) have been obtained from all the villages certifying that the villagers along with the Gram Panchayat have no objection to the windmill installation in

their village, and that the project activity has led to no significant negative impacts. The villagers were mainly concerned whether they would be permitted to use the land around the windmills for agricultural purposes; which, has been granted. The dates of the meetings as per the NOCs are as follows:

03/07/05 in village Ghatnandre
 09/04/05 in village Jamde
 23/03/05 in village Tisangi
 01/09/05 in village Titane

The MEDA gave statutory clearance to the project for its establishment and operation. This is a reflection of the environmentally benign activity that adheres to the prescribed standards of compliance.

Being the buyer of the electricity generated, MSEDCL is a significant player and contributor to the success of the project. It has cleared the project and the proponent has already signed a Power Purchase Agreement with MSEDCL.

It was conveyed to the villagers that they could continue with their agricultural practices in the wind farm area, keeping the minimum necessary distance from the WEGs. Further, eligible candidates from the villages would be hired by Suzlon as security guards or trained for operations and maintenance related jobs.

7 Schedule:

The Schedule of project activities is given in the table below. The project will implement monthly monitoring as well as reporting for monitoring of electricity exported, imported from the grid and calculation of net electricity supplied to the respective Grid Substation. The operational lifetime of the project is 20 years and length of the VCS crediting period is 10 years i.e., from 01-April-2006 to 31-March-2016 which can be renewed.

S.No.	Activity	Date
1	Placement of Purchase Orders for all the 12 WEGs	3 rd May 2005 to 27 th August 2005
2	Obtained necessary clearances from the Government Authorities	November 2005 to February 2006
3	Signing of Power Purchase Agreement	August 2005 to February 2006
4	Commissioning of WEGs	July 2005 to March 2006
5	VCS Validation Contract Date	6 th November 2008

8 Ownership:

8.1 Proof of Title:

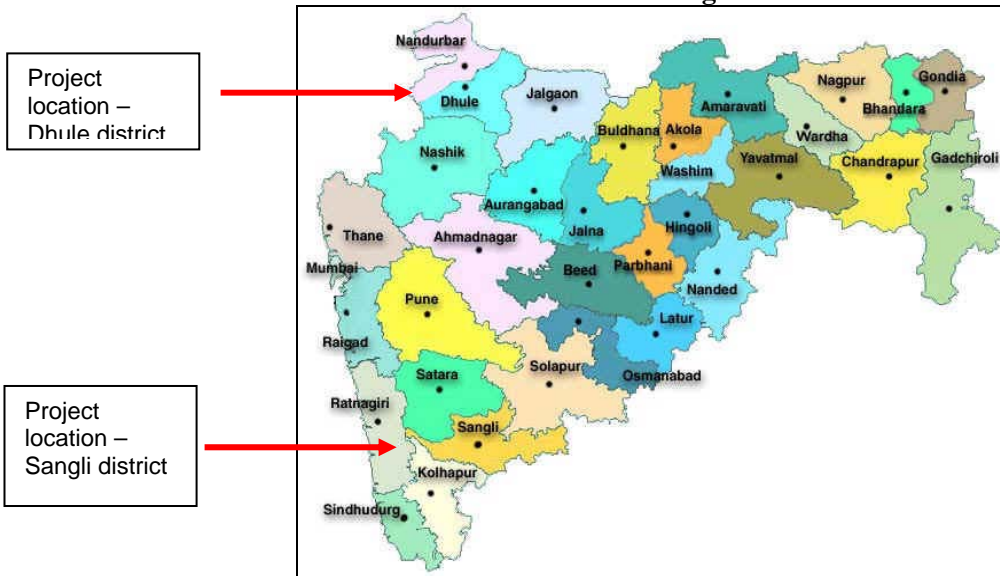
C. Mahendra has been duly authorized by all other investors to take any actions as may be required from time to time for VCS validation and verification activities on their behalf. The authority letters between individual investors and C. Mahendra supporting this statement above have been provided to the DOE. Additionally, copies of PPA have been provided to the DOE as proof of title.

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

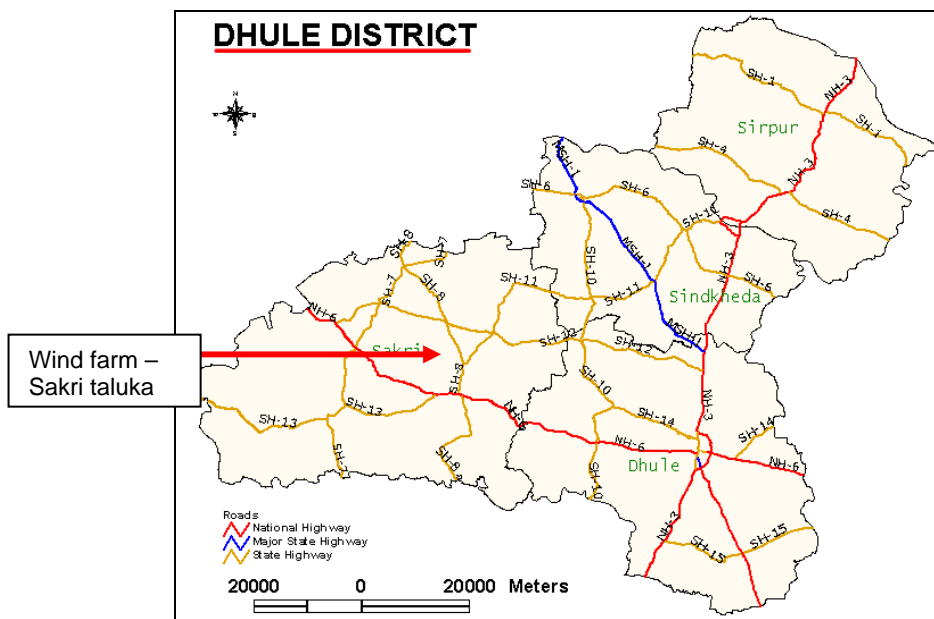
As of now (15th September 2009), the project is not registered under any other GHG program for the crediting period from 1-April-2006 to 31-March-2016.

Annexure-1: Location Map

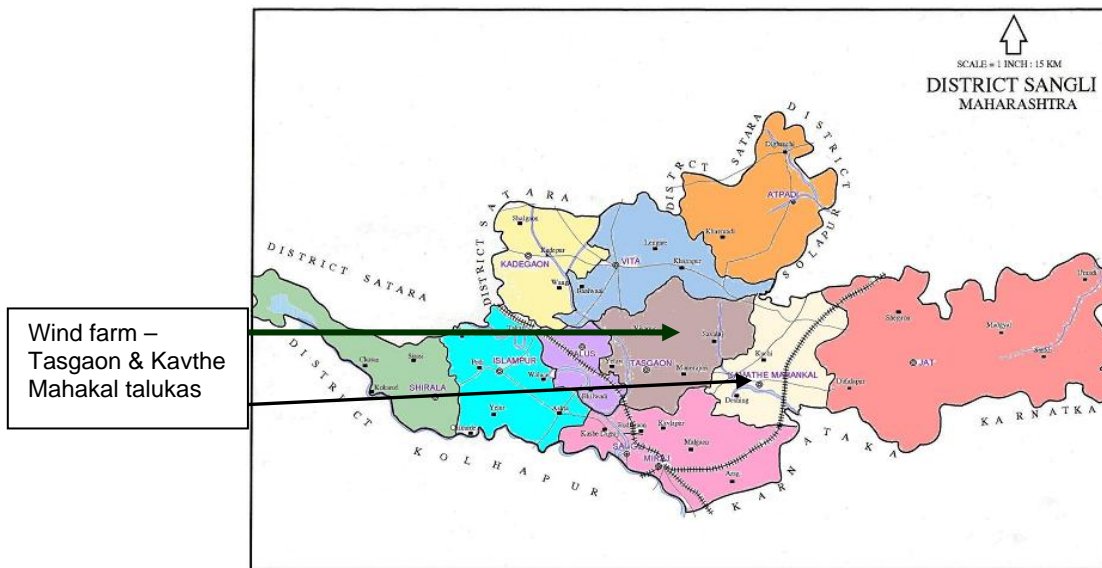
Location of Dhule and Sangli in Maharashtra



Wind farm location in Dhule



Wind farm location in Sangli



Annexure-2: Baseline Information

Baseline Emission Factor:

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

Simple Operating Margin

	tCO ₂ e/MWh
Simple Operating Margin - 2005-06	1.01949
Simple Operating Margin - 2006-07	1.00835
Simple Operating Margin - 2007-08	0.99917
Average Operating Margin of last three years	1.009003

Build Margin

	tCO ₂ e/MWh
Build Margin for 2007-08	0.597712

Combined Margin calculations

	Weights	tCO ₂ e/MWh
Operating Margin	0.75	0.75675
Build Margin	0.25	0.14942
Combined Margin		0.90617

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

Annexure -3: Selection of Appropriate Benchmark

The guidance to investment analysis issued in EB 41 (paragraph 11) states that in cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for equity IRR.

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

The benchmark WACC for the project is 13.20%.

Selection of Appropriate Benchmark:

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

The guidance to investment analysis issued in EB 41 (paragraph 11) states that in cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for equity IRR.

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

Accordingly, the weighted average cost of capital applicable to the project type has been considered. Weighted average cost of capital (WACC) is calculated as weighted average cost of equity and cost of debt as illustrated below

$$\text{WACC} = [D / (D+E)] * [\text{Cost of Debt}] + [E / (D+E)] * [\text{Cost of Equity}]$$

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 10.25 – 10.75 % [Source: Reserve Bank of India, <http://www.rbi.org.in/scripts/WSSViewDetail.aspx?TYPE=Section&PARAM1=4>] the average PLR of 10.5 % 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 loan tenure of the typical power project is 10 years, it may be noted that for the first 10 years, all power projects in India are required to pay tax @ 7.87% (as per section 80 IA of Income Tax Act). Accordingly the marginal tax rate has been considered as 7.87%

Cost of Equity:

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM)³. The CAPM economic model is used worldwide to determine the required/expected return on equity based on potential risk of an investment. The CAPM framework is the Nobel award winning work of financial economist Dr. William Sharpe.

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

where:

K_e = Rate of return on equity capital;

R_f = Risk-free rate of return;

B = Beta;

$R_m - R_f$ = Market risk premium;

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 188 of text book on “Corporate Finance Theory and Practice” by Dr. Aswath Damodaran⁴, Stern School of Business, New York University (attached as Appendix 1), 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 Indian government bond rates available at the different dates as below:

Date	March 2005 (Earliest Investment decision date)	May 2005 (PO date for Rindiam Exports and Ambika Diamonds)	July 2005 (PO date for Ratnakala Exports)	August 2005 (PO date for C. Mahendra Exports)
Data available	2004-2005	2004-2005	2004-2005	2004-2005
Risk free rate	6.11%	6.11%	6.11%	6.11%

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>)

Risk Premium:

³ 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>

⁴ Dr. Damodaran, one of the foremost authorities in the world in the field of Investment Analysis

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

Beta:

Beta (B) indicates the sensitivity of the company to market risk factors. Beta represents the market risk for an asset and is calculated as the statistical measure of volatility of a specific asset/investment relative to the movement of a market group. The conventional approach for estimating beta of an investment is a regression of returns on investment against returns on a market index. For companies that are not publicly listed, the beta is determined by referring beta values of publicly listed companies that are engaged in similar types of business. The project activity type is wind power generation; the approach therefore should be to base the beta for the project on the beta values of listed wind power generation companies in India. However, there was only one wind energy company (BF Utility) listed on any stock exchange in India (both BSE- Bombay Stock Exchange⁵ and NSE-National Stock Exchange⁶) in year 2006. Therefore, in the absence of adequate data on companies which are exclusively into the exactly same type of business (i.e wind power projects), the next best option for assessing the risk of these projects is to consider the data available on companies which are involved in similar businesses.

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

The applicable Beta value has been determined on the basis of the Beta values of 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. Snapshots of the values from Bloomberg have been provided to the DOE.

The table below summarises the beta values:

Company Name	March 2005 (Earliest Investment decision date)	May 2005 (PO date for Rindiam Exports and Ambika Diamonds)	July 2005 (PO date for Ratnakala Exports)	August 2005 (PO date for C. Mahendra Exporst)
GUJARAT INDS	1.61	1.608	1.413	1.322
TATA POWER CO	1.31	1.321	1.309	1.315
RELIANCE INFRASTRUCTURE	0.825	0.863	0.936	0.941
NEYVELI LIGNITE	1.604	1.486	1.519	1.507
CESC	1.457	1.491	1.594	1.573
BF UTILITIES	1.622	1.673	1.241	1.139
Average Beta	1.40	1.41	1.34	1.30

Source: Bloomberg

⁵ <http://www.bseindia.com/>

⁶ <http://www.nseindia.com/>

Calculation of Benchmark WACC:

The WACC is the weighted average of the cost of equity and cost of debt used for financing. As per the additionality tool, standard parameters (and not project specific ones) are required to be used for arriving at the benchmark rate. In India, a debt to equity ratio of 70:30 is considered as the norm for financing wind power projects⁷. Accordingly the WACC has been calculated based on a 70:30 debt to equity ratio.

$$\text{WACC} = [D / (D+E)] * [\text{Cost of Debt}] + [E / (D+E)] * [\text{Cost of Equity}]$$

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

$$\text{WACC} = 70\% * \text{Cost of debt} + 30\% * [R_f + B \times (R_m - R_f)]$$

⁷ MERC in its order dated September 2003 has used this ratio in its tariff calculation. Likewise, several other regulations and orders refer this as the normative debt equity ratio for wind power projects.

Dates	Applicable Beta	Risk Free Rate	Market return	Average Risk Free Return	Market Risk Premium	Cost of Equity	Interest Rate (PLR)	Marginal Tax rate	WACC
March 2005 (Earliest Investment decision date)	1.40	6.11%	17.63%	6.11%	11.52%	22.3%	10.50%	7.87%	13.46%
May 2005 (PO date for Rindiam Exports and Ambika Diamonds)	1.41	6.11%	17.11%	6.11%	11.00%	21.6%	10.50%	7.87%	13.25%
July 2005 (PO date for Ratnakala Exports)	1.34	6.11%	17.69%	6.11%	11.58%	21.6%	10.50%	7.87%	13.24%
August 2005 (PO date for C. Mahendra Exporst)	1.30	6.11%	17.90%	6.11%	11.79%	21.4%	10.50%	7.87%	13.20%

The minimum of these WACCs have been taken as the project WACC to be on the conservative side.

Thus, the project WACC is 13.20%.

Annexure -4: Feeder Details

S.No.	WEG Number	Name of Investor	Commissioning Date	Connected Feeder
1.	G – 320	C. Mahendra Exports Ltd.	31-Mar-2006	Ghatnandre III
2.	G – 52	C. Mahendra Exports Ltd.	25-Mar-2006	Ghatnandre VII
3.	G – 53	C. Mahendra Exports Ltd.	25-Mar-2006	Ghatnandre VII
4.	G – 54	C. Mahendra Exports Ltd.	25-Mar-2006	Ghatnandre VII
5.	G – 55	C. Mahendra Exports Ltd.	20-Feb-2006	Ghatnandre VII
6.	G – 56	C. Mahendra Exports Ltd.	20-Feb-2006	Ghatnandre VII
7.	G – 57	C. Mahendra Exports Ltd.	25-Mar-2006	Ghatnandre VII
8.	G – 38	C. Mahendra Exports Ltd.	14-Feb-2006	Ghatnandre VI
9.	G – 311	Ratnakala Exports	20-Feb-2006	Ghatnandre III
10.	G – 319	Ratnakala Exports	31-Mar-2006	Ghatnandre I
11.	K – 139	Ambika Diamonds	11-Jul-2005	Jamde 12
12.	K – 123	Rindiam Export	01-Sep-2005	Jamde 12

Appendix -1

and a risk premium (in the CAPM) or premium (in the APM and multifactor models). They also need measures of a firm's exposure to market risk in the form of betas. These inputs are used to arrive at an expected return on an equity investment:

$$\text{Expected Return} = \text{Riskless rate} + \text{Beta (Risk Premium)}$$

This expected return to equity investors includes compensation for the market risk in the investment, and it is the cost of equity. In this section, we concentrate on the estimation of the inputs to this model — the riskless rate, the risk premium, and the beta of equity. Although much of our discussion is directed at the CAPM, it can be extended to apply to the arbitrage pricing and multifactor models as well.

Riskless Rate

In Chapter 6, we defined a riskless asset as one for which the investor knows the expected return with certainty. Consequently, for an investment to be riskless over a specified time period (time horizon), two conditions have to be met:

1. There is no default risk, which generally implies that the government has to issue the security. Not all governments are viewed as default free, and this does create a practical problem in obtaining riskless rates in some markets.
2. There is no uncertainty about investment rate, which implies that there are no cash flows prior to the end of our time horizon, since these cash flows have to be reinvested at rates that are unknown today.

Riskless Rate and Time Horizon Should we use a short-term or a long-term government bond rate as a riskless rate? The answer will depend on when our cash flows come due. Assume, for instance, that we are analyzing a five-year project and that we need a five-year riskless rate. A six-month treasury bill is not riskless for a five-year time horizon because there is reinvestment risk at the end of each six-month period. In fact, neither is a five-year government bond with coupons without risk since the coupons have to be reinvested, at the rates prevailing at that time, every six months for the next five years. Only a five-year zero-coupon government bond fulfills our conditions: it has no default risk, and there are no cash flows prior to the end of the fifth year.

Thus, the riskless rate is the rate on a zero-coupon government bond that matches the time horizon of the cash flow being analyzed. Here, since the only cash flow is the principal on the bond coming due at maturity, there is neither default nor reinvestment risk. In theory, this translates into using different riskless rates for each cash flow on an investment — the one-year zero-coupon rate for the cash flow in year 1, the two-year zero-coupon rate for the cash flow in year 2, and so on. In practice, using a long-term government rate (even on a coupon bond) as the riskless rate on all the cash flows in a long-term analysis will yield a close approximation of the true rates.¹ For short-term analysis, it is appropriate to use a short-term government security rate as the riskless rate.

Riskless Rates When There is Sovereign Risk We have implicitly assumed in our discussion of riskless rates that governments do not default on their obligations.

¹ The exception to this rule occurs when short-term rates are very different (higher or lower) from long-term rates. In this case, we should use an estimate different riskless rates for each cash flow.

that they issue long-term bonds, and that these bonds are traded to yield a market interest rate. In a number of economies, one or all of these assumptions may be violated. In some developing countries where governments in the past have failed to meet their promised obligations, investors do not view the government as default-free. In many other markets, the government might not issue long-term bonds, and the best that one can obtain is a short-term government rate.

There are three ways in which we can get around not having a long-term default-free rate. One is to bypass the question of a riskless rate entirely by doing the analysis in a different currency (such as the U.S. dollar) where a riskless rate is easy to obtain. The second is to find the rate at which the largest and safest corporations in that country can borrow long term at the local currency and reduce that rate by a small default premium (say, 1 to 2 %) to arrive at a long-term riskless rate. The third solution applies when short-term government bond rates (which are default free) are available but not long-term rates. Assume, for instance, that there are one-year Malaysian government bonds (denominated in Malaysian Ringgit) trading at 12%, that the one-year U.S. government bond rate is 4%, but that there are no long-term Malaysian government bonds. An approximate long-term Malaysian government bond rate (in Ringgit) can be estimated by adding the spread of 8% between the one-year government bonds to the 10-year or 30-year U.S. government bond rate. For instance, with a 10-year U.S. government bond rate of 6%, this would yield a 10-year Malaysian government bond rate of 14%.

Currency Choices and Real Rates In most analyses, other questions need to be answered about the riskless rate. If we are working with a U.S. company, should the riskless rate always be a rate on a U.S. government security? If the U.S. company plans an investment in South Africa, should we use the South African Rand riskless rate instead? What if we were looking at a South African company instead? The riskless rate has to be defined in the same terms as the cash flows on the analysis. If the analysis is done in dollar terms, the riskless rate always has to be a U.S. government security rate, whether the firm doing the analysis is a U.S. firm or a non-U.S. firm and whether the project is in the United States or any other country. This should be the case even if the country in which the company is located has its own dollar-denominated bonds,² which carry a default risk premium. The country default risk premium is best reflected in the risk premium component and not in the riskless rate. If the cash flows are in South African Rand, the riskless rate has to be a Rand riskless rate.

There is a second choice we might need to make in terms of the riskless rate. Some analyses are based entirely on real cash flows; that is, the cash flows are estimated, as if there were no inflation in the currency. If the analysis is done in real terms, the riskless rate has to be a real riskless rate, which can be obtained in one of two ways:

- If there are default-free securities that guarantee a real rate, that real rate is a real riskless rate. In the United States, for instance, there are inflation-protected treasury bonds for which the holder receives a guaranteed real rate³ rather than a guaranteed nominal rate.

² To provide an illustration, Brazil has dollar-denominated long-term bonds called C-bonds that yield higher rates than the U.S. treasury bond.

³ For instance, in early 1998, the inflation-protected U.S. treasury bond was trading to yield 4% to its holder. An investor in the bond is therefore guaranteed a return of 4% plus whatever the inflation rate is during the period.

Appendix 2

- 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 premium 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.

- ✓ **CG 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 return

⁴ The most widely used dataset, from Ibbotson Associates, has returns going back to 1926. Jeremy Siegel’s Wharton monthly-published data going back to the early 1800s.

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 framework⁵ 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 premium 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

- **Larger time periods**, 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 error⁷ of about 4 to 5%.
- **Long-term fixed 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 return over long periods.⁸ The geometric mean yields lower premium

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 premium 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 30 years without significant bubbles, we are looking at the exception. To provide a contrast, consider the other stock markets in which one could have survived in 1930; many of these markets did not survive, and an investor would have lost much of his or her wealth.