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

CONTENTS

A. General description of the small-scale project activity

B. Baseline methodology

C. Duration of the project activity / Crediting period

D. Monitoring methodology and plan

E. Calculation of GHG emission reductions by sources

F. Environmental impacts

G. Stakeholders comments

Annexes

Annex 1: Information on participants in the project activity

Annex 2: Information regarding public funding

Appendixes

Appendix 1 Location map of the project activity

Appendix 2 Details of baseline calculation

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>.

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

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

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Generation of electricity from 1.2 MW capacity wind mills by Sun-n-Sand Hotels Pvt. Ltd. at Satara, Maharashtra
Version : 02
Date: 21st July 2006

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

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The Sun-n-Sand Hotels Pvt. Ltd owns and manages the Sun-n-Sand Hotel chain in India. In the board meeting held on 26th February 2001 they took a decision to invest in the renewable energy market and set up wind mills in Maharashtra. They set up 2 nos of 600 kW capacity wind turbines supplied by Enercon in Satara, in the state of Maharashtra in India. The total capacity of the project was 1.2 MW. The project was designed to supply electricity to Maharashtra state grid, which is part of the western regional state grid. However, after supplying to the state grid for one year, the project proponent did not receive any payment. Hence they were compelled to sign a power purchase agreement with a third party, at ~15% lower power rate for a period of 2 years.

The project activity meets several sustainable development objectives including:

- Reduction in the consumption of fossil fuels in the grid for generating additional electricity equivalent to that generated by the wind mills;
- Reduction in GHG emission (CH_4 and CO_2) and other air pollutants occurring from fossil fuel extraction, processing, transportation and burning ;
- Rural and Infrastructural development in the areas around the Project
- Help in economic and social development of remote villages in Maharashtra by making investment in that area.
- Contributes towards achieving the objectives of the policy on wind power generation of Government of India and Government of Maharashtra., which is to promote generation of energy through non-conventional sources to supplement the ever increasing demand of the state.
- Contribution towards meeting the electricity supply deficit in Maharashtra
- Conserving natural resource including land, forest ,water and the ecosystem
- Encourage other entrepreneurs irrespective of sector, to adopt this technology and invest in wind energy

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India	Sun-n-Sand Hotels Pvt. Ltd.(SNS)	No

SNS will be the sole owner of the CERs generated from the project. Entities from Annex I countries would be identified at a later stage. The SNS Corporate office shall be the principal contact for the CDM project activity.

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

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

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A.4.1.1. Host Party(ies):

>>India

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

>>Western Region/ Maharashtra

A.4.1.3. City/Town/Community etc:

>>Satara

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

>>

The project is located at a village named Varekarwadi, 92 km from the city of Satara in Maharashtra between 17°24' (N) and 73°45' (E). The nearest railway station is Satara and airport is Pune. A location map is presented in Appendix 1.

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

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The project comes under Type I – Renewable Energy Project and Category I.D.- Grid connected Renewable Electricity generation as per Appendix B of the simplified modalities and procedures for small-scale CDM project activities (version 08, 3rd March 2006).

The proposed project activity basically generates electricity from wind energy and supplies it to the state electricity grid. Wind energy being renewable energy, type I category has been chosen and the generated electricity is supplied to grid meeting the applicability conditions for AMS I.D (detailed in section B.2), accordingly the category has been chosen. The capacity of the project is 1.2 MW which is below the15 MW limit and qualifies under small scale projects

The wind mills were supplied by Enercon (India) Limited, having the technology support of Enercon GmbH who claims to have developed the 'most grid friendly' technology in the field of wind mills. They supplied their then latest model E-40 machines for this project. The machines uses gear less technology which enables it to operate at a higher range of wind velocity. The mills have 3 rotor blades of diameter 43.7m, with swept area of 1500 sq m. The rated wind speed is 13.5 m/s with cut in and cut off speed ranging from 2.5 m/s to 25 m/s and extreme gust of 59.5 m/s. The variable speed and active pitch control system was designed for a rated output of 600 kW. Each machine is then connected to 400/33000 V, 3 phase transformers with internal electrical lines connecting the projects with local evacuation facility. The local evacuation facility consist of a 33kV line connecting to 33 kV Varekarwadi-Kale line which is

connected to 33/110 kV 25 MVA transformer in Kale grid substation located 20 km away from the wind mills.

The Wind mills generate 3-phase power at 400V, which is stepped up to 33KV. The wind farms operate as base load units and can operate in the frequency range of 47.5 - 51.5 Hz and in the voltage range of 400 V +(-) 12.5%.

Installation and operation of the windmills do not pose any environmental hazards. The technology of harnessing wind power through windmills is environmentally safe and sound. The host Government also agrees to this fact and does not ask for Environmental Impact Assessment for this type of projects. As supplier of wind energy convertors (wind mills), Enercon is well known in the market. They have a strong R&D back up and are the leaders in the German market with their new gearless technology, increased grid compatibility and additional safety features of their technology. They have ISO 9001:2000 for internal quality control and their technology is approved by Ministry of Non-Conventional Energy Sources

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

>>

The project activity is generating electricity from wind for which GHG emission is nil. The generated electricity is supplied to a third party, who would otherwise have purchased power from the state electricity grid. Thus the power generated in the project activity is actually displacing the electricity generated from the fossil fuels in the grid. In case the project activity would not have been there, the same amount of electricity would have been generated from the power plants connected in the grid of which the majority are based on fossil fuels. Thus the project is replacing the anthropogenic emission from the fossil fuel based power plant connected to the electricity grid.

The project activity is in line with the Renewable Energy Policy of Government of India which targets 10% of additional grid power generation capacity to be from Renewable Energy sources by 2012. It is also getting the benefits provided by the National and sectoral policies for promoting renewable energy generation in India, (e.g. promotional measures of Electricity Act 2003).

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

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The estimated amount of emission reductions over the chosen 10 years of crediting period is **26,504 t/CO_2**. The yearwise details are presented below:

Years	Annual estimation of emission reductions in
	tonnes of CO2 e
2002	2680
2003	2449
2004	2871
2005	2643
2006	2643
2007	2643
2008	2643
2009	2643
2010	2643
2011	2643
Total estimated reductions (tonnes of CO2 e)	26504
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnesof CO2 e)	2650

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

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Till date, no public funding has been sought for the project activity. The project proponent will identify potential participants if additional funds are required in the future.

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

>>

As mentioned under *Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project Activities,* the following results into debundling of large CDM project:

"A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point."

For the proposed project activity the project participants do not own any more wind mills in this Satara region in the state of Maharashtra, hence they could not have gone for additional registration for any similar project within the previous 2 years whose project boundary is within 1 km of the project boundary of the proposed activity. Thus it is confirmed that the small scale project activity is not a debundled component of a larger project activity.

SECTION B. Application of a baseline methodology:

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

>>
Project has applied approved methodology available for small-scale CDM project at UNFCCC website under Appendix B of the simplified modalities and procedures for small-scale CDM project activities.
Methodology type I.D
Title – Grid connected Renewable electricity generation.

Reference: Latest amended version 08 (3rd March 2006) of Appendix B to the simplified M&P for small-scale CDM project activities

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

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Applicability criteria	Project case
Renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and biomass, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel or non-renewable biomass fired generating unit	The project is a wind mill project hence applicable for this category
If the unit added has both renewable and non-renewable components, the eligibility limit of 15 MW for a small scale CDM project activity applies only to the renewable component. If the unit added co-fires (non-)renewable biomass and 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 activity. The renewable project capacity is 1.2 MW, well below the limit of 15 MW.
Biomass combined heat and power systems that supply electricity to a grid are included in this category. To qualify under this category, the sum of all forms of energy output shall not exceed 45 $MW_{thermal}$.	Not applicable
Project activities adding renewable energy capacity should consider the following cases: 1) Adding new units; 2) Replacing old units for more efficient units. To qualify as a small scale CDM project activity, the aggregate installed capacity after adding the new units (case 1) or of the more efficient units (case 2) should be lower than 15 MW.	Not applicable, the entire windmills are new and this project is not capacity enhancement or upgradation project.
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	Not applicable. This project is not a retrofit or modification of existing facility.

modified or retrofitted unit shall not exceed the limit of 15 MW.	

The above comparison confirms that the chosen methodology is applicable for this project activity**.**

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

Sl. No.	Key Information/data used for baseline	Source of data/information
1	Electricity generation	Month wise data collected and compiled from State electricity board credit reports
2	Transmission /wheeling loss	Wind project tariff order 03-04, MERC, Mumbai
3	Grid electricity generation & fuel consumption	Website of Central Electricity Authority
4	Calorific values of fuels use	IPCC guidelines (Table 1-2 & Table 1-24)
5	Carbon content and oxidation factor of fuels	IPCC guidelines (Table 1-4 & 1-6)

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

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Additionality Check:

The project proponent had to overcome the following barriers in order to implement the project

Investment barrier

The entire project was planned based on supplying the produced electricity to the western regional grid of India. At the time of the investment decision, there were enough evidences of grid authorities delaying the payments, sometimes indefinite delay which made industries of similar nature suffer. It was a big investment risk to develop the project based on such a customer. This risk actually proven to be a disastrous one. The Maharashtra state electricity board really did not make any payment after receiving power for almost one year. Then the project proponent was compelled to sign an agreement with a third party at ~ 15% lower power rates, resulting in a much lower return on the investment compared to that expected

Though wind energy is a clean energy, it is a costlier option, especially in India where availability of coal is abandonce. A comparative study of cost of electricity generation from different alternatives of power production is given below [1]:

Sl. No	Description	Cost of power generation (Rs/kWh)
1.	Coal	2.72
2.	Fuel oil based generator sets	3.25
3.	Wind energy	4.24

[1] Source of information: PDD of Nagda Hills wind energy project – a registered project

The figures are comparable for this project also. The cost of power generation for this project activity is Rs 4.19/kWh. Thus coal becomes the most preferred fuel for power generation since it is the least cost option. Wind energy on the other hand has the lowest load factor and the highest uncertainty in production because it is entirely dependent on weather conditions.

Project proponent had chosen the cleanest alternative in spite of it being the most expensive one. Concept of CDM incentive helped them to make their decision easier towards more environment friendly technology. It improved their IRR from 16.84% to 19.86% and improved the financial attractiveness of the project.

Technological barrier

This project proponent also took a risk of putting up a new model of wind mill of the supplier, E-40 of 600kW capacity. This design of wind mill was first time experimented in India, by Enercon India, where the project proponent agreed to try out their investment. It was the first time experience for the persons actually involved in operation and maintenance to work on the E-40 machines.

Generation of electricity from wind energy was not a very common practice in India when the project decision was taken. The decision of putting up these wind mills were taken in the year 2001 when only 1.25% of total installed capacity of India was from Wind sources. The share of wind energy was even lower in Western region where only 1.1% of total generation capacity was fetched from wind sources. The project proponent had to take the risk of investing in a power source which was very uncommon in this region as shown in the table below[2]:

As on 31st March 2001							
	Hydro	**Coal**	**Diesel**	**Gas**	**Wind**	**Nuclear**	**Total**
Western Grid	4307	20692	17	4845	347	760	30968
India	25153	61011	871	10462	1270	2860	101626

Installed capacities are expressed in MW.

When compared to the wind power potential of Maharashtra, the actual utilisation of this energy was also very low as presented in the table below[3]:

State	Maharashtra		
Install capacity of wind power	157 MW	(As on 31st March 2001)	
	Wind potential		***Utilisation (as % of potential)***
Gross	3650 MW		4.30 %
Technical*	3020 MW		5.20 %

**technical potential is calculated assuming 20% grid penetration*

The above mentioned data also demonstrates the fact that despite having government promotional policies for utilization of wind energy the actual utilization was <6% of its potential. The project proponent had

[2] Source of information : Table 2.4 General review 2001-02 of Central Electrical Authority of India

[3] Data source for wind potential : Ministry of Non Conventional Energy Sources, Annual report 2004-05

invested in an unconventional and unpopular source of energy where the performance uncertainty is much higher compared to alternative sources.

Other barriers (Organisational capacity, capacity to absorb new technology, Institutional barrier)

The choice of the location of the windmills was driven by the meteorological condition. Evacuation of power from the windmill site to the nearest grid substation also was a major problem for setting up this project. Installation of system for transmitting power from the windmill site to grid substation required a significant investment which is not viable for this type of small scale project. Project proponent had to approach and agree to the terms of the supplier for the placing the evacuation system who were already existing there and working on some other projects

The project proponent being in the hospitiality and service industry did not have any expertise in the renewable energy business. The technology was new to them. They did not have the infrastructure or organisational capacity to manage, operate and maintain the wind mills. They also did not have skilled manpower to operate the machines. The available manpower was trained to work in service industry and did not have the capacity to absorb the new technology of wind mill operation and linking up with grid the supply. Under this situation the alternative was to invest the money in the service industry and not replace the grid power which came mainly from fossil fuel based plants. Instead, the project proponent has taken up this risk and tried to overcome the barrier by incurring a recurring expenditure by appointing the supplier itself to operate and maintain the project activity.

The above paragraphs on three barriers explain that the proposed project activity was not a Business as usual case for the project proponent.

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

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The project boundary encompasses the physical, geographical site of the windmills at Satara.

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

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The baseline for this project is the net electricity supplied to the customer by the windmills multiplied by the emission coefficient of the Western regional electricity grid.

The emission coefficient (EF_y) is calculated in a transparent and conservative manner as:

- Average of the "approximate operating margin" and "build margin" (step 9a of AMS I.D ver 08) and
- Weighted average emissions (step 9b of AMS I.D ver 08) of the current generation mix

The lower one was taken for calculation of the CER to remain more conservative.
For the approximate operating margin calculation the *ex ante* option, i.e the option 1 of section 9c of methodology AMS I.D was chosen, where a 3 year average grid data, based on the most recent statistics available at the time of PDD submission was considered.

For the build margin, most recent information available on plants already built at the time of PDD submission was considered, which is the option 1 of section 9d of methodology AMS I.D. This also do not require *ex post* monitoring.

Since five most recently built plants did not comprise 20% of the generation of the grid, more than five recently built power plants were considered in the build margin to meet the target of 20% generation.

The net electricity is calculated as: Generation – Auxiliary consumption – transmission/wheeling loss

The Maharashtra Electricity Regulatory Commission (MERC) has set guidelines for calculation of wheeling/transmission loss. As per this guideline, transmission loss is to be considered as 5% of total generation until the actual value is established and communicated to the power producers by MERC and wheeling charges are 2% of the total generation. Accordingly 7% of total generation is considered as transmission / wheeling loss in the baseline calculation. As and when MERC comes up with the actual values those will be considered for baseline calculation.

Separate meters are installed to measure the generation and auxiliary consumption for individual windmills. These meters are maintained by the State Electricity Boards.

Choice of grid:
The Western regional grid has been selected for the following reason:

The management of generation and supply of power within the regional grid is undertaken by the load dispatch centers (LDC). Different states within the regional grids meet the demand from their own generation facilities plus generation by power plants owned by the central sector i.e. NTPC (National Thermal Power Corporation Ltd expand the abbreviations used first time) and NHPC (Nationa Hydroelectric Power Corporation Ltd)etc. Specific quota is allocated to different states from the central sector power plants. Depending on the demand and generation there are exports and imports of power within different states in the regional grid. Thus there is trading of power between states in the grid. The import and export of power between regional grids in India is very low (<1% of their generation). Since the CDM project would be supplying power to the regional grid it is also preferred to take the regional grid as project boundary than the state boundary. It also minimizes the effect of inter state power transactions, which are dynamic and vary widely.

The baseline scenario considers that the electricity would have otherwise been generated by operation of existing power plants in the western grid and by addition of new generation sources.

Availability of renewable resources:
The project activity, installs windmills, which adds to the renewable energy capacity of the region. The mills are located in a well designed wind farm, where the windmills are spaced at adequate distances to utilise the full wind potential of the zone. Unlike biomass or bio-waste, wind energy availability is not limited to the extent that addition of windmills in a well designed windfarm, can reduce the production of other existing windmills. Hence this impact (as described in section 10 of AMS I.D) has not been considered for this project activity.

Details of the calculation formulae are presented in Section E.

Date of completing the final draft of this baseline section *(DD/MM/YYYY)*: 05/07/2006

Name of person/entity determining the baseline: PricewaterhouseCoopers (P) Limited has assisted the project proponent in determining the application of baseline methodology for the identified CDM project. They are not a project participant. The details of their contact address are given below:

Organization:	PricewaterhouseCoopers (P) Ltd.
Street/P.O.Box:	252 Veer Savarkar Marg, Shivaji Park,
Building:	3rd Floor, B Wing,
City:	Dadar West,Mumbai
State/Region:	Maharastra
Postcode/ZIP:	400 028
Country:	India
Telephone:	91 22 6669 1200 (Board)
FAX:	91 22 6654 7804/5
E-Mail:	ram.babu@in.pwc.com
URL:	www.pwc.com
Represented by:	
Title:	Mr.
Salutation:	Associate Director
Last Name:	Babu
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Department:	Sustainable Business Solutions
Mobile:	98 201 35929
Direct FAX:	
Direct tel:	91 22 6669 1302
Personal E-Mail:	ram.babu@in.pwc.com

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

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

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

>>

The real action on the project was initiated during the year February 2001 when the Board decision was taken for investing in windmills.

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

>>

20 years

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

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C.2.1. Renewable crediting period:

>>

Not Applicable

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

>>

Not Applicable

C.2.1.2. Length of the first crediting period:

>>

Not Applicable

C.2.2. Fixed crediting period:

>>

C.2.2.1. Starting date:

>>

1st January 2002.

C.2.2.2. Length:

>>

10 years

SECTION D. Application of a monitoring methodology and plan:

>>

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

>>

Project has applied approved methodologies available for small-scale CDM project at UNFCCC website under Appendix B of the simplified modalities and procedures for small-scale CDM project activities.
Methodology type I.D.
Title – Grid connected Renewable electricity generation.

Reference: Latest amended version 08 (3rd March 2006) of Appendix B to the simplified M&P for small-scale CDM project activities

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

>>

Monitoring methodology is in accordance with the baseline methodology followed for this project activity Applicability of the baseline methodology is described in section B.1.

D.3 Data to be monitored:

Electricity generation from individual wind turbine to be metered and recorded on a continuous basis. The total power(EG_y) supplied to the grid is the summation of the power generated from all the 2 nos of wind turbines less the transmission loss and auxiliary consumption.

ID number	*Data variable*	*Data unit*	*Measured (m), calculated (c), estimated (e),*	*Recording frequency*	*Proportion of data to be monitored*	*How long the data to be kept?*	*How will the data be archived? (electronic/ paper)*	*Comment*
1. EG_{GEN}	Quantitative Total Electricity Generated (metered in individual wind mills)	MWh/yr	m	Continuously	100%	Crediting period +2 years after	Electronic	Metered at plant Site incharge of the Contractor operating the mills will be responsible for regular calibration of meter.
2. EG_{loss}	Quantitative losses and auxiliary consumption	MWh/yr	c & m	Continuously	100%	Crediting period +2 years after	Electronic	Measured for auxiliary consumption and Calculated for transmission loss as per the guidelines of MERC
3. EG_y	Quantitative Net Electricity supplied to State grid	MWh/yr	c	Continuously	100%	Crediting period +2 years after	Electronic	Calculated using above data and reported in the credit note of MSEB

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

>>

ID Number	Data monitored	Uncertainty level of data (High/ Medium/ Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned
1,2,3	Electricity generation & supply	Low	Yes	These data will be used for the calculation of project electricity generation.

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

>>

Project proponent has signed an 'Operation and Maintenance' contract with the supplier to operate and manage the wind mills. The performance of the mills, safety in operation and scheduled /breakdown maintenances are organized and monitored by the contractor. The wind mill site-in-charge of the contractor reports the power generation and performance of the wind mill daily to the project proponent through their website. A consolidated monthly report is also provided to them. A power purchase agreement has been signed with a third party and power is wheeled to them through Maharashtra state electricity grid (MSEB). Monthly reading is taken jointly by the representatives of MSEB and the contractor and communicated to the project proponent, on which the units are billed. The Accounts department of Sun-n-Sand Hotel group thus receives the data from both the sources and keeps track of project activity which reduces the carbon emission reductions. The project performance is communicated to the higher management by the accounts department

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

>>

PricewaterhouseCoopers (P) Limited has assisted the project proponent in determining the application of monitoring methodology for the identified CDM project. They are not the project participants and their detailed contact address is presented below:

Organization:	PricewaterhouseCoopers (P) Ltd.
Street/P.O.Box:	252 Veer Savarkar Marg, Shivaji Park,
Building:	3rd Floor, B Wing,
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Telephone:	91 22 6669 1500 (Board)
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E-Mail:	ram.babu@in.pwc.com
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Represented by:	
Title:	Mr.
Salutation:	Associate Director
Last Name:	Babu
Middle Name:	Ram
First Name:	P
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Direct FAX:	
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Personal E-Mail:	ram.babu@in.pwc.com

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

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E.1.1 Selected formulae as provided in appendix B:

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Not Applicable

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

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

>>

There is no CO_2 emission from this wind mill project.

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

>>

Since the energy generating equipment is not transferred from another activity no leakage is envisaged, as per the applied methodology.

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

>>

The sum of E.1.2.1 and E.1.2.2 is zero

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

>>

Baseline calculations are given as:

$BE_y = EG_y \cdot EF_y$ ……(1)

$EGy = EG_{GEN} - EG_{loss}$ ……(2)

Where:

- BE_y Baseline emission (t CO_2/year)
- EG_y Electricity supplied to grid (MWh/year)
- EG_{GEN} Electricity generated by the windmills (MWh/year)
- EG_{loss} Auxiliary consumption and transmission/wheeling loss (MWh/year)
- EFy Baseline CO_2 emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh)

The baseline emission factor (EF_y) was calculated as the average of the "approximate operating margin"(EF_{OMy}) and the "build margin" (EF_{BMy}), as per step 9a and also as weighted average emissions (in kg CO_2equ/MWh) of the current generation mix as per step 9b of approved methodology type I.D and the lower one was taken for calculated the CER to remain more conservative.

As per 9 a:

$EF_y = 0.5 \text{ X } EF_{OM,y} + 0.5 \text{ X } EF_{BM.y}$

Where:

Approximate operating margin: is the weighted average emissions (in kg CO_2equ/kWh) of all generating sources serving the system (western regional grid in this case), excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation; and

$$EF_{OMy} = \frac{\sum_{i,j} F_{i,j,y} \bullet COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where:

$F_{i,j}$	Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in the year(s) y.
j	Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants.
$COEF_{i,j,y}$	Is the CO_2 emission coefficient of fuel i (tCO_2/ mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y.
$GEN_{j,y}$	Is the electricity (MWh) delivered to the grid by source j.

And

Build margin: is the weighted average emissions (in kg CO_2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

$$EF_{BMy} = \frac{\sum_{i,m} F_{i,m,y} \bullet COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where:

$F_{i,m}$	Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources m in the year(s) y.
m	Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid
$COEF_{i,m,}$	Is the CO_2 emission coefficient of fuel i (tCO_2/ mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources m and the percent oxidation of the fuel.

$GEN_{m,y}$ Is the electricity (MWh) delivered to the grid by source m.

The CO_2 emission coefficient COEFi is obtained as

$COEF_i = NCV_i$ X $EFCO_{2,i}$ X $OXID_i$

where:

- **NCV_i** is the net calorific value (energy content) per mass or volume unit of a fuel i,
- **$OXID_i$** is the oxidation factor of the fuel
- **$EFCO_{2,i}$** is the CO_2 emission factor per unit of energy of the fuel i.

As per 9 b:

The weighted average emissions (in kg CO_2equ/kWh) of the current generation mix.

$$EF_y = \frac{\sum_{i,j} F_{i,j,y} \bullet COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where:

$F_{i,j}$	Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in the year(s) y.
j	Refers to the power sources delivering electricity to the grid, including low-operating cost and must-run power plants.
$COEF_{i,j,}$	Is the CO_2 emission coefficient of fuel i (tCO_2/ mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel.
$GEN_{j,y}$	Is the electricity (MWh) delivered to the grid by source j.

It was found after calculations that the baseline emission factor (EF_y) was more conservative when based on the weighted average emission of the current generation mix (as per Step 9b), as hence this value has been used for baseline calculations.

All these calculations including those for the western regional grid have been provided in Appendix 2.

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

>>

Refer to the table in Section E.2

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

>>

Period	Baseline emission	CER
	t CO_2/y	t CO_2/y
January 02 - December 02	2,680	2,680
January 03 - December 03	2,449	2,449
January 04 - December 04	2,871	2,871
January 05 - December 05	2,643	2,643
January 06 - December 06	2,643	2,643
January 07 - December 07	2,643	2,643
January 08 - December 08	2,643	2,643
January 09 - December 09	2,643	2,643
January 10 - December 10	2,643	2,643
January 11 - December 11	2,643	2,643
Total		**26,504**

The detailed calculation is presented in Appendix 2

SECTION F.: Environmental impacts:

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

>>

The host Party, i.e. Ministry of Environment and Forest, Government of India, does not require Environmental Impact Assessment EIA of wind mill projects. As mentioned, SNS management has proactively taken up an EIA study to understand the impact and react upon it.

The study showed no significant environmental impacts due to the project activity. For managing the minor and / or potential impacts a few mitigating measures have been planned as listed below:

- To prevent soil erosion during the rainy season, a supervisory visit would be made by the representatives of the project proponent to the site before monsoon. They should check for existence of uncovered or loose exposed soil due to the project activity, which has the potential of getting washed away in heavy rains. Any such area identified, would be covered with top soil and proper vegetation to be planted on it for meeting the objective
- Soil samples to be collected yearly and analysed for general characteristics and heavy metals content to study whether any damage is being caused by the O&M activity of the project.
- Noise monitoring to be done on half yearly basis on the following spots:
  - Near the windmill (within 100 m from the base when the mill is in operation and/or when the maintenance work is in progress)
  - At the boundary of the nearest village which may get affected due to the windmills of project proponent.
- Any time any soil excavation work being taken up due to the project activity, it will be ensured by the project proponent that the excavated pits are filled up and the debris is leveled.

The project proponent will also ensure that all necessary safety and environmental requirements of relevant Indian legislation are met for the facilities implemented.

SECTION G. Stakeholders' comments:

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

>>

A meeting was organized on 4/10/2005 by the project proponent at the project site to get the comments and suggestions of the local stakeholders on their project activity. Representatives of a wide cross section of the society of the local inhabitants were invited through public notice to express their views and Enercon, the supplier of the wind mill, who also operates and maintains them, along with the representatives of the project proponent were present to clarify their queries and receive their feedback on the project activity. The venue of the meeting was at the site office of Enercon. To get an organized and structured feedback from the stakeholders, the meeting was designed in a question answer format, where social, economic and environmental issues were put up in the form of questions and comments were invited on them. Project proponent replied to their queries appropriately and suggestions came up in this meeting have been given due consideration and future actions were planned accordingly.

Generally the stakeholder comments are invited at the initial stage of the project. Wind energy being an environment friendly process of electricity generation, the project proponent did not envisage any adverse effect on the local stakeholders, instead it was expected to improve the rural infrastructure and bring in socio-economic development in the locality. This impression was also supported by the feedback of the suppliers of this technology, who were already existing in this locality for quite some time. The extent of the development could be verified only after actually operating the wind mills for a period of time. Hence, the project proponent decided to conduct a meeting to collect feedback and suggestions for further improvement after operating the mills for two to three years.

G.2. Summary of the comments received:

>>

A brief description of the comments received from the stakeholders on various issues are as follows:

Socio-economic – All participants expressed that the project in brief has not adversely affected them. In fact they highly appreciated the tarred roads laid for the windmills, which have improved their connectivity with other locations. Employment of local people as security persons, drivers, technical assistants, casual labours in the windmill sites has helped to increase the local employment. There were also demands to increase employment opportunity further.

Environmental – The villagers confirmed that due to the windmills,

there was no major change in the landscape,
soil erosion was not a major issue,
there was no shortage of water for agriculture or for drinking purpose
no change in the migratory pattern of birds
no disturbance due to noise or dust, and
trees / plantation were not cut during the construction.

They also did not find the vehicle traffic during the construction stage and for the operation of the mills, as disturbing

Other comments – The villagers observed that the voltage of the electricity supplied to their area has improved after the constructions of windmills at their site. The frequent fluctuation of voltage has also reduced.

They also expressed gratitude for enlightening them to understand the importance of non-conventional energy

They confirmed that the debris generated during the project construction had been disposed off in an environment friendly manner.

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

>>

In general there was no adverse comment on the project activity by the local stakeholders. However, there was a demand for employing more local villagers in the windmill operation & maintenance jobs. Project proponent, not having direct control on the operation of the windmills has requested the operation and maintenance contractor to provide due consideration to this issue in their future recruitments. They also thanked the local people for their co-operation in operating the wind mills.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	SUN-N-SAND HOTELS PVT. LTD.
Street/P.O.Box:	39, Juhu Beach
Building:	Juhu
City:	Mumbai
State/Region:	Maharashtra
Postcode/ZIP:	400049
Country:	India
Telephone:	91-22-66938888
FAX:	91-22-26202170
E-Mail:	ab@sunnsandhotel.com
URL:	
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Advani
Middle Name:	Gul
First Name:	Rajesh
Department:	
Mobile:	91 9820702302
Direct FAX:	91-22-26201972
Direct tel:	91-22-66938888
Personal E-Mail:	ab@sunnsandhotel.com

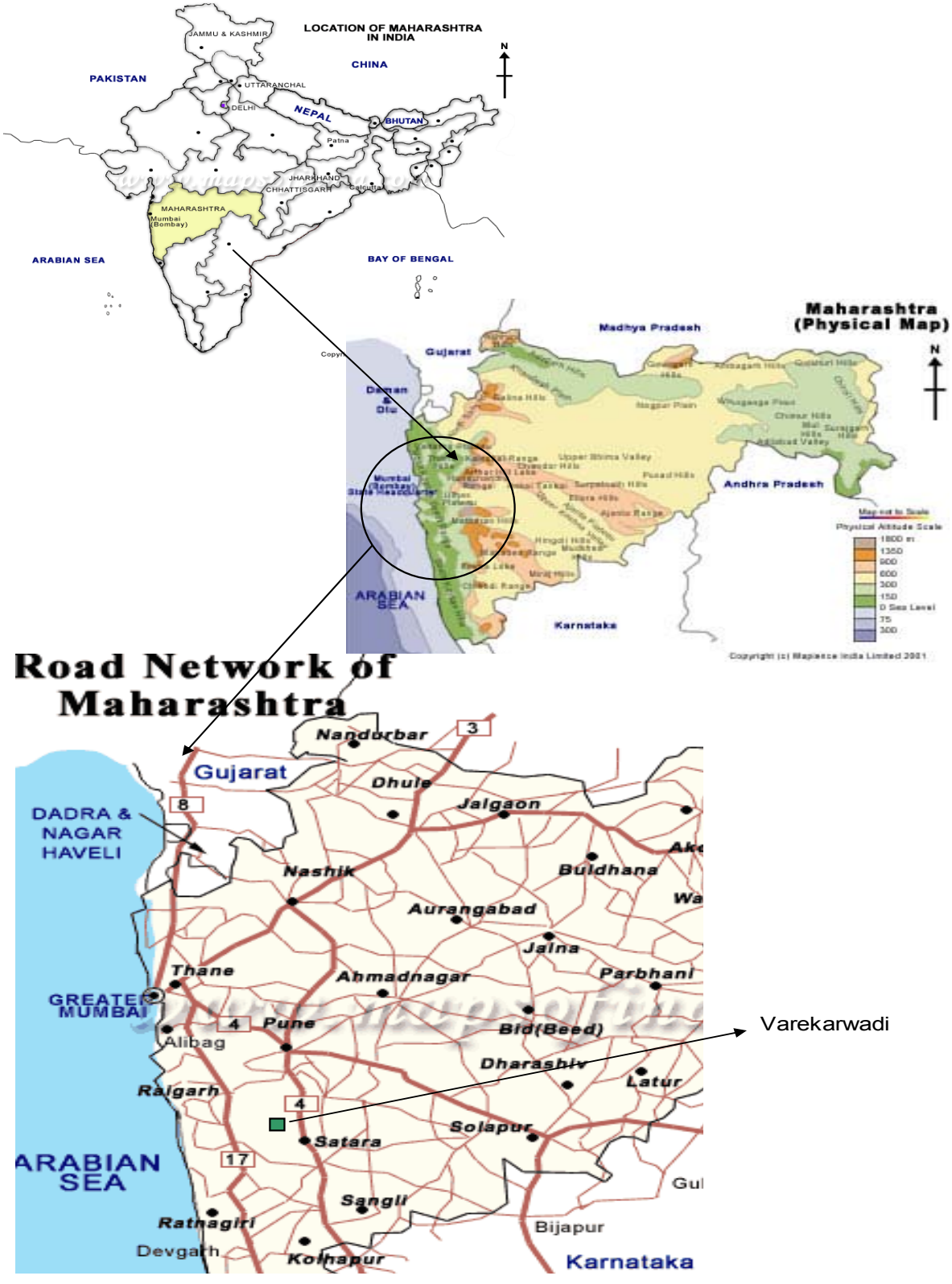
Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No ODA is flowing to the project. This is a unilateral CDM Project Activity undertaken by the project proponent. The proponent proposes to identify potential participants in due course and it is as yet not known if any public funding shall be sought. In case public funding is sought, the proponent shall duly ensure that it is additional to any ODA.

Appendix 1

LOCATIONAL MAP OF THE WIND MILL SITE



Appendix 2

Base line calculations

Approximate operating margin calculation for Western Regional grid for the year 2004-05:

	Fuel				Emission factor	CO2 Emissions	Electricity generation			
	Units	Consumption	Density (kg/Lt)	10^3 MT	($tCO_2/10^3$ tonnes) for NG =(tCO_2/M Cu.m)	(tCO2)	Gross Electricty generation (GWh)	Auxiliary consumption (%)	Net ele Gen (GWh)	TCO2/GWh
Steam stations		*		*			*	**		
Coal	000 MT	94123	1	94123	1852	174344583	142813	8.4	130817	
Furnace Oil	KL	1066231	0.93	992	3078	3052399				
Light Oil	KL	10028	0.827	8.29	2918	24198				
LSHS/HHS/HSD	KL	574238	0.827	475	3146	1493904				
GAS	MT	39012	1	39	2919	113890				
Lignite	000 MT	2609	1	2609	972	2535752				
						181564726			*130817*	*1387.933*
Gas Stations										
Natural Gas	M Cu M	4667	1	4667	1931	9013632	25526	2.0	25029	
HSD	KL	1625	0.827	1.34	3146	4228				
Naphtha	KL	776908	0.76	590	3268	1929429				
						10947289			*25029*	*437.39142*
Diesel Stations										
LSHS	KL	0	0.827	0	3146	0	0	0.0	0	
Diesel	KL	0	0.827	0	3146	0		0.0	0	
Total						**192512014.6**			**155845.221**	

* Source ;table 6.1, CEA general Review
** Table 5.5, CEA general review

Approximate OM **1235.27699 tCO2/GWh**

Approximate operating margin calculation for year 2003-04:

	Fuel				Emission factor	CO2 Emissions	Electricity generation			
	Units	Consumption	Density (kg/Lt)	10^3 MT	($tCO_2/10^3$ tonnes) for NG =(tCO_2/M Cu.m)	(tCO2)	Gross Electricty generation (GWh)	Auxiliary consumption (%)	Net ele Gen (GWh)	TCO2/GWh
Steam stations		*		*			*	**		
Coal	000 MT	89075	1	89075	1852	164994143	136910	8.4	125410	
Furnace Oil	KL	1187213	0.93	1104	3078	3398746				
Light Oil	KL	10685	0.827	8.84	2918	25783				
LSHS/HHS/HSD	KL	423797	0.827	350	3146	1102526				
GAS	KL				2919	0				
Lignite	000 MT	2560	1	2560	972	2488127				
						172009325			*125410*	*1371.5793*
Gas Stations										
Natural Gas	M Cu M	3721	1	3721	1931	7186571	21508	2.1	21052	
HSD	KL	2767	0.827	2.29	3146	7198				
Naphtha	KL	1082436	0.76	823	3268	2688199				
						9881969			*21052*	*469.40429*
Diesel Stations										
LSHS	KL	0	0.827	0	3146	0	0	0.0	0	
Diesel	KL	0	0.827	0	3146	0		0.0	0	
Total						**181891293.2**			**146461.827**	

* Source ;table 6.1, CEA general Review
** Table 5.5, CEA general review

Approximate OM **1241.90239 tCO2/GWh**

Approximate operating margin calculation for year 2002-03:

	Units	Consumption	Density (kg/Lt)	10^3 MT	($tCO_2/10^3$ tonnes) for NG =(tCO_2/M Cu.m)	(tCO2)	Gross Electricty generation (GWh)	Auxiliary consumption (%)	Net ele Gen (GWh)	TCO2/GWh
Steam stations		*		*			*	**		
Coal	000 MT	91350	1	91350	1852	169208138	137392	8.74	125384	
Furnace Oil	KL	135786	0.93	126	3078	388727				
Light Oil	KL	46383	0.827	38.36	2918	111923				
LSHS/HHS/HSD	KL	2006346	0.827	1659	3146	5219593				
GAS	MT	204166	1	204	2919	596034				
Lignite	000 MT	19311	1	19311	972	18768840				
						194293256			*125384*	*1549.5865*
Gas Stations										
Natural Gas	M Cu M	3505	1	3505	1931	6769398	18713.4	1.91	18356	
HSD	KL	697009	0.827	576.43	3146	1813298				
Naphtha	KL	426280	0.76	324	3268	1058654				
						9641351			*18356*	*525.24321*
Diesel Stations										
LSHS	KL	0	0.827	0	3146	0	0	0.0	0	
Diesel	KL	0	0.827	0	3146	0		0.0	0	
Total						**203934606.3**			**143739.913**	

* Source ;table 6.1, CEA general Review
** Table 5.5, CEA general review

Approximate OM **1418.78 tCO2/GWh**

Build margin calculation for Western regional grid:

Plants added	State	Date of addition	Installed capacity MW	PLF	Gross Gen GWh	Auxilary Consm %	Net Gen GWh	Emission Factor tCO2/GWh	Total t CO2
Hydro		*			**	***			
Koyna I & II	Maharashtra	2004-05	40	0.212	74	0.74	74		0
Other hydro projects of WR****		2004-05	846.75	0.206	1529	0.59	1520		0
Indira Sagar HE proj (1,2,3,4)	MP (NHDC)	1-Jan-04,18-Jan-04,27-Feb-04,28-Mar-04	500	0.152	666	0.54	662		0
Bansagar Tons	MP	24-Aug-02,24-Aug-02	35	0.152	47	0.21	47		0
Sardar Sarover HE	Gujarat	9/4/2002	100	0.161	141	0.84	140		0
Bansagar Tons-PhIII(2)	MP	8/25/2001	20	0.152	27	0.21	27		0
Bansagar Tons-PhII(1)	MP	2/18/2002	15	0.152	20	0.21	20		0
Bansagar Tons-PhIII(1)	MP	11/26/2000	20	0.152	27	0.21	27		0
Rajghat(1,2,3)	MP	15-10-99,29-09-99,03-11-99	45	0.152	60	0.21	60		0
Dudhganga(1,2)	Maharashtra	27-02-00,31-07-99	24	0.212	45	0.74	44		0
Koyana (st IV(1,2,3)	Maharashtra	28-03-00,03-03-00,25-11-99	750	0.212	1393	0.74	1383		0
Kadana PSSextn	Gujarat	27-05-98	60	0.161	85	0.84	84		0
Warna	Maharashtra	26-04-98	8	0.212	15	0.74	15		0
Koyana Stage IV	Maharashtra	31-03-99	250	0.212	464	0.74	461		0
Dimbhe	Maharashtra	14-02-97	5	0.212	9	0.74	9		0
Surya (unit 1)	Maharashtra	29-03-96	6	0.212	11	0.74	11		0
Bhandardara (unit 1)	Maharashtra	30-03-96	34	0.212	63	0.74	63		0
Kadana (Unit 3)	Gujarat	31-03-96	60	0.161	85	0.84	84		0
Steam									0
Aknimota T.P.S	Gujarat	31/03/2005	125	0.785	860	9.89	775	1388	1193370
Khaperkheda TPS	Mah	5/31/2000	420	0.75	2759	8.02	2538	1388	3829862
Surat LigniteTPP (Unit1,2)	Gujarat	16-01-00,6-11-99	250	0.785	1720	9.89	1550	1388	2386739
Sanjay Gandhi Extn TPP (4)	MP	23-11-99	210	0.715	1315	9.88	1185	1388	1824466
Vindyachal STPS (8)(C)	MP	26-02-00	500	0.715	3130	9.88	2821	1388	4343967
Wankabori TPS(7)	Gujarat	31-12-98	210	0.785	1444	9.89	1302	1388	2004861
Birsinghpur (3)	MP	28-02-99	210	0.715	1315	9.88	1185	1388	1824466
Vindhyachal STPS (7)*	MP	3/3/1999	500	0.715	3130	9.88	2821	1388	4343967
Kutch Lignite	Gujarat	2/4/1997	75	0.785	516	9.89	465	1388	716022
Gandhinagar TPS	Gujarat	19.03.98	210	0.785	1444	9.89	1302	1388	2004861
Chandrapur (Unit 7)	Maharashtra	1/10/1997	500	0.75	3285	8.02	3022	1388	4559360
Baroda ST(1)	Gujarat	18-11-97	61	0.785	420	9.89	378	1388	582364
Wind									0
Wind projects of WR****		2004-05	26.2	0.153	35.2	0.0	35.2		
Private	Mah	3/31/2004	6.24	0.138	7.5	0.0	7.5		0
State	Mah	3/31/2004	1.96	0.138	2.4	0.0	2.4		0
Pvt	MP	3/31/2004	0.06	0.160	0.1	0.0	0.1		0
Pvt	Gujarat	3/31/2004	35.29	0.182	56.2	0.0	56.2		0
State	Goa	3/31/2004	0.11	0.153	0.1	0.0	0.1		0
wind	Mah	1/6/2001	242.22	0.138	291.8	0.0	291.8		0
Wind	Gujarat	1996-97	128.71	0.182	204.9	0.0	204.9		0
Wind	MP	1996-97	9.59	0.160	13.5	0.0	13.5		0
Wind	Maharashtra	1996-97	5.37	0.138	6.5	0.0	6.5		0
Gas					0		0		0
Dhuvaran CCPP GT	Gujarat	6/4/2003	67.85	0.789	469	1.66	461	437	205189
Dhuvaran CCPP ST	Gujarat	9/22/2003	38.77	0.789	268	1.66	264	437	117246
Hazira CCGT(1,2)	Gujarat	30-09-2001,16-10-01	104	0.789	719	1.66	707	437	314512
Salgaocar CCGT (1)	Goa	5/7/1999	48	0.799	336	2.08	329	437	147034
Peguthan CCGT *	Gujarat	23.10.98	250	0.789	1729	1.66	1700	437	756039
Baroda ST(1)	Gujarat	18-11-97	61	0.789	422	1.66	415	437	184473
Dabhol CCGT (1,2)	Maharashtra	11/12/1998	480	0.340	1428	2.3	1395	437	624594
Dabhol CCGT (ST-1)	Maharashtra	11/12/1998	260	0.340	773	1.66	761	437	338322
Peguthan (1,2,3)	Gujarat	22-10-97	135	0.789	933	1.66	918	437	408261
Hazira CCGT Essar(unit 1)	Gujarat	26-05-97	185	0.789	1279	1.66	1258	437	559469
Baroda GT	Gujarat	26-08-97	106	0.789	733	1.66	721	437	320560
Hazira CCGT Essar(1,2,3)	Gujarat	10-8-95, 10-8-95, 13-11-95	330	0.789	2282	1.66	2244	437	997971
				Total	**38087**	**GWh**	**30044.2315**		**32709974.36**

Total generation of Western grid **184084 GWh**

Generation from recently built plants **38087 GWh = 20.7 % of the total system**

Data source : www.cea.nic.in **BM= 1088.727** tCO2/GWh

* Table2.7, CEA, General Review 2006,2005,2002-2003,2001-2002,2000-2001,1999-2000,1998-1999,1997-1998

** Table 2.4 & 3.4, CEA General Review 2006

*** Table 5.5, CEA, General Review 2006

**** Comparison beteween Table 2.4 of General review 2006 & General review 2005

Weighted average of approximate operating margin calculation:

Approximate OM		
2002-2003	1.419	tCO_2/MWh
2003-2004	1.242	tCO_2/MWh
2004-2005	1.235	tCO_2/MWh
Generation weighted average	1.297	tCO_2/MWh

Average of approximate operating margin and build margin (EFy as per 9a of AMS I.D):

Approximate OM	$EF_{OM,y}$	1.297	tCO_2/MWh
BM	$EF_{BM,y}$	1.089	tCO_2/MWh
EF-AMS I.D 9a	EF_y	1.193	tCO_2/MWh

Weighted average emissions of current generation mix (EFy as per 9b of AMS.I.D)

	Fuel				Emission factor	CO2 Emissions	Electricity generation			
	Units	Consumption	Conversion factor to mass unit	10^3 MT	($tCO_2/10^3$ tonnes) for NG =(tCO_2/M Cu.m)	(tCO2)	Gross Electricty generation (GWh)	Auxiliary consumption (%)	Net ele Gen (GWh)	TCO2/GWh
Steam stations		*		*			*	**		
Coal	000 MT	94123	1	94123	1852	174344583	142813	8.4	130817	
Furnace Oil	KL	1066231	0.93	992	3078	3052399				
Light Oil	KL	10028	0.827	8.29	2918	24198				
LSHS/HHS/HSD	KL	574238	0.827	475	3146	1493904				
GAS	KL	39012	1	39	2919	113890				
Lignite	000 MT	2609	1	2609	972	2535752				
Gas Stations						*181564726*			*130817*	*1387.933*
Natural Gas										
HSD	M Cu M	4667	1	4667	1931	9013632	25526	2.0	25029	
Naphtha	KL	1625	0.827	1.34	3146	4228				
	KL	776908	0.76	590	3268	1929429				
Diesel Stations						*10947289*			*25029*	*437.39142*
LSHS										
Diesel	KL	0	0.827	0	3146	0	0	0.0	0	
	KL	0	0.827	0	3146	0		0.0	0	
Total from fossil fuel										
						192512015	**168339**		**155845**	
Hydro stations**							10609.57	0.59	10547	
Nuclear stations**							5100	11.18	4530	
Wind stations**							884.12	0	884	
Total from LC/MR plants							*16594*		*15960*	
Total generation							**184933**		**171806**	

Data source:	www.cea.nic.in	**EF-AMS I.D 9b**	**Average OM** (EF_y)	**1.121**	**tCO2/MWh**
*	Table 6.1, CEA general Review				
**	Table 5.5, CEA general review				

Emission co-efficient calculation for fuels:

Type of FUEL	Net Calorific Value (TJ/ 10^3 tonnes or TJ/Mcum)	Carbon Emission Factor (t C/ TJ)	Fraction of Carbon Oxidised - Oxidation Factor	Emission Coefficient (tCO_2/ 10^3 tonnes or tCO2/Mcum)
Steam Stations	**	*	***	
Coal	19.98	25.8	0.980	1852.3
Furnace diesel	40.19	21.1	0.990	3078.3
Light Oil	40.19	20.0	0.990	2917.8
LSHS/HHS/ oil/HSD	43.33	20.0	0.990	3145.8
Gas(TJ/1000T)	52.30	15.3	0.995	2919.4
Lignite	9.80	27.6	0.980	971.9
Gas Stations				
Natural Gas (TJ/Mcum)	34.60	15.3	0.995	1931.4
HSD	43.33	20.0	0.990	3145.8
Naphtha	45.01	20.0	0.990	3267.7
Diesel Stations				
LSHS	43.33	20.0	0.990	3145.8
Diesel Oil	43.33	20.0	0.990	3145.8

Data sources	
**Calorific values	
Coal,Lignite	Default values obtained from Table 1-2 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook
Naphtha,FO,HSD,JSHS	Default values obtained from Table 1-3 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook
Natural gas	http://www.ocean.washington.edu/courses/envir215/energynumbers.pdf www.evworld.com/library/energy_numbers.pdf
Gas	Default values obtained from Table 1-24 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories:
* Carbon emission factor	Default values obtained from Table 1-4 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook
*** Oxidation factor	Default values obtained from Table 1-6 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

CER Calculation:

Year	Period	Power generation			PLF	Loss % of power generation	Average carbon emission factor	Baseline emission	CER
		gross	auxiliary consumption +losses	net supply					
		MWh	MWh	MWh			$t CO_2/MWh$	$t CO_2/y$	$t CO_2/y$
1	January 02 - December 02	2415	169	2,246	0.23	7.00	1.121	2,680	2,680
2	January 03 - December 03	2296	244	2,052	0.22	10.61	1.121	2,449	2,449
3	January 04 - December 04	2612	205	2,407	0.25	7.84	1.121	2,871	2,871
4	January 05 - December 05	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
5	January 06 - December 06	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
6	January 07 - December 07	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
7	January 08 - December 08	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
8	January 09 - December 09	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
9	January 10 - December 10	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
10	January 11 - December 11	2441	225	2,216	0.23	9.22	1.121	2,643	2,643
								Total	**26,504**