CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

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Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

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

14.1 MW grid connected wind energy project in Tamilnadu by ITC Limited.
Version: 3.0
Date: 06/07/09

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

Objective of the Project

ITC Ltd intends to execute and implement 14.1 MW of Wind Electricity Generators (WEGs) for captive consumption at its packaging and printing facility located at Tiruvottiyur, Chennai, Tamil Nadu in India. The proposed project activity will result in meeting the energy demand from alternate / environmentally benign source of energy resulting in avoidance of GHG emissions into the atmosphere.

Nature of the Project

The project installs 4 WEGs of 1.65MW (supplied by Vestas Wind Technology India Private Limited) and 5 WEGs of rating 1.5 MW (supplied by Suzlon Energy Ltd), totalling to 14.1 MW, in Theni and Tirunelveli districts of Tamil Nadu.

The plant and machinery will be owned by ITC Limited, whereas the EPC contractors will be individually responsible for operation and maintenance of the machines supplied by them.

The Electricity Act 2003 (India) permits open access i.e. carrier has been separated from content thereby facilitating implementation of captive electricity generation facilities to use the available transmission infrastructure (operated by state / central transmission companies) by paying wheeling charges in the form of %age of electricity transmitted through the network. The fee in the state of Tamilnadu is 5% of the transmitted electricity, which will be paid by ITC on monthly basis for the electricity volume evacuated using transmission facility. In addition to this the state utility will levy 5% electricity for extending the banking facility to ITC Limited for non-real time consumption of electricity.

Project Participant

ITC Limited is one of India's premier private sector companies with a market capitalisation of US $ 14 billion and a turnover of over US $ 5 billion. ITC is rated among the World's best big companies, Asia's 'Fab 50' and the World's most reputable companies by Forbes magazine, among India's most respected companies by Business World and among India's most valuable companies by Business Today.

ITC Limited has a diversified presence in Tobacco, Hotels & Hospitality, Paperboards & Specialty Papers, Packaging and printing, Agri-Business, Packaged Foods & Confectionery, Information Technology, Branded Apparel, Personal Care, Stationery, Safety Matches and other FMCG products.

ITC Limited has taken initiatives in following the best practices and has already registered 6 CDM projects with UNFCCC.

Contribution to sustainable development

The Ministry of Environment and Forests, Govt. of India has stipulated the social well being, economic well being, environmental well being and technological well being as the four indicators for sustainable development in the interim approval guidelines by host country for Clean Development Mechanism (CDM) projects[1] approval. The following paragraphs will details out the project adherence to the indicators-

Social well being:

"The CDM project activity should lead to alleviation of poverty by generating additional employment, removal of social disparities and contribution to provision of basic amenities to people leading to improvement in quality of life of people"

- The candidate CDM project has resulted in investment in rural sector thereby creating employment opportunities for the skilled, semi skilled and unskilled manpower available in and around project facility.

Economic well being:

"The CDM project activity should bring in additional investment consistent with the needs of the people"

- The project invests approx. INR 897.2 millions in the region, which would not have happened without the CDM project.
- Southern grid, being a power deficit grid[2], needs additional power generating units.

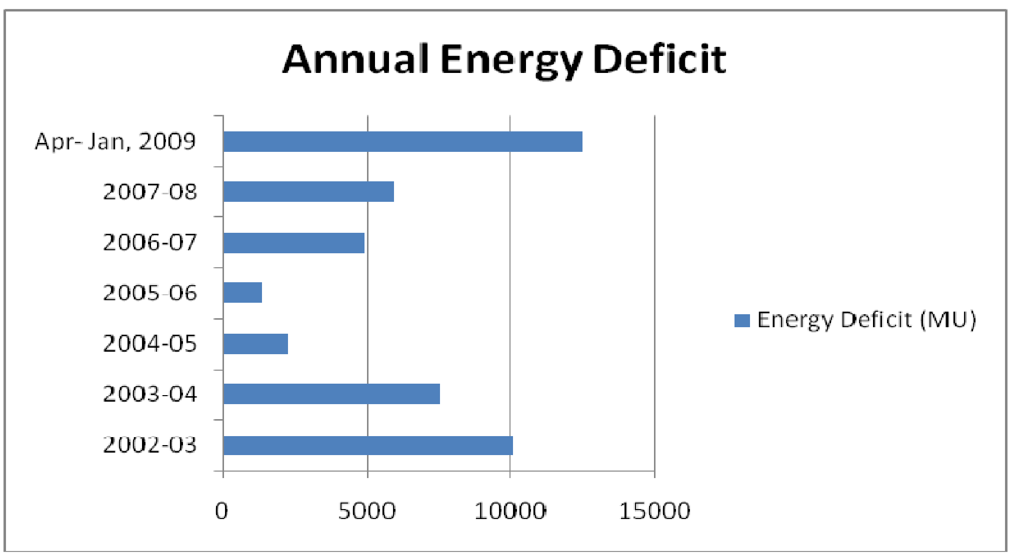

Fig.1 Annual Energy deficit of Southern Grid

It's highly desirable that this deficit be met with renewable energy generating sources so as to reduce the harmful impact on the environment.

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

[2] http://www.cea.nic.in/planning/POWER%20SCENARIO%20AT%20A%20GLANCE/POWER%20SCENARIO%20AT%20A%20GLANCE.pdf

- The project will increase availability of power in the grid generated from an emission-free resource; it will positively contribute towards reduction in (demand) use of finite natural resource like Coal.

Technological well being:

"The CDM project activity should lead to transfer of environmentally safe and sound technologies with a priority to the renewables sector or energy efficiency projects that are comparable to best practices in order to assist in upgradation of technological base"

- The project promotes high capacity MW class Suzlon and Vestas WEGs at the project site that paves the way for future investments in this sector.
- This will also give rise to increased interest in wind energy in the country. This in turn would push the investment into research into creating better wind turbines

Environmental well being:

"This should include a discussion of impact of the project activity on resource sustainability and resource degradation, if any, due to proposed activity; bio-diversity friendliness; impact on human health; reduction of levels of pollution in general;"

The Project brings about environmental well being by-

- Generating power from wind energy, being a renewable source, contributes to resource conservation. There is no emissions from the project activity
- CO_2 abatement and reduction of greenhouse gas emissions through development of renewable technology;
- Reducing the average emission intensity (SO_x, NO_x, PM, etc.), average effluent intensity and average solid waste intensity of power generation in the system; and
- Having no harmful impact on human health because of zero emissions for the generating source.

A.3. Project participants:

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

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

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

A.4.1.1. Host Party(ies):

India

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

Tamil Nadu

A.4.1.3. City/Town/Community etc:

Districts of Theni and Tirunelveli

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

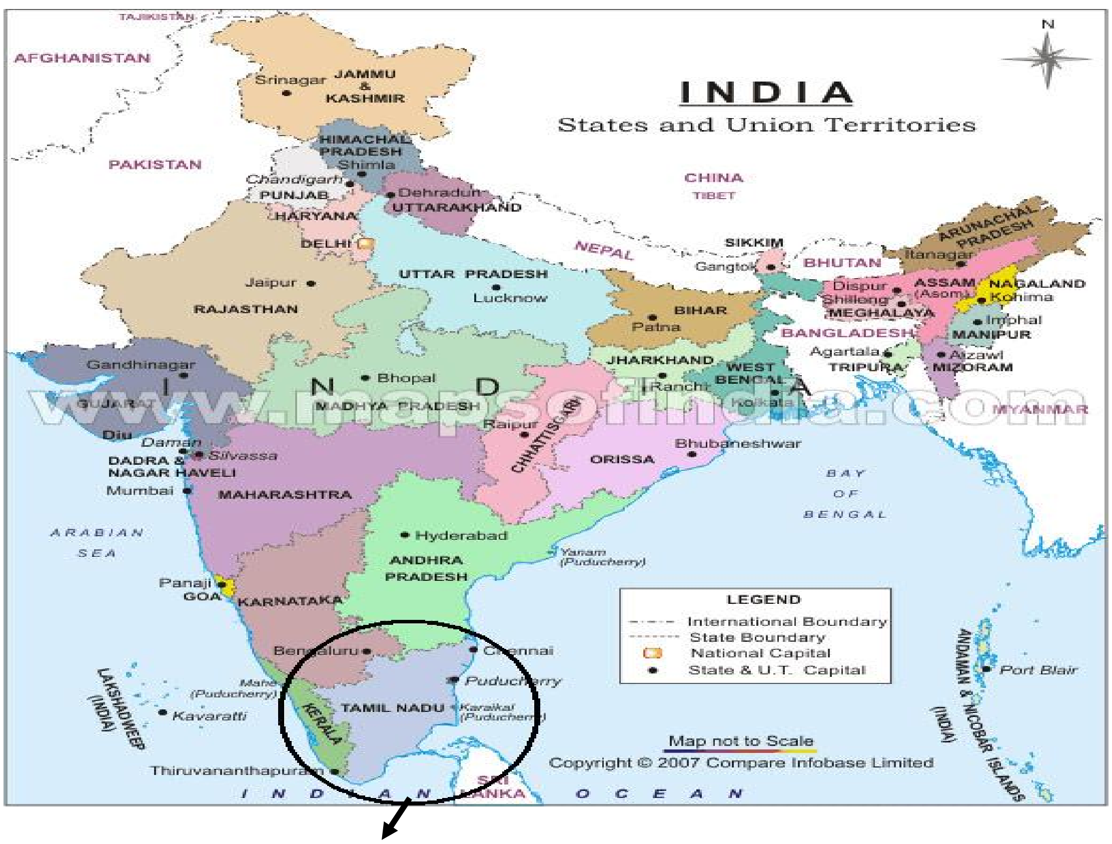
Suzlon WEGs are installed in districts of Tirunelveli and Vestas WEGs are installed in Theni.

Madurai is the nearest airport and also the nearest railway station from Theni.

Tirunelveli has Trivandrum as the nearest airport and Valliyoor is the nearest railway station. The other details of WEGs are –

Make	Location No.	Survey Nos. (SF Nos.)	Village	Taluk	District	Latitude	Longitude
Vestas	234	SF No. 234/1(P)*, 234/6(P)	Poomalaikundu	Theni	Theni	$N9^0$ 53' 19.2''	$E77^0$ 26' 23.4''
Vestas	637	SF No. 637/5A(P), 648/2(P), 648/4	Poomalaikundu	Theni	Theni	$N9^0$ 53 39.0	$E77^0$ 26' 59.1''
Vestas	122	SF No. 122/1B(P), 122/1C(P), 122/1D, 123/1(P)	Vallalnathi	Andipatti	Theni	$N9^0$ 56' 07.5''	$E77^0$ 32' 24.3''
Vestas	147	SF No.147/2A(P), 147/3A, 147/3B, 148/2(P)	G.Usilampatti	Andipatti	Theni	$N9^0$ 56' 01.0''	$E77^0$ 32' 58.8''
Suzlon	R - 142	540/1(P),540/2(P), 540/3(P),541/1, 541/2(P),542/2B(P)	Udhayathoor	Radhapuram	Tirunelveli	$N08^0$ 15' 21.3''	$E77^0$ 45' 10.5''
Suzlon	R-300	300/4A(P),300/4B, 300/4C(P),300/4D(P), 300/4E,300/4F, 300/4G,300/4H, 300/4I,300/4J, 300/4K,300/4L,	Thiruvambalapuram	Radhapuram	Tirunelveli	$N08^0$ 15' 01.4''	$E77^0$ 43' 31.0''

		300/4M(P), 300/4N(P),300/4S(P), 300/4T(P)					
Suzlon	R-432	203/1(P)	Kasthurirengapuram	Radhapuram	Tirunelveli	N08^0 16' 59.1''	E77^0 46' 42.6''
Suzlon	R-435	433/2A(P),433/2B, 433/2C,433/2D, 433/2E(P),433/2H(P), 433/2I,433/2J, 433/2K(P)	Udhayathoor	Radhapuram	Tirunelveli	N08^0 14' 23.6''	E77^0 44' 25.7''
Suzlon	R-436	492/1B(P)	Udhayathoor	Radhapuram	Tirunelveli	N08^0 15' 0.8''	E77^0 44' 13.1''
***(P) indicates Part**							



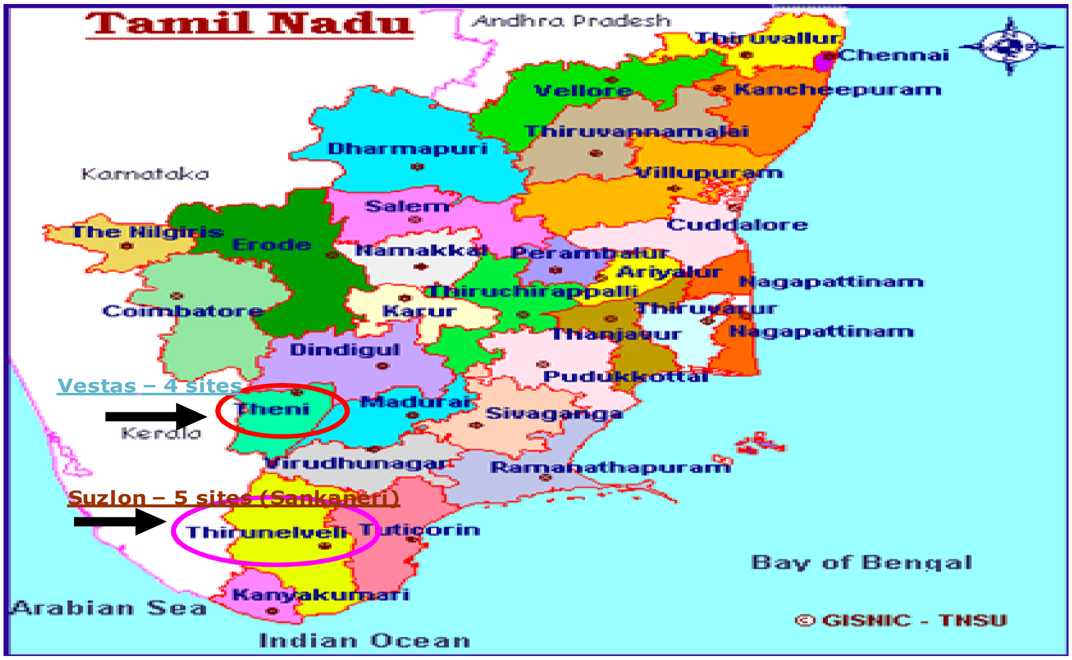


Fig.2 Location of Theni and Tirunelveli

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

The type and category of project activity as per Appendix B to the simplified modalities and procedures for small-scale CDM project activities are as under:

Sectoral Scope I Energy Industries (renewable/non-renewable sources).
Project Type: I, Renewable energy projects
Project Category: D, Grid connected renewable electricity generation

Technical Description of the Project Activity

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 to the mechanical energy of rotation of the blades. The generator converts this mechanical energy of rotation into electricity.The technology is a clean technology since there are no GHG emissions associated with the electricity generation.

The project installs the model V82 Vestas-make WEGs of individual capacity of 1.65 MW and S82 Suzlon-make WEGs of 1.5 MW. Technical specifications of the WEGs are furnished in Appendix-1

Technology transfer:
No technology transfer from other countries is involved in this project activity

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Renewable crediting period, of 21 years, is being opted. The emission reduction during the first crediting period is-

Years	**Estimation of annual emission reductions in tonnes of CO_2e**
Year 1 (01/12/2009-30/11/2010)	36,154
Year 2 (01/12/2010-30/11/2011)	36,154
Year 3 (01/12/2011-30/11/2012)	36,2534
Year 4 (01/12/2012-30/11/2013)	36,154
Year 5 (01/12/2013-30/11/2014)	36,154
Year 6 (01/12/2014-30/11/2015)	36,154
Year 7 (01/12/2015-30/11/2016)	36,2534
Total estimated reductions (tonnes of CO_2e)	2,53,2768
Crediting period (Years)	**7**
Average	36,182

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

No public funding or Official Development Assistance (ODA) has been used on this project activity

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

According to paragraph 2 of Appendix C to the Simplified Modalities and Procedures for Small-Scale CDM project activities (FCCC/CP/2002/7/Add.3), a small-scale project is considered a debundled component of a large project activity if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same project participants
- In the same project category and technology
- Registered within the previous two years; and
- Whose project boundary is within 1km of the project boundary of the proposed small scale activity

The project participant hereby confirm that there is no registered small scale project activity within the previous two years with them in the same project category and technology whose project boundary is within 1 km of the project boundary of the proposed small scale activity.

SECTION B. Application of a baseline and monitoring methodology

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

Project Type: I - Renewable energy project
Project Category: I D - Grid connected renewable electricity generation
Version: 13
Reference: Appendix B of the simplified M&P for small scale CDM project activities (UNFCCC, 2003b)

B.2 Justification of the choice of the project category:

The approved small scale methodology AMS 1D Version 13 is the choice of the baseline and monitoring methodology and is applicable because:

AMS I.D applicability criteria	Compliance of the proposed project activity
This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	The Project is wind based renewable energy source, zero emission power project connected to the Tamil Nadu state grid, which forms part of the Southern regional electricity grid. The Project will displace equivalent amount of fossil fuel based electricity generation that would have otherwise been provided by the operation and expansion of the fossil fuel based power plants in Southern regional electricity grid.
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 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.	The project activity has only renewable energy component and the capacity is less than 15 MW (14.1 MW)
Combined heat and power (co-generation) systems are not eligible under this category.	The project activity is not a co-generation
In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be	The project activity is a green field activity of capacity 14.1 MW

physically distinct from the existing units.	
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.	The project activity is a green field activity of capacity 14.1 MW

B.3. Description of the project boundary:

The project boundary encompasses the physical, geographical site of the WEGs at Theni and Tirunelveli.

As the "Tool to calculate the emission factor for an electricity system", version 01.1, for the baseline emission factor (used for baseline emission calculation, ref. Section B.4) states that the spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to, the project boundary is composed of the Wind Energy Generators, the metering equipment for each generator and substation, and the grid which is used to transmit the generated electricity.

Historically, the Indian power system was divided into five independent regional grids, namely Northern, Eastern, Western, Southern, and North-Eastern. Each grid covered several states. Since August 2006, however, all regional grids except the Southern Grid have been integrated and are operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids will be treated as a single grid and is being named as NEWNE grid from FY 2007-08 onwards as depicted in the CO_2 Baseline Database. The Southern grid has also been planned to be synchronously operated with rest of all Indian Grid by early 12^{th} Plan (2012-2017).

Power generation and supply within the two grids 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 their demand with their 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.

As the Project is connected to the Southern regional electricity grid, the Southern grid is the "project electricity system".

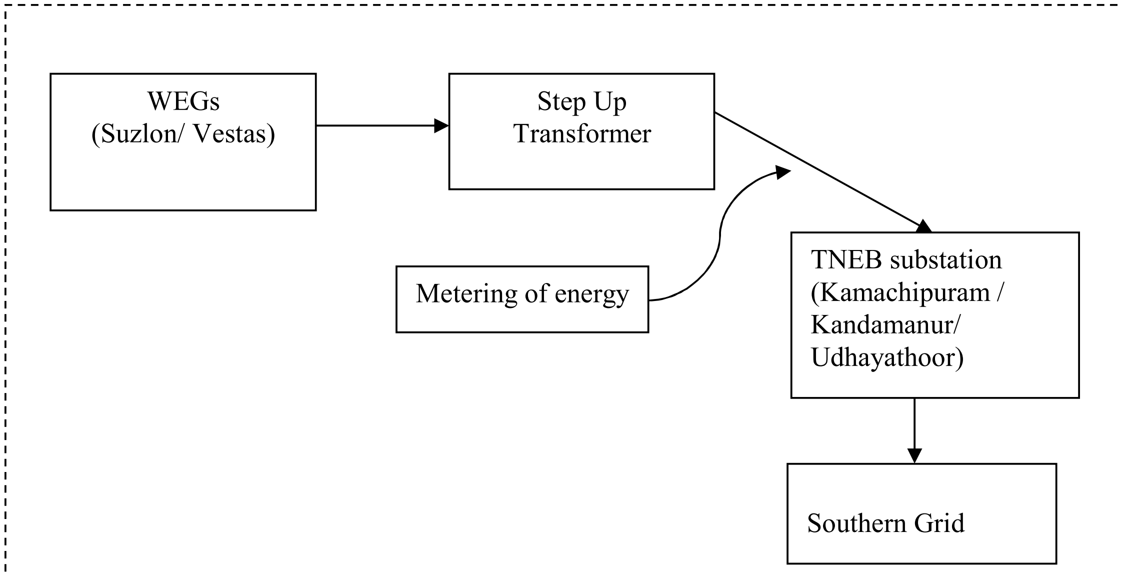


Fig.3 Project boundary

- - - - Project Boundary

All the Vestas WEGs are connected to Kamachipuram and Kandamanur substation and Suzlon WEGs are connected to Udhayathoor substation of TNEB.

B.4. Description of baseline and its development:

As per the Indicative Simplified Baseline and Monitoring Methodologies for selected small scale CDM Project activity categories (AMS.I.D Version 13 Scope 1), the baseline for wind energy generating systems is the electricity (measured in kWh) produced by the generating unit multiplied by an emission coefficient (measured in tCO_2e/MWh) calculated in a transparent and conservative manner as either of the following.

(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 tCO_2e/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

We have used option (a) i.e. combined margin as per "Tool to calculate the emission factor for an electricity system" version 01.1, as the emission co-efficient for calculating the baseline emissions. (Details in Section B.6.1)

Since 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.

Accordingly the baseline emissions are given as:

BEy = EGy * EFy …………………………..(1)

Where:

- BEy Baseline emissions (tCO_2e/year)
- EGy Electricity generation by the project activity (MWh/year)
- EFy Baseline emission coefficient determined in accordance with option (a) specified above

The key information and data used for calculation of baseline have been taken from following sources:

S.No.	Key Information/data used for baseline	Source of data/information
1.	Electricity generation	Joint Meter Reading at Site
2.	Emission factor based on combined margin of the Southern electricity grid	Baseline Carbon Dioxide Emission Database Version 4.0[3] from the Central Electricity Authority website http://www.cea.nic.in
3.	Plant Load Factor	As per generations estimates given by Sulzon and Vestas

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 small-scale CDM project activity:

The project installs WEGs for captive consumption of the generated electricity. The wheeling agreement between ITC Ltd and TNEB allows for wheeling of the generated electricity from the Kandamanur, Kamachipuram and Udhayathoor substations to ITC's printing and packaging plant located at Tiruvottiyur. TNEB also allows banking of energy for 1 year for the period between April to March Unutilized energy, between 1 April to 31 March, cannot be carried forward beyond 31 March.

In the absence of this project, this energy would have been drawn from the Southern grid, which is fossil fuel power plant dominated (ref. Section B.6.1). As wind energy generation is free from any emissions and energy would anyway be withdrawn from the southern grid, there is reduction in GHG emission after installation of the WEGs. However, CER revenues are must for this project to become financially viable.

The low cost of power purchase from the WEGs by TNEB adversely affects the project financial return. The low return on the sale of power leads to project proponents in Tamil Nadu using the energy for their captive use. Even with this model, the project is financially not attractive for ITC. ITC Limited approved this project based on financial feasibility because of CER revenues that would be generated after this project is registered as a CDM project.
The chronology of events is as follows-

Date	Event
15th September, 2006	Contract with PwC (Consultants)
6th March,2008	Note on project feasibility
23rd April, 2008	CMC meeting approving the project based on the note
25th April, 2008	email from corporate conveying confirmation of the project approval based on the project note

[3] http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver4.zip

	dated 6th March, 2008
29th April, 2008	Certification from SBU Management committee of the directives given by CMC
10th July, 2008	Purchase orders for Suzlon
23rd & 25th July, 2008	Purchase orders for Vestas
5th September, 2008	Intimation to DNA and UNFCCC regarding the wind project
20th September, 2008	2 Suzlon WEGs commissioned
23rd September, 2008	2 Vestas WEGs commissioned
24th September, 2008	1 Suzlon WEG commissioned
26th September, 2008	1 Suzlon WEG commissioned
27th September, 2008	1 Suzlon WEG commissioned
30th September, 2008	2 Vestas WEGs commissioned
23rd and 24th October, 2008	Stakeholder Consultation meeting
15th November, 2008	Contract with DNV (DoE)
5th March, 2009	Submission for DNA approval

Investment into wind involves greater risk as compared to other projects. Its dependence on the climatic condition of the region gives rise to a high uncertainty factor that puts the whole project investment into peril.

Investment Barrier

A suitable financial indicator, **post tax equity IRR** has been identified to demonstrate the investment barriers faced by the project. The post tax IRR of the project has been compared with the benchmark Cost of Equity.

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, where there is no debt component involved

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

The benchmark cost of equity for the project is 15.94%.

The assumptions made in the project are-

		Remarks/Sources	
Capacity of Machines in MW	1.5 & 1.65 MW	From Purchase orders	
Number of Machines	9.00	From Purchase orders	
Project Capacity in MW	14.10	From Purchase orders	
Project Commissioning Date	Sep-08	From Commissioning certificate	

Project Cost per MW (Rs. In Millions)	63.63	From Purchase orders	
Operations			
Base Plant Load Factor in %	31.57	As per calculations in the financial model	
Captive consumption (Million units)	35.27	Board note	
Insurance Charges @ % of capital cost	0.12%	Purchase orders	
% Escalation of Insurance charges	5%		
Operation & Maintenance Cost base year @ % of capital cost	2.04%	Purchase orders	
% of escalation per annum on O & M Charges	5.0%	Purchase orders	
Tariff			
Wind energy sale tariff (Rs.)	*2.18*	TNERC tariff order and Wheeling agreement (75% of the normal tariff of Rs. 2.90/unit)	
HT Tariff (Rs.)	*3.71*	Energy bills	
Reactive energy charge (Rs./kvarh)	*0.25*	Wheeling agreement	
Reactive energy as % of gross generation	*5 %*	Assumption based on estimates from vendors at the time of investment decision	
Banking charges (% of energy banked)	*5 %*	Wheeling agreement	
Banked energy (% of total energy generated)	28%	Assumption from data given by vendors at the time of investment decision	
Wheeling charges for Captive operations (% of energy generated)	*5 %*	Wheeling agreement	
Generation Tax (Rs./KWh)	0.1		
Project Cost			
Land and Infrastructure, Generator & Electrical Equipments, Mechanical Equipments, Civil Works, Instrumentation & Control, Other Project Cost, Pre operative Expenses, etc.			
Total Project Cost	**Rs. 897.20 million**	Purchase orders	
Means of Finance			
Own Source	Rs 897.2 Million	Purchase orders	
Term Loan	0		
Total Source			
Terms of Loan			
Interest Rate	*NA*		
Tenure	*NA*		

Moratorium	*NA*	
Income Tax Depreciation Rate (Written Down Value basis)		
on Wind Energy Generators	*80%*	As per Indian Income Tax act
On other Assets	*0%*	
Book Depreciation Rate (Straight Line Method basis)		
On all assets	*5%*	Assumed
Book Depreciation up to (% of asset value)	*100%*	Assumed
Income Tax		
Income Tax rate	*34%*	As per Indian Income Tax act
Minimum Alternate Tax	*11%*	As per Indian Income Tax act
Working capital		
Receivables (no of days)	*0*	
O & m expenses (no of days)	*0*	
Working capital interest rate	*0%*	
Date of Purchase order	**10-Jul-08**	Purchase orders
Delivery and erection	**2 months**	Based on timeline in the Purchase Order
Crediting period starts	**1-December-09**	Assumed
Length of Crediting period	**21 years**	Assumed
Baseline Emission Factor for Southern Region (tCO_2/MWh)	**0.92718**	As per section B.6.1

The post tax equity IRR for base PLFs of 31.57% is 11.36% which is below the benchmark of 15.94%. **This proves the additionality of the project.**

Sensitivity Analysis on PLF
The base PLF is based on the estimated generations given by Suzlon and Vestas in their Purchase Orders (Please see excel sheet 'Base PLF Calculation' in the financial model). The PLF for Vestas machines has been calculated after ignoring the following factors for conservativeness-

1. Modelling error (5%)
2. Uncertainty of wind (5%)

Even through it is highly unlikely that the PLF would go above the base PLF, we have still conducted a sensitivity analysis on the base PLF to demonstrate that the benchmark is not crossed even with 10% increase in base PLF.

PLF	Post tax equity IRR without CER revenues in %
28.41% (- 10%)	9.34
31.57% (0%)	11.36
34.73 (+10%)	12.4

It's clear from the above analysis that even a 10% increase in PLF, the post tax equity IRR is below the benchmark. The equity IRR improves after CER revenues are considered, therefore the CER revenues can improve the commercial attractiveness of the project activity. The equity IRR with CDM revenues is 17.39%, above the benchmark.

Sensitivity Analysis on Capital cost

The capital cost considered for IRR calculations is the final negotiated value agreed with the WEG suppliers. The WEGs EPC contracts are fixed price contract and are not subject to any variations. Therefore any subsequent variation in capital cost is unlikely. We have still carried out a sensitivity analysis to show the additionality of the project even at 10% decrease in capital cost.

Capital Cost	Post tax equity IRR without CER revenues in %
807.48 (-10%)	13.63
897.2 (0%)	11.36
986.92 (+10%)	9.41

Sensitivity on O&M cost

O&M	Post tax equity IRR without CER revenues in %
1.83% (- 10%)	11.64
2.04% (0%)	11.36
2.24% (+10%)	11.09

The equity IRR is below the benchmark at 10% reduction in O&M cost.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emission reductions are calculated as:

ERy = BEy – PEy – Ly

Where: *BEy* is the baseline emissions
PEy is project activity emissions and;
Ly is the amount of emissions leakage resulting from the project activity.

Baseline Emissions for the amount of electricity supplied by project activity, *BEy* is calculated as

BEy = EGy * EFy

Where: *EGy* is the electricity supplied to the grid,
EFy is CO_2 emission factor of the grid

Calculation of Baseline Emission Factor

According to AMS I.D, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as:
(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'
(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The project proponent has chosen the combined margin approach to calculate the emission coefficient for the grid. According to the tool the baseline emission coefficient will be determined using the following steps:

STEP 1. Identifying the relevant electric power system

Southern grid as per section B.3

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:

<table>
<tr><th></th><th>2000-01</th><th>2001-02</th><th>2002-03</th><th>2003-04</th><th>2004-05</th><th>2005-06</th><th>2007-08[4]</th></tr>
<tr><td>North</td><td>25.9%</td><td>25.7%</td><td>26.1%</td><td>28.1%</td><td>26.8%</td><td>28.1%</td><td rowspan="2">19.0%</td></tr>
<tr><td>East</td><td>10.8%</td><td>13.4%</td><td>7.5%</td><td>10.3%</td><td>10.5%</td><td>7.2%</td></tr>
<tr><td>South</td><td>28.1%</td><td>25.5%</td><td>18.3%</td><td>16.2%</td><td>21.6%</td><td>27.0%</td><td>27.1%</td></tr>
<tr><td>West</td><td>8.2%</td><td>8.5%</td><td>8.2%</td><td>9.1%</td><td>8.8%</td><td>12.0%</td><td rowspan="2">19.0%</td></tr>
<tr><td>North-East</td><td>42.2%</td><td>41.7%</td><td>45.8%</td><td>41.9%</td><td>55.5%</td><td>52.7%</td></tr>
<tr><td>India</td><td>19.2%</td><td>18.9%</td><td>16.3%</td><td>17.1%</td><td>18.0%</td><td>20.1%</td><td>21.0%</td></tr>
</table>

Source: CO_2 Baseline Database for the Indian Power Sector – Central Electricity Authority

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

The 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 CO_2 emissions per unit net electricity generation (tCO_2/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 CO_2 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.

[4] Based on the re-categorized grids according to http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver4.zip

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:

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

Where:
$EF_{grid,\ OMsimple,\ y}$ is Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,\ y}$ is the net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,\ m,\ y}$ CO_2 is emission factor of power unit m in year y (tCO_2/MWh)
m is all power units serving the grid in year y except low-cost / must-run power units
y is 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

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

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

The average ex-ante OM value obtained is 0.9985 tCO_2/MWh

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 CO_2 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 value obtained is 0.713 tCO_2/MWh

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:

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

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, $w_{OM} = 0.75$ & $w_{BM} = 0.25$ and $w_{OM} + w_{BM} = 1$)

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 927.18 tCO_2e/GWh or 0.92718 tCO_2e/MWh.

Project Emissions:

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

$PE_y = 0$

Leakage:

Since no equipment is transferred from another project activity or that any existing equipment is transferred to another activity, leakage as per AMS ID is taken as zero.

Ly = 0

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 CO_2 Baseline Database for the Indian Power Sector
Ministry of Power: Central Electricity Authority (CEA)
Version 4
Dated: 1st September 2008
Key baseline information is reproduced in annexure 3.
The detailed excel sheet is available at:
http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

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

Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO_2e/MWh
Description:	Operating Margin Emission Factor of Southern Regional Electricity Grid
Source of data used:	"CO_2 Baseline Database for Indian Power Sector" published by the Central Electricity Authority, Ministry of Power, Government of India. The "CO_2 Baseline Database for Indian Power Sector" is available at www.cea.nic.in
Value applied:	0.9985
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 "Tool to calculate emission factor for an electricity system".
Any comment:	

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2e/MWh
Description:	Build Margin Emission Factor of Southern Regional Electricity Grid
Source of data used:	"CO_2 Baseline Database for Indian Power Sector" published by the Central Electricity Authority, Ministry of Power, Government of India. The "CO_2 Baseline Database for Indian Power Sector" is available at www.cea.nic.in
Value applied:	0.713
Justification of the choice of data or description of	Build Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with "Tool to calculate emission factor for an

measurement methods and procedures actually applied :	electricity system".
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Emission Reductions = Baseline emissions – Project emissions – Leakage

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)
= 0.92718 tCO_2e/MWh

Annual electricity supplied to the grid by the Project
= 14.1 MW (Capacity) x 31.57% (PLF) x 8760 (hours)
= 38,994 MWh

Annual baseline emissions
= 0.92718 tCO_2e/MWh x 38994 MWh
= 36,154 tCO_2e

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

The emission reductions for the first of 3 crediting periods is-

Years	Estimation of project activity emissions ($tCO2_e$)	Estimation of baseline Emissions ($tCO2_e$)	Estimation of Leakage ($tCO2_e$)	Estimation of overall emission reductions ($tCO2_e$)
Year 1 (01/12/2009-30/11/2010)	0	36,154	0	36,154
Year 2 (01/12/2010-30/11/2011)	0	36,154	0	36,154
Year 3 (01/12/2011-30/11/2012)	0	36,253~~4~~	0	36,253~~4~~
Year 4 (01/12/2012-30/11/2013)	0	36,154	0	36,154
Year 5 (01/12/2013-30/11/2014)	0	36,154	0	36,154
Year 6 (01/12/2014-30/11/2015)	0	36,154	0	36,154
Year 7 (01/12/2015-30/11/2016)	0	36,253~~4~~	0	36,253~~4~~
Total (tonnes of $CO2_e$)	**0**	2,53,27~~8~~6	**0**	2,53,276~~8~~

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

B.7.1 Data and parameters monitored:

Data / Parameter:	EGy
Data unit:	MWh (Mega-watt hour)
Description:	Net electricity supplied to the grid by the Project
Source of data to be used:	Electricity supplied to the grid as per the joint meter readings
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Annual electricity supplied to the grid by the Project = 14.1 MW (Capacity) x 31.57% (PLF) x 8760 (hours) = 38,994 MWh
Description of measurement methods and procedures to be applied:	Net electricity supplied to grid is measured by main meters (export and import) at the Metering Point. This is further described in Annexure – 4.
QA/QC procedures to be applied:	QA/QC procedures are elaborated in Annexure – 4 (Monitoring Plan).
Any comment:	

B.7.2 Description of the monitoring plan:

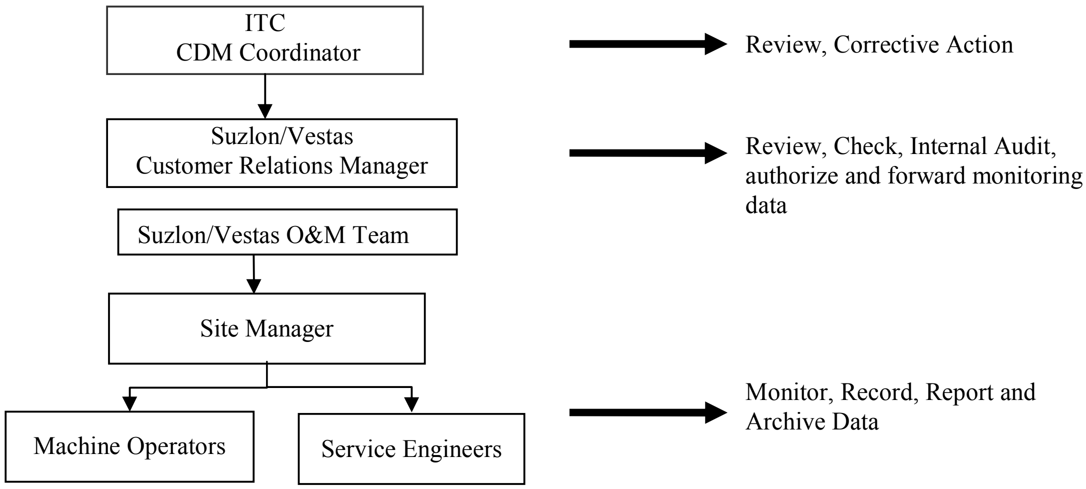
The project activity falls in the technology measure as described in the paragraph 1 of the Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. The applicable simplified baseline and monitoring methodology for selected small scale CDM project activities AMS I.D. version 13 requires monitoring of the following.

- Metering the electricity generated by the renewable technology
- In the case of co-fired plants, the amount of biomass and fossil fuel input consumed.

Further, wind based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity supplied to the grid. The Project is operated and managed by Suzlon and Vestas. They follow 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 as set in the power purchase agreement. The project will adhere to all the mandatory regulatory and statutory requirements at the state as well as national level.

The operational and management structure implemented by ITC along with Suzlon and Vestas is as follows-



The daily generation report is sent to ITC by Suzlon and Vestas relationship manager. The daily generation report contains data on grid availability, machine availability and generation of electricity. ITC reviews the machine availability from the generation report and initiates the forward corrective action request to Suzlon and Vestas in case the performance is not as per agreed O&M terms.

The monitored data will be maintained as hard copies in the form of photo copies of generation report, issued by TNEB every month showing export and import of energy. The copies of such TNEB generation report are primary document relating to actual number of units fed to the grid and will be maintained for 7+2 years (crediting + 2 years) Daily generation reports from Suzlon and Vestas would be compiled into monthly reports and saved electronically for 7+2 years (crediting + 2 years).
Details of the meter reading are available in Annex. 4

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

Date of completion: 31st October, 2008
Name of responsible person/entity: ITC limited and consultants appointed by them

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:

10/07/2008 – Purchase Order for supply of Plant & WEGs

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

20 Years

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

Renewable 21 Years

C.2.1. Renewable crediting period

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

01/12/2009 or the date of registration with UNFCCC (whichever is later)

C.2.1.2. Length of the first crediting period:

7 Years and 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

NA

C.2.2.2. Length:

NA

SECTION D. Environmental impacts

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

As per the Schedule 1 of the EIA notification 2006, given by the Ministry of Environment and Forests under the Environment (Protection) Act 1986, the proposed project doesn't fall under the list of activities requiring EIA[5]. 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, thus no EIA study was conducted.

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

The environmental impacts from the proposed CDM project activity are not considered significant.

SECTION E. Stakeholders' comments

[5] http://envfor.nic.in/divisions/iass/notif/eia.htm

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

Stakeholder's consultation meeting was organized on 23 Oct 2008 at Theni district and on 24 Oct 2008 at Tirunelveli district. Notice was circulated to all the stakeholders 15 days in advance to the meeting dates. The stakeholders included the original land owners, residents of the nearby villages, representative of local NGO, representatives of Suzlon/Vestas team, representatives of ITC Limited, etc. Meeting at Theni was headed by Mr.S Murugan, AHM Trust (NGO) and at Tirunelveli by Mr. Jesu Antony, Head, Thiruvambalapuram Village.

The meeting included talks on Clean Development Mechanism, developments in the area because of the project and ITC's commitment towards sustainable development. The talks were translated into Tamil, whenever required. An interactive session with the villagers helped clear their doubts about the project's impact on agriculture. A questionnaire was also circulated at the end.

The minutes of meeting are available in Appendix 2.

E.2. Summary of the comments received:

The stakeholders gave their responses during the interaction session and through the questionnaires that was circulated at the end of the meeting. Villagers at Theni were concerned about the impact on ground water levels and agriculture yield of the land after implementation of the project as wind mill installation is new to this area. There were no such concerns in the meeting at Tirunelveli as the villagers are well aware about absence of these impacts.

Villagers were happy because of the huge investment that is being pumped into their area and were excited about new employment opportunities and infrastructure developments because of the project. They were also pleased because of the enhancement of street lighting, they could travel during night. Copies of the filled questionnaires from the attendees of the meeting are available for verification.

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

Technical representatives of Vestas addressed the concern by Villagers in Theni regarding the impact on ground water level and agriculture yield. The villagers were quoted numerous examples of successful wind mill installation in the state and elsewhere in the country. They mentioned that wind mill installation used an environmentally benign source and hence have no effect on the ground water level or agriculture yield.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	ITC Limited
Street/P.O.Box:	SBU- Packaging & Printing
Building:	90, Chamiers Road (New no. 84)
City:	Chennai
State/Region:	Tamil Nadu
Postfix/ZIP:	600018
Country:	India
Telephone:	+91 44 42081502
FAX:	+91 44 24340294
E-Mail:	
URL:	www.itcportal.com
Represented by:	B. K. Pramanick
Title:	Head of Finance, SBU – Packaging and Printing
Salutation:	Mr.
Last Name:	
Middle Name:	
First Name:	B. K. Pramanick
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Direct tel:	+91 44 42081502
Personal E-Mail:	Biman.Pramanick@itc.in

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No Pubic funds are available

Annex 3

BASELINE INFORMATION

Baseline Emission Factor:

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

Simple Operating Margin

	tCO2e/MWh
Simple Operating Margin - 2005-06	1.0057
Simple Operating Margin - 2006-07	0.9991
Simple Operating Margin - 2007-08	0.9906
Average Operating Margin of last three years	0.9985

Build Margin

	tCO2e/MWh
Build Margin- 2007-08	0.713

Combined Margin calculations

	Weights	**tCO2e/MWh**
Operating Margin	0.75	0.9985
Build Margin	0.25	0.713
Combined Margin		**0.92718**

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

Annex 4

MONITORING INFORMATION

- Meters are installed right next to each WEG
- The Wind Energy Generator will provide with energy meters with facilities to record export and import of energy. The meter has 0.5 class accuracy.
- The reading of the meters shall be taken periodically by authorized officer of TNEB and representative of Vestas/Suzlon, if present.
- ITC Ltd will install check meters at each WEG. There check meters will be approved by TNEB and would be used in case the main meter fails.
- The meters shall be calibrated once in a year. Both parties shall seal Main and Check meters. Defective meters shall be replaced immediately.
- If during the annual calibrations, both the main and the check meters are found to have errors beyond permissible limits, the bill shall be revised for the previous 3 months or the exact period of know and agreed upon by both the parties, by applying corrections as determined by the meter testing wing of TNEB to the consumption registered by the meter with lesser error.

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Annex 5

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, cost of equity has been chosen as the appropriate benchmark as the project has zero debt component.

Cost of Equity:

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM)[6]. 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.

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;

[6] 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 188 of text book on "Corporate Finance Theory and Practice" by Dr. Aswath Damodaran[7], 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 time of board note preparation (6-March-2008). This has been considered as it was in the year of investment (i.e in that year, the company had the alternative of this long term risk free investment). The data on government bond rates is published by Reserve Bank of India. (Web-link: http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/87503.pdf)

The applicable risk free rate is 7.89 %.

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 4]. 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 4]. It is also preferred to calculate the risk premium based on geometric mean of the returns since arithmetic mean overstates the risk premium. Geometric mean is defined as the compounded annual return over the same period [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran. Attached as appendix 5].

Therefore the risk premium has been calculated as the difference in compounded annual return bewteen the BSE-Sensex and the Government bond rates since the year of inception of BSE Sensex, i.e. 1979 – 80. The detailed calculations are presented in the attached excel sheet.

The applicable risk premium is 9.36 %.

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 are no company purely into wind energy business listed on any stock

[7] Dr. Damodaran, one of the foremost authorities in the world in the field of Investment Analysis

exchange in India (both BSE- Bombay Stock Exchange and NSE-National Stock Exchange) in year 2008. 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 (5 years average). The value of Beta is specific to company's debt equity ratio. So as to make it relevant to the project's 100% equity case, the equity beta has been calculated after unlevering (for company specific debt/equity ratio) and then levering (for 0% debt) the beta value.

The table below summarizes the beta values:

Company Name	Beta (Levered)=A	Tax rate=B	D/E Ratio=C	Un-levered Beta =A/(1+(1-B)*C)=D	D/E ratio of project=E	Re-levered Equity Beta=D/(1+(1-B)*E)
JAIPRAKASH	0.997	11.31%	0.313	0.780	0.000	0.780
NTPC LIMITED	0.8	27.83%	0.187	0.705	0.000	0.705
CESC	1.302	0	0.393	0.934	0.000	0.934
ENERGY DEV CO	0.875	22.22%	0.062	0.835	0.000	0.835
GUJARAT INDS	0.92	0.2707	0.499	0.675	0.000	0.675
NEYVELI LIGNITE	1.189	0.225	0.139	1.074	0.000	1.074
RELIANCE INFRA	1.187	0.0752	0.200	1.001	0.000	1.001
TATA POWER CO	1.115	0.2431	0.352	0.880	0.000	0.880
Average Beta	**1.05**			0.861		**0.861**

Cost of Equity

Ke = Rf + B x (Rm - Rf)

Rf= Risk-free rate of return = 7.89%

Rm – Rf = Market risk premium = Market Return – Average Risk Free Return = 19.58% - 10.22% = 9.36%

Cost of Equity = 7.89% + 0.861*(9.36%) = 15.94%

Appendix 1

Technical specifications of Suzlon S 82/1500kW

Rotor

Diameter	82 m
No of Rotor Blade	3
Orientation	Upwind/Horizontal axis
Rotational Direction	Clockwise
Rotor Blade material	GRP
Rotor swept area	5281 m^2
Hub Height	78.5 m
Regulations	Pitch regulated

Operational Data

Cut-in wind speed	4 m/sec
Rated wind speed	14 m/sec
Cut out wind speed	20 m/sec

Gear Box

Type	Integrated 3 stage- 1 planetary and 2 helical

Gear ratio	1:95.09
Manufacturer	Winergy/Hansen
Nominal load	1650 kW

Yaw drive system

Method of operation	Active electrical yaw motors
Bearing type	Polamide slide bearing

Operating brakes

Aerodynamic brake	3 times independent pitch regulated
Mechanical brake	Hydraulic disc brakes

Generator

Type	Asynchronous Generator 4 pole
Rotation speed	1511 RPM
Rated Output	1500 kW
Rated Voltage	690 V
Frequency	50 Hz
Protection	IP 54
Insulation	Class "H"
Enclosure class	IP 54
Cooling system	Air cooled
Slip Control	Macro slip providing sip upto 16.7%

Technical specifications of Vestas V 82/1650kW

Diameter:	82 m
Area swept:	5,281 m2

Nominal revolutions: 14.4 rpm

Number of blades: 3

Power regulation: Active-Stall®

Air brake: Full blade pitch by three separate hydraulic pitch cylinders

Tower

50Hz, 230V: Hub height (approx.) 78 m

Operational data

Cut- in wind speed: 3.5 m/s

Nominal wind speed: 13 m/s

Cut-out wind speed

(10 minutes): 20 m/s

Generator

Type: Asynchronous water cooled

Nominal output: 1,650 kW

Operational data: 50/60 Hz 690/600V

Gearbox

Type: Planetary/helical stages

Control

Type: Microprocessor-based monitoring of all turbine functions with the option of remote monitoring. Output regulation and optimisation via Active-Stall®.

Appendix 2

Stakeholder meeting on 23rd October

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23rd October 2008

STAKE HOLDER'S MEETING

ITC has conducted a stakeholder meeting on 23rd October 2008 for the "14.1 MW grid connected wind energy project in Tamil Nadu by ITC Limited" at Vallalnathi village, Theni District.

People Present at the meeting:

1. Mr. S Murugan, WTC Coordinator, Ambelal Heinrch Memorial Trust (NGO)- Chairperson
2. Mr. Ramaswamy Pillai - Senior Engineer, Vestas Wind Technology India Pvt. Ltd.
3. Mrs. Radha Vijayaraghavan, Manager Finance, PPB,ITC
4. Mr. Sharique Ahmad, PwC
5. Representatives from the village

Agenda of the meeting

- Welcome speech by the organizers.
- Introduction to 'Clean Development Mechanism' by Mr. Sharique Ahmad
- Speech by Mrs. Radha Vijayaraghavan
- Interactive session with the stake holders.
- Vote of thanks.

Welcome Speech

The meeting started with the welcome address by Mr.Ramaswamy Pillai from Vestas Wind Technology India Private Limited and following that ITC had explained about the Wind Technology in detail and employment opportunities created by the project. The social benefits due to the implementation of wind mill and the arrangements made in the project to protect environment had been discussed.

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Introduction to CDM

Mr. Sharique Ahmad, PwC explained about CDM to all the stakeholders and in his speech he explained how carbon levels in the atmosphere is increasing and to reduce the green house gas emission various Non-Polluting initiatives are to be initiated. He further explained how wind farm Projects generates pollution free energy and helps in creating employment opportunities to the villagers. He further added wind power projects also helps in catering the power shortages faced by the nation.

Speech by ITC representative

Mrs Radha Vijayaraghavan started her speech by emphasizing ITC's commitment towards sustainable development and about their efforts to reduce global green house gas emissions. She then explained that the Wind mill technology is a suitable alternative to fossil fuel based power plants and the Green Power generated through Wind technology will reduce CO_2 emission from the fossil fuel based grid power.

Interactive session

The local population welcomes the project due to various benefits, such as development of infrastructure in the area.

The doubts of local people had been cleared by Vestas and the people expressed their consent. They told this unit would lead to social and environmental development.

Queries from stake holders and responses by the project proponent.

1. **Can the wind farm project lead to variation in rainfall ?**
   Wind power project does not result in to any variation in the rain fall and the same is proven scientifically.

2. **Has the project affected the ground water level?**
   No. Wind project does not affect either the ground level or drinking water quality of nearby area of the project.

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3. **How other source of power generation leads to pollution?**
   As power is generated mainly from fossil fuels which leads emission of CO_2 NO_X & SO_X and hence pollution.

4. **Will the project help in improving the electricity supply to the villagers or the neighborhood areas?**
   It is expected as power generated from wind is fed to state electricity grid.

Queries from project proponent and responses by the stake holders.

1. **Have you observed any disturbance due to noise from the project during the construction period?**
   No

2. **Did project provide employment opportunities or improve economic development of area?**
   Yes

3. **Are there any other benefits of wind power projects that you have observed? If yes, please list below.**
   Employment to local Villagers
   Improved transportation to Villagers

4. **Is there any problem for animals grazing or any other activity that you were carrying out in past at the site?**
   No

5. **Do the project personnel and authorities maintain a good relationship with villagers?**
   Yes

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6. **Should such projects be promoted?**
   Yes

7. **Would you like to know more about how electricity is generated from wind and why it is one of the cleanest sources of energy?**
   Yes

8. **Other Comments if any:**
   Village development
   Employment opportunity at village level

These kinds of projects shall be developed in all the districts

Vote of thanks

Mr. Ramaswamy Pillai delivered the vote of thanks.

NAME AND ADDRESS	SIGNATURE
1. S MURUGAN Women Development Co-ordinator A.H.M. TRUST B. Dharmathupatty Post (ChairPerson)	[signature]

Stakeholder meeting on 24th October 2008

ITC Limited
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90, Chamiers Road [New No. 44]
Chennai 600 018 India
Telephone 91 44 4206 1503
Fax +91 44 2434 0994

24th October 2008

STAKE HOLDER'S MEETING

ITC has conducted a stakeholder meeting on 24th October 2008 for the "14.1 MW grid connected wind energy project in Tamil Nadu by ITC Limited" at Radhapuram, Tirunelveli District.

People Present at the meeting:

1. Mr. Jesu Antony, Head, Thiruvambalapuram Village - Chairperson
2. Mr. R Kumaraswamy Pillai – Asst. Manager CRM, Suzlon Energy Limited
3. Mrs. Radha Vijayaraghavan, Manager Finance, PPB,ITC
4. Mr. Sharique Ahmad, PwC
5. Representatives from the village

Agenda of the meeting

- Welcome speech by the organizers
- Introduction to 'Clean Development Mechanism' by Mr. Sharique Ahmad
- Speech by Mrs. Radha Vijayaraghavan
- Interactive session with the stake holders.
- Vote of thanks.

Welcome Speech

The meeting started with the welcome address by Mr. R Kumaraswamy Pillai from Suzlon Energy Limited and following that ITC had explained about the Wind Technology in detail and employment opportunities created by the project. The social benefits due to the implementation of wind mill and the arrangements made in the project to protect environment had been discussed.

Introduction to CDM

Mr. Sharique Ahmad, PwC explained about CDM to all the stakeholders and in his speech he explained how carbon levels in the atmosphere is increasing and to reduce

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green house gas emission various Non-Polluting initiatives are to be initiated. He further explained how wind farm Projects generates pollution free energy and helps in creating employment opportunities to the villagers. He further added wind power projects also helps in catering the power shortages faced by the nation.

Speech by ITC representative

Mrs Radha Vijayaraghavan started her speech by emphasizing ITC's commitment towards sustainable development and about their efforts to reduce global green house gas emissions. She then explained that the Wind mill technology is a suitable alternative to fossil fuel based power plants and the Green Power generated through Wind technology will reduce CO_2 emission from the fossil fuel based grid power.

Interactive session

The local population welcomes the project due to various benefits, such as development of infrastructure in the area.

The doubts of local people had been cleared by Suzlon and the people expressed their consent. They told this unit would lead to social and environmental development.

Queries from stake holders and responses by the project proponent.

1. **Can the wind farm project lead to variation in rainfall ?**
   Wind power project does not result in to any variation in the rain fall and the same is proven scientifically.

2. **Has the project affected the ground water level?**
   No, Wind project does not affect either the ground level or drinking water quality of nearby area of the project.

3. **How other source of power generation leads to pollution?**
   As power is generated mainly from fossil fuels which leads emission of CO_2 NO_X & SO_X and hence pollution.

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4. **Will the project help in improving the electricity supply to the villagers or the neighborhood areas?**
   It is expected as power generated from wind is fed to state electricity grid.

Queries from project proponent and responses by the stake holders.

1. **Have you observed any disturbance due to noise from the project during the construction period?**
   No

2. **Did project provide employment opportunities or improve economic development of area?**
   Yes

3. **Are there any other benefits of wind power projects that you have observed? If yes, please list below.**
   Employment to local Villagers
   Improved transportation to Villagers

4. **Is there any problem for animals grazing or any other activity that you were carrying out in past at the site?**
   No

5. **Do the project personnel and authorities maintain a good relationship with villagers?**
   Yes

6. **Should such projects be promoted?**
   Yes

7. **Would you like to know more about how electricity is generated from wind and why it is one of the cleanest sources of energy?**
   Yes

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8. Other Comments if any:

Village development
Employment opportunity at village level
These kinds of projects shall be developed in all the districts

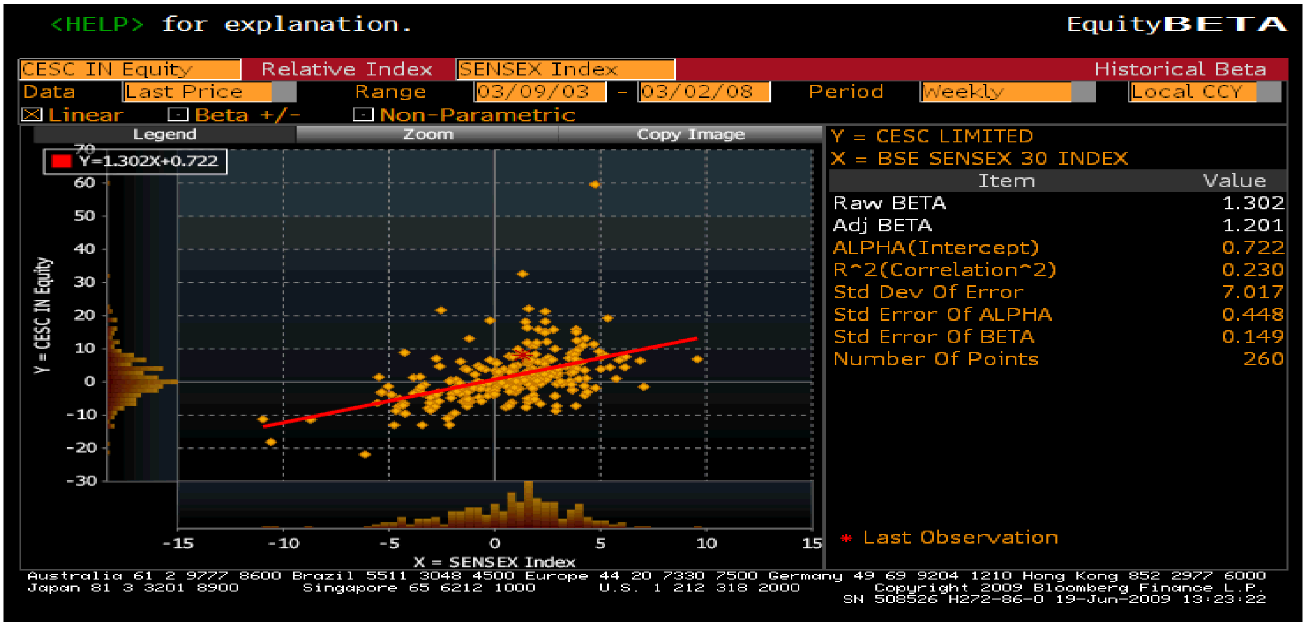
Vote of thanks

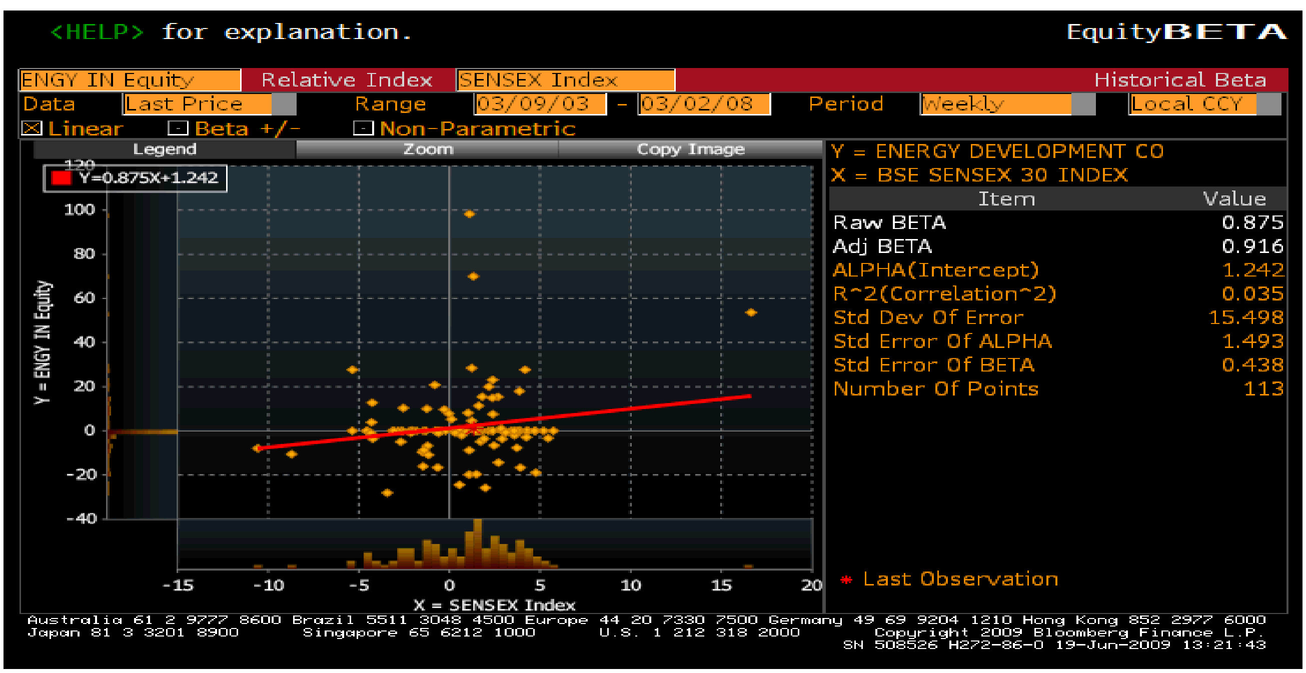
Mr. Kumaraswamy Pillai delivered the vote of thanks.

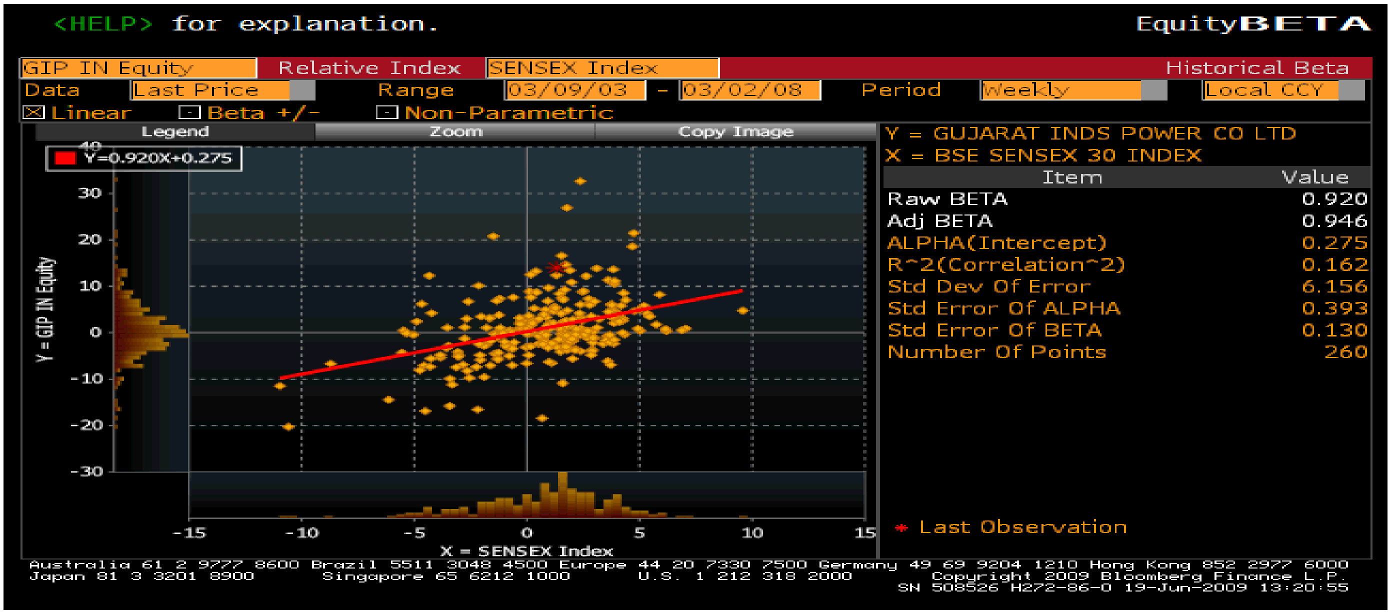
<u>**NAME AND ADDRESS**</u>	<u>**SIGNATURE**</u>
IAS [illegible] X. தலைவர். [illegible] [illegible]. கிராமம்.	IAS [illegible] 24/10/06

Appendix 3

Screenshots of Beta Value



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SENSEX Index
Historical Beta
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Last Price
Range
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Period
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Local CCY
Linear
Beta +/-
Non-Parametric
Legend
Zoom
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Y = GUJARAT INDS POWER CO LTD
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Std Error Of BETA 0.130
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Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2009 Bloomberg Finance L.P.
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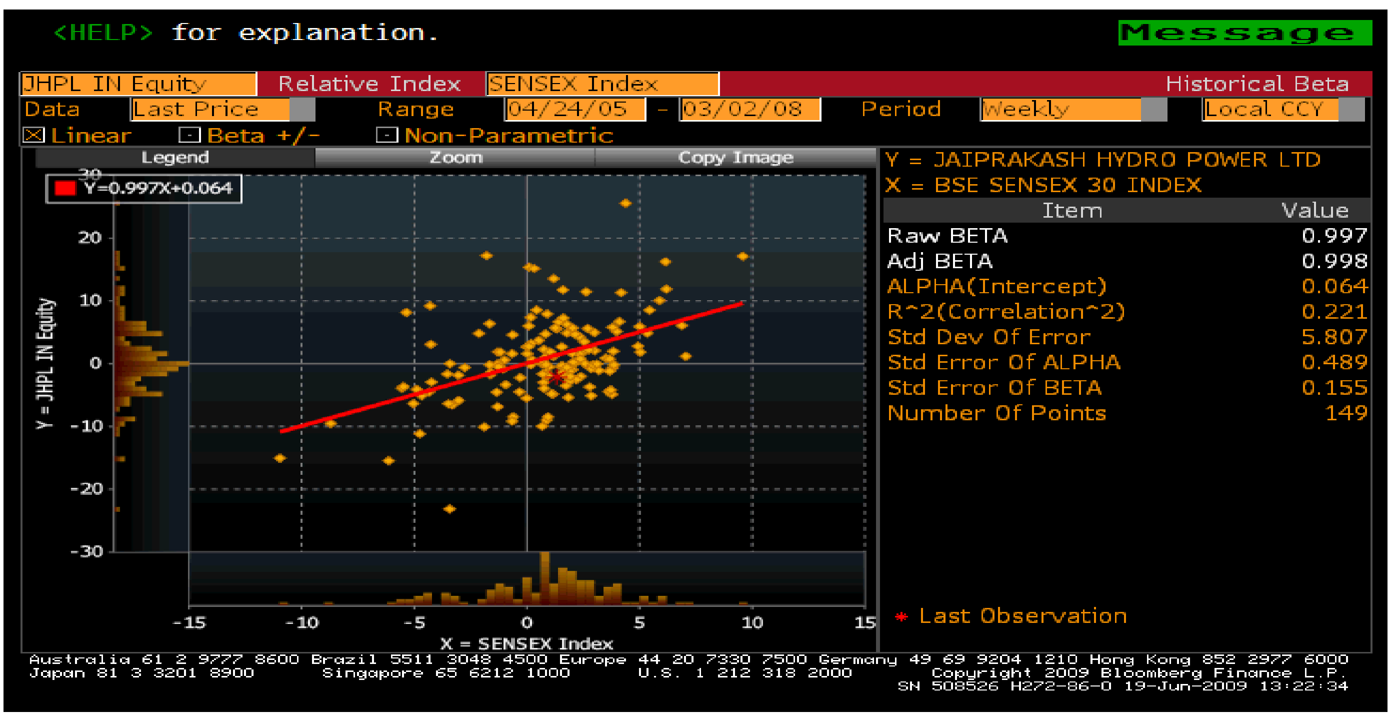
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Last Price
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Local CCY
Linear
Beta +/-
Non-Parametric
Legend
Zoom
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X = SENSEX Index
Y = JAIPRAKASH HYDRO POWER LTD
X = BSE SENSEX 30 INDEX
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Std Error Of ALPHA 0.489
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Last Observation
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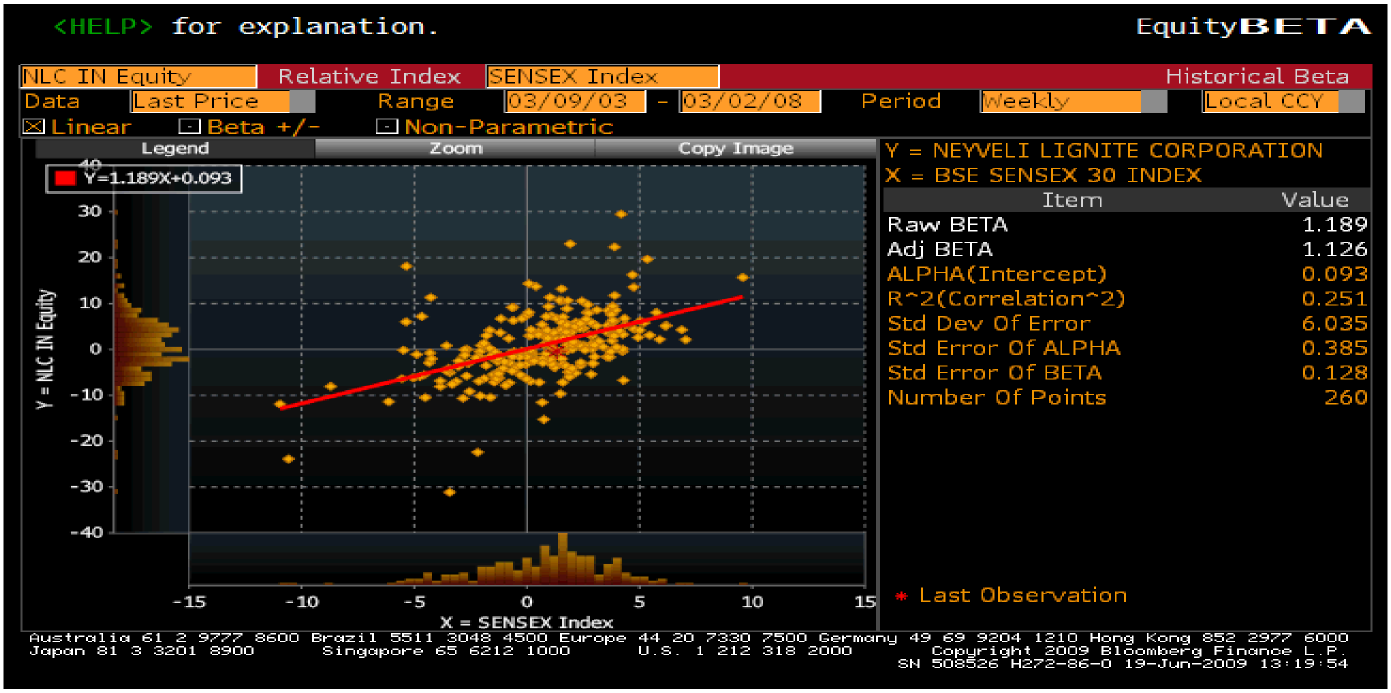
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03/02/08
Period
Weekly
Local CCY
Linear
Beta +/-
Non-Parametric
Legend
Zoom
Copy Image
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Y = NLC IN Equity
X = SENSEX Index
Y = NEYVELI LIGNITE CORPORATION
X = BSE SENSEX 30 INDEX
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Number Of Points 260
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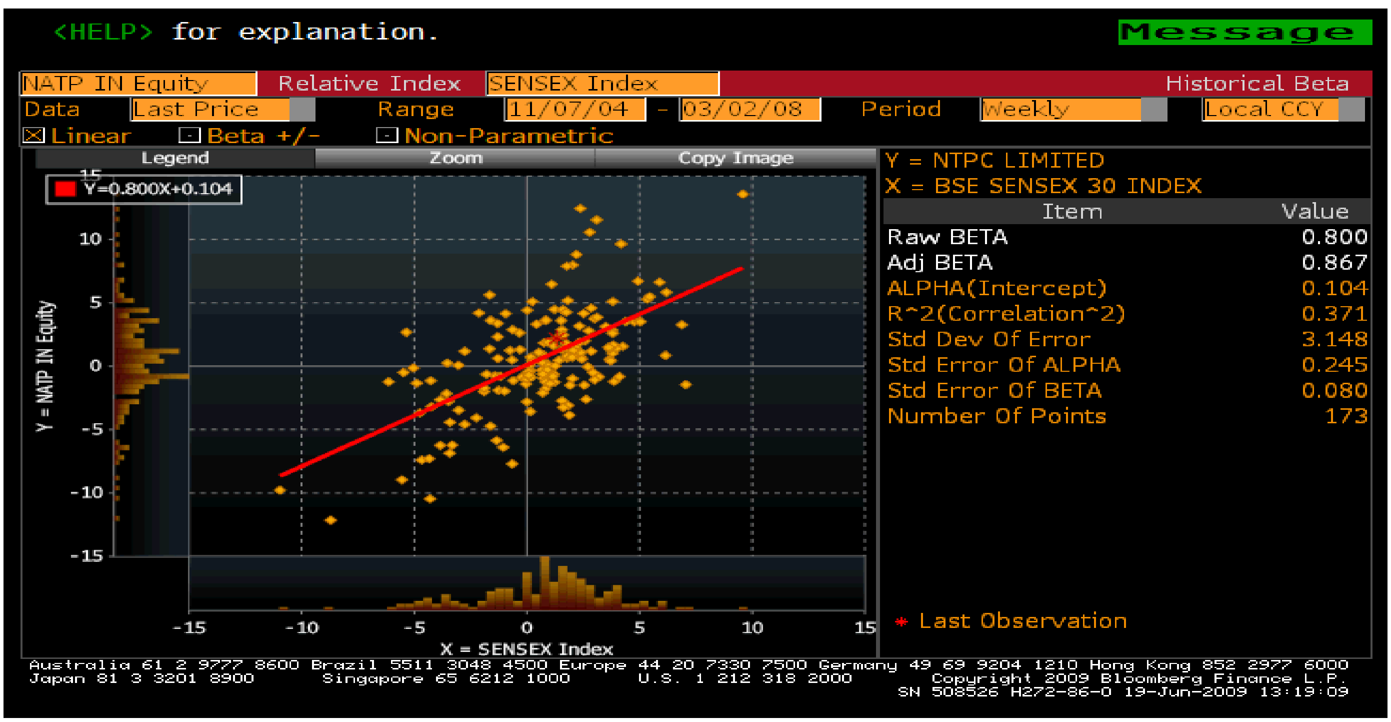
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Linear
Beta +/-
Non-Parametric
Legend
Zoom
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X = SENSEX Index
Y = NTPC LIMITED
X = BSE SENSEX 30 INDEX
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Std Error Of BETA 0.080
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Last Observation
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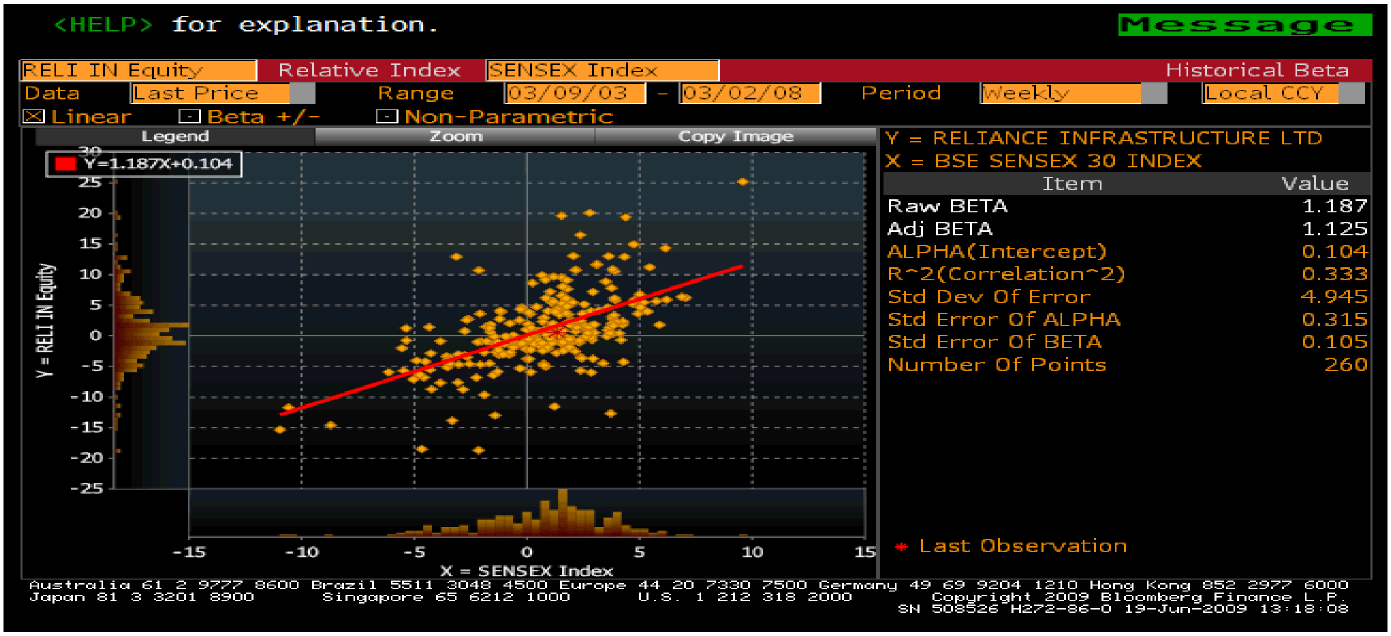
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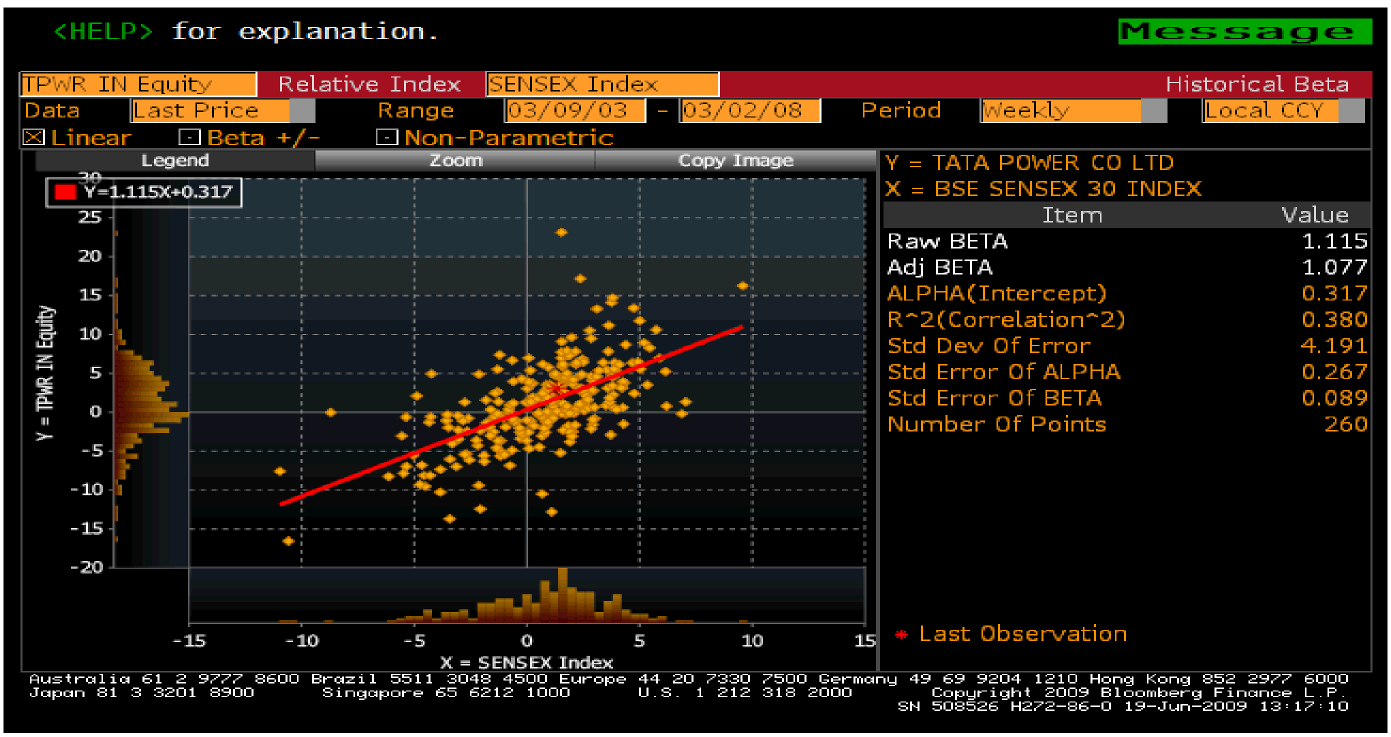
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Y = TATA POWER CO LTD
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Copyright 2009 Bloomberg Finance L.P.
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Appendix 4

and a risk premium (in the CAPM) or premiums (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:

Expected Return = Riskless rate + 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 returns 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 reinvestment rates*, 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 value.[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 try to 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 bonds 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-US 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 rate[3] 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 1999, 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 5

- 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.

CC 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.

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

[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.