CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

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SECTION A. General description of project activity

A.1 Title of the project activity:

VGL - Waste Heat based 4 MW Captive Power Project at Raipur

Version No. – 01

Date: 21st October 2005

A.2. Description of the project activity:

Purpose:

The purpose of the project activity is to utilize the heat content of the flue gases generated from the Direct Reduction Iron (DRI) kiln of sponge iron making process, for generating power. Prior to the project activity, the project proponent was importing power from grid and the waste flue gas from the kiln was released to the atmosphere. The power generated from waste heat displaces grid power and hence indirectly reduces greenhouse gas (GHG) emissions at the thermal power plants connected to grid.

Salient features of the project:

Vandana Global Limited (VGL) is a sponge iron and steel manufacturing industry that belongs to the 'Vandana Group of Industries' of Chhattisgarh State, India. The other companies belonging to the Group are Vandana Rolling Mills Limited, Vandana Udyog Limited, Vandana Ispat Limited, Vandana Industries Limited and Vandana Vidyut Limited. VGL produces around 60000 tonnes of Sponge Iron and 30000 tonnes of Steel ingots per annum.

The project generates 4 MW of waste heat power from process flue gas of the DRI kiln. This power is used to cater to the in-house power requirement of VGL plant and wheeling the power through Chhattisgarh state grid. The net result is a reduction in electricity demand from the state grid supply and corresponding GHG emission reduction at its thermal power plants.

`The benefits from the project is not just in the form of power produced from the waste energy source but also the improvement of local environment and reduction in GHG emissions i.e. CO_2 in global scenario.

Therefore, the project fundamentally achieves the following goals:

- Utilization of heat energy of waste gas.

- Meet the process requirement of power without any T&D losses.
- Technological up gradation and sustainable industrial growth in the state.
- Conserves natural resources and environment in local as well as global front. .

Project contribution to sustainable development:

The contributions of the project activity towards sustainable development have been addressed under the following pillars of sustainable development:

Socio-economic benefits: - Project activity has led to direct and indirect employment during stages of power plant construction and operation in the region. Also, with growing technological advancement the project activity contributes to capacity building in terms of technical knowledge and managerial skills.

The project shows less dependence of project proponent on grid electricity and better management of waste. This brings in related benefit for the employees and the local community.

Environmental Well-being: - In India, coal is the most abundantly available fossil fuel which is mainly used for power generation. Power plants run by coal contribute more than 85% of power generation in the state[1]. The waste heat recovery based CPP in VGL is displacing electricity generated by grid-connected thermal power plants in an equivalent amount. In this way, the project activity is curtailing further depletion of non-renewable energy resources like coal, thus increasing its availability to other important processes in future.

Technological Well-being: - With the project activity, the company upgrades its technology through improved instrumentation and automation. Proper education and training has been imparted to the managerial and operational staff for improving their knowledge base and to ensure proper operation of the unit. The project activity introduces a cleaner and energy efficient technology by enabling utilization of heat energy in process waste gas streams in power generation, thereby enabling project proponent to reduce carbon dioxide emission and other associated pollution elsewhere at the thermal power plants; equivalent of which would have been emitted in absence of the project. Ash from electrostatic precipitator (ESP) is collected in ash silo and sold to brick manufacturers. Thus the implementation of project activity is a demonstration of a clean technology.

[1] www.cseb-powerhub.com/generation.htm

Implementing such modern technologies will lead to sustainable economical and industrial growth in the long run and further conserving natural resources like coal. The detailed references of the above mentioned contributions are provided in Section F – Environmental Impacts.

A.3. Project participants:

Name of the 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 Ministry of Environment and Forests (MoEF)	Vandana Global Limited	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

India

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

Chhattisgarh

A.4.1.3. City/Town/Community etc:

Raipur

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

The project activity has been implemented in the VGL Sponge Iron Manufacturing plant located in Siltara Industrial area in Raipur district of Chhattisgarh state of India. Raipur is well connected with road, rail and airport infrastructure. The geographical location with rail/road connectivity of Raipur is detailed in the maps shown in Fig 1 below.

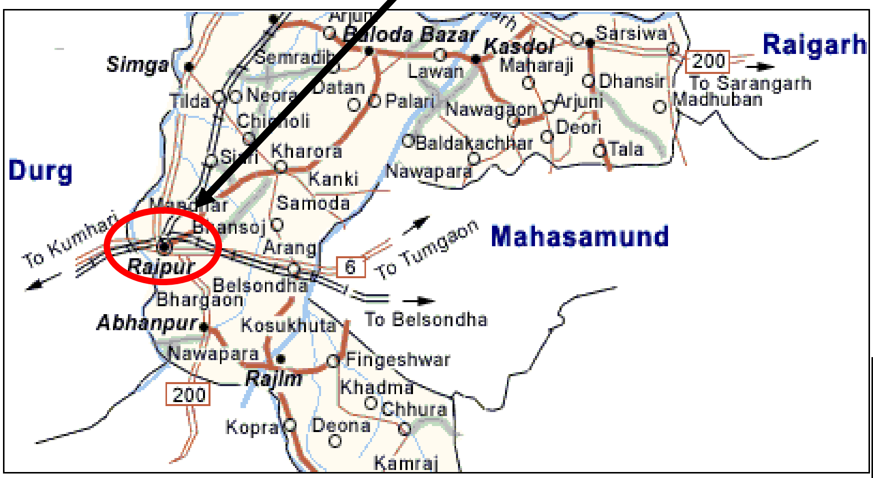

Fig 1: Location of project activity.
(Maps not to scale).

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

The project activity is an electricity generation project utilizing waste heat where aggregate electricity generation savings of the project exceeds the equivalent of 15 GWh per annum. The baseline and monitoring and methodology is adopted as per ACM0004. The project activity may principally be categorized in Category 1- Energy Industries (Renewable/Non-Renewable sources) as per the scope of the project activities enlisted in the 'list of sectoral scopes and approved baseline and monitoring methodologies' on the UNFCCC website for accreditation of Designated Operational Entities[2].

A.4.3. Technology to be employed by the project activity:

VGL sponge iron plant has a 200 tonnes per day (tpd) capacity DRI kiln and is currently producing around 60000 tonnes per annum (tpa) of sponge iron. The Waste Heat Recovery (WHR) based captive power plant at VGL utilizes the sensible heat content of waste flue gas from DRI kiln to generate electricity for its captive requirement. The exhausted flue gas of the sponge iron kiln is received at the After-Burning Chamber (ABC) inlet at a temperature of around 900^{o}C. The waste gases are burnt in ABC to remove traces of carbon monoxide. After secondary combustion the hot flue gases leave the ABC at a temperature of around 950^{o}C which is finally introduced to the WHRB through a hot gas duct.

The flue gas is circulated through two passes in the WHRB to transfer the sensible heat energy of the waste gas to water and generate 30 tonnes per hour (tph) of steam at 67kg/cm^2, 510^{0}C. Finally, the gas is passed through Economiser bundles for optimum recovery of heat from the hot exhaust.

The high pressure steam is fed into fully condensing steam turbo-generator of 8 MW capacity. The steam turbine is coupled with an electric generator which converts the mechanical energy of the turbine into electrical energy. The turbine is of single cylinder, single exhaust, condensing type with uncontrolled extraction for the deaerator, designed for high operating efficiencies and maximum reliability. The generator is a three phase, four pole, synchronous type with brushless excitation.

The waste gases after maximum heat transfer in the WHRB is led to exhaust stack through Electrostatic Precipitator (ESP) which reduces Suspended Particulate Matter (SPM) load to a large extent. SPM is collected in the hoppers of the ESP. The particulate matter collected in the hoppers is conveyed to existing ash silo by a conveyor belt. The project will generate around 25 Million kWh per annum.

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2 http://cdm.unfccc.int/DOE/scopes.html

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

VGL has set-up the CPP with an objective to utilize waste gases of substantial heat content available from the DRI kilns of the Sponge Iron manufacturing unit and to use it to generate electrical energy for its own utilization in the manufacturing facilities of sponge iron and steel.

The project has employed a non-GHG emitting technology - Waste Heat Recovery and Steam Generating System. In the absence of the project, the electricity requirements of equivalent amount would have been met by CSEB grid supply resulting into an equivalent amount of CO_2 emission from the thermal power stations. As mentioned earlier, more than 85% of CSEB grid comprises of thermal power mix (coal, gas). However, due to project activity, project proponent has been able to reduce and replace an equivalent amount of demand on grid electricity, resulting in reduction of corresponding CO_2 emissions at the thermal power plants of the grid.

The project does not contribute to any additional GHG emission. It utilizes only the sensible heat content of the waste gases available at the outlet of the ABC attached to the Sponge Iron kiln located within the premises and connected by hot gas duct with the WHRB. The chemical composition of the waste gas at the inlet and outlet of the boiler remain same and no other secondary fuel is fired in the boiler. Taking into consideration the power deficit in India, future demand rise in Chhattisgarh[3] and recent capacity additions to meet the electricity demand in the state, the project activity contributes by reducing this demand by around 25 MU per year. The project activity reduces anthropogenic emissions by sources that would have occurred (due to future generation mix) or are occurring (due to present generation mix) to cater to a certain proportion of the demand. The average estimated total of emission reductions to be achieved by the project is 20491.90 tonnes of CO_2/year and 204919 tonnes of CO_2 for the entire 10 year crediting period.

The Chhattisgarh and Indian governments do not require sponge iron manufacturing industries to utilize the heat content of the waste gases generated from the DRI kilns. The project proponent has implemented the project activity over and above the national or sectoral requirements. The GHG reductions achieved by the project activity are additional to those directed by the governmental policies and regulations. The

[3] Refer- power shortage of approximately to 917 MW by the year 2010-11 as reported in the Infrastructure Development Action Plan for Chhattisgarh – Final Report (http://www.chhattisgarh.nic.in/opportunities/Power.pdf)

other “additionality” criteria of the project activity are dealt with in section B.3. The project activity will result in zero amount of GHG emission.

VGL decided to implement the project activity despite facing regulatory barriers from government authorities for power generation. VGL was fully aware of the CDM developments during project decision making stage and decided to invest in project activity taking into consideration the financial assistance which would be made available under CDM. The financial assistance and the enhanced visibility that CDM would provide acted as incentive for VGL to overcome the barriers associated with implementation of the project activity.

Hence, in absence of the approval and registration of the project activity as a CDM project activity the associated barriers would prevail and VGL would eventually resort to business-as-usual scenario which is letting off the waste heat into atmosphere and importing power from grid. The waste heat based power plant is not only justified in view of its capability to affect the generation mix but also lead as an example of eco-friendly power from a sponge iron industry. The project meets the requirement of additionality tests of the ‘Tools for the demonstration and assessment of Additionality’ and its operation has the effect of reducing GHG emissions below the level that would have occurred in its absence (refer section B3 for further details).

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Operating Years	**CO_2 Emission Reductions (tones of CO_2)**
2005-06	20491.90
2006-07	20491.90
2007-08	20491.90
2008-09	20491.90
2009-10	20491.90
2010-11	20491.90
2011-12	20491.90
2012-13	20491.90
2013-14	20491.90
2014-15	20491.90
Total estimated reductions (tonnes of CO_2 e)	**204919**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	20491.90

A.4.5. Public funding of the project activity:

There is no public funding from any of the parties in Annex I to the UNFCCC, available for the project activity.

SECTION B. Application of a baseline methodology

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

Title : Consolidated baseline methodology for waste gas and/or heat for power generation

Reference: Approved consolidated baseline methodology ACM0004/ Version 01, Sectoral Scope:01, 8 July 2005

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

As stated in ACM0004, "*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities".*- The project activity under consideration recovers the heat content of waste gases emitted from the DRI Kiln in WHRB and utilizes the same to produce steam which is further used to generate electricity.

Apart from the key applicability criteria, the project activity is required to meet the following conditions in order to apply the baseline methodology-

The methodology applies to electricity generation project activities:

1. *"that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, electricity"*-As per the Baseline Scenario analysis, conducted in Section B.2 of this PDD, the project activity displaces electricity generation with fossil fuels in the electricity grid of Chhattisgarh. Therefore the project activity meets the above applicability criteria.
2. *"where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity"*- The project activity involves utilization of the heat content of waste gases of the sponge iron kiln, earlier dissipated into the atmosphere, for power generation. There is no fuel switch involved in the sponge iron kiln operation.

Furthermore, "*The methodology covers both new and existing facilities*"- The project activity has been undertaken in the existing sponge iron plant of VGL and the waste gases used in the project activity are emitted from the sponge iron kiln currently operating in the facility site.

As stated above, the project activity under consideration meets all the applicability conditions of the baseline methodology. This justifies the appropriateness of the choice of the methodology in view of the project activity and its certainty in leading to a transparent and conservative estimate of the emission reductions directly attributed to the project activity.

B.2. Description of how the methodology is applied in the context of the project activity:

The project activity involves setting up of 4MW WHR based CPP by VGL to meet its own power requirement at the manufacturing facilities of sponge iron and steel and wheel the power through the state grid. The methodology is applied in the context of the project activity as follows:

Identification of Alternative Baseline scenarios and selection of appropriate baseline scenario:

As per the methodology, the project proponent should include all possible options that provide or produce electricity (for in-house consumption and/or other consumers) as baseline scenario alternatives. These alternatives are to be checked for legal and regulatory compliance requirements and also for their dependence on key resources such as fuels, materials or technology that are not available at the project site. Further, among those alternatives that do not face any prohibitive barriers, the most economically attractive alternative is to be considered as the baseline scenario.

As mentioned above, the project activity requires supplying power to the captive demand of the manufacturing unit of VGL. Five plausible alternative scenarios were available with the project proponent which was discussed during project inception stage:

Alternative 1: Import of power from grid– continuation of current scenario

The VGL plant would continue to purchase required power from Chhattisgarh State Electricity Board (CSEB). An equivalent amount of CO_2 emissions would take place at the thermal power plants supplying power to CSEB grid. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option.

Alternative 2: 4 MW Coal based CPP at VGL

The project proponent may generate the same amount electricity (4 MW) from coal based CPP at its existing sponge iron plant. The power generated would meet VGL's own demand in the manufacturing units and wheel the remaining power through the CSEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be considered as one of the plausible baseline alternative.

Alternative 3: 4 MW Gas based CPP at VGL

VGL may generate its own power using natural gas based captive power plant and an equivalent amount of carbon dioxide would be generated at the power plant end. Though this alternative is in compliance with all regulatory and legal requirements it is not a realistic alternative due to non-availability of natural gas distribution network in Chhattisgarh[4]. Therefore, alternative 3 may be excluded from baseline scenario.

Alternative 4: 4 MW light diesel oil or furnace oil based CPP at VGL

VGL may set up 4 MW light diesel oil (LDO) or furnace oil (FO) based CPP at its existing sponge iron plant. The power generated would meet VGL's own demand and the remaining power would be wheeled through CSEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be one of the plausible baseline option.

Alternative 5: Implementation of project activity without CDM benefits

VGL may set up a 4 MW waste heat recovery based CPP at its existing sponge iron plant. The power generated would meet VGL's own demand and the remaining power would be wheeled to CSEB grid. This alternative is in compliance with all applicable legal and regulatory requirements. The heat energy of the kiln flue gases would be utilized and for the total power supplied, VGL would reduce an equivalent amount of CO_2 emissions at the thermal power plants feeding to the CSEB grid. However, for this alternative the project proponent faced a number of regulatory and technological barriers (as detailed in Section B3 below) and hence this option is not a part of baseline scenario.

[4] State wise/Sector wise Allocation of Natural Gas - http://petroleum.nic.in/ngbody.htm

Evaluation of the alternatives on economic attractiveness:

From the discussion above it is found that alternatives 1, 2 and 4 can be a part of baseline scenario. Further, as per the methodology, the alternatives are evaluated on the basis of economic attractiveness. The broad parameters used for evaluation are capital cost and the unit rate of electricity purchased or produced. Table 1 below shows the economic evaluation of the three options:

Table 1: Evaluation of Alternatives based on Economic Attractiveness

Alternative	Capital Cost (Rs. Million / MW)	Generation/ Purchase Cost (Rs./kWh)		Source of Information	Comments	Conclusion
1)Import of power from the grid	Nil	Year 2001-2002	4.38	Electricity bills of VGL for the respective years	Continuation of current situation, annual expenses in the form of tariff is low, no additional investment, easy government approvals	This option is economically attractive
		Year 2002-03	3.46			
		Year 2003-04	2.87			
2) Coal based CPP	42.5 – 45.0	1.78 - 1.92		Indicative prices available in India during project conception stage[5]	High Capital Cost - uneconomical for small sizes, difficulty in accessing bank loans, government clearances cumbersome.	This option is economically unattractive
4) LDO/FO Based CPP	7.5 - 12.0	3.5 - 4.6		Indicative prices available in India during project conception stage[5]	VGL expected further oil price hike in future, hence the variable cost of power generation would be high.	This option is economically unattractive

[5] Captive Power Plants- Case study of Gujarat India - http://iis-db.stanford.edu/pubs/20454/wp22_cpp_5mar04.pdf

Thus in view of the above points, the Baseline Alternative 1: 'Import of electricity from the grid' is most likely baseline scenario and has been considered as business as usual scenario for the baseline emission calculations. Further, the following points corroborate that 'import of electricity from grid' is the baseline:

- This is a usual practice being followed by the other similar industries in the state- ie. business-as-usual-scenario. Only 7 sponge iron plants (including VGL) out of around 65[6] (refer Step 4 in section B3 of Tool for the demonstration and assessment for Additionality for details) in the state have waste heat recovery based captive power generation.
- No power generation risk involved
- The VGL plant is connected to the state grid and will be dependent on the same in absence of the project.
- The grid's generation mix comprises of power generated through sources such as thermal (coal and gas), hydro and nuclear power plants and renewable energy. The project activity would therefore displace an equivalent amount of electricity the plants would have drawn from the grid. The Baseline Emission Factor of the grid is more conservative than that of the coal based CPP.

We may therefore conclude that in the absence of project activity, the VGL plant would draw power from CSEB, and the system boundary would include the grid's generation mix. It may also be noted that in the pre-project scenario the VGL drew power from CSEB. This further reaffirms that the grid as baseline will be the most appropriate choice.

Establishing the additionality for the project activity

This step is based on Annex I to EB 16 Report and follows the "Tool for the demonstration and assessment of additionality". Information/data related to preliminary screening, identifying alternatives, common industry practice and other financial, regulatory and technology related barriers were used to establish the additionality. Details of establishing additionality are explained in section B3.

<u>Estimation of emission reductions resulting from the project activity</u>

[6] Chattisgarh Sponge Iron Manufacturers' Association

As per the methodology, the emission reductions resulting from the project activity is calculated as a difference between the baseline emissions and the project emissions. The methodology does not require the project proponent to consider any emission due to leakage. The baseline emissions and the project emissions are quantified as per the guidelines given in the methodology:

Baseline Emissions

Since "Alternative 1: Import of electricity from the grid" is the baseline scenario, therefore the baseline emission is calculated as per Option 2 for estimation of baseline emissions of the methodology. The VGL project activity is developed in Chhattisgarh and would displace an equivalent amount of electricity the plant

- otherwise would have drawn from CSEB in absence of the project activity and
- supplies to CSEB by the project activity

Baseline Emissions Factor

The CO_2 baseline emission factor of the state grid of Chhattisgarh, has been calculated as Combined Margin [average of the Operating Margin, calculated as 3-year average, based on 2002-2003, 2003-2004 and 2004-2005 (the most recent statistics available) and Build Margin, calculated for the most recent year, 2004-2005] following the guidelines provided in ACM0002 and was found to be 0.820 kg. of CO_2/ kWh. Please refer to "Annex 3: Baseline Information" and Appendix III for detailed analysis of the generation mix of Chhattisgarh state grid and calculation of the grid emission factor.

Electricity generation in the project activity

The project activity would generate a net electricity of 25 million kWh per annum to meet its in-house consumption and wheel the surplus electricity to the grid. Without the project activity, the same energy load would have been taken up by grid power and emission of CO_2 would have occurred due to fossil fuel combustion.

Project Emissions

As per the methodology, project emissions are applicable only if auxiliary fuels are fired for generation start up, in emergencies, or to provide additional heat gain to waste gases before entering the WHRB However there is no provision of auxiliary fuel firing for generation start up or for additional heat gain of the waste gases in the project activity. Therefore there is no project emission resulting from the project activity. Please refer to Section D.2.1 for details.

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 CDM project activity:

As per the decision 17/cp.7, para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in absence of registered CDM project activity. The methodology requires the project proponent to determine the additionality based on 'Tool for the demonstration and assessment of additionality' as per EB 16 meeting. The flowchart in Fig 2 below provides a step-wise approach to establish additionality of the project activity.

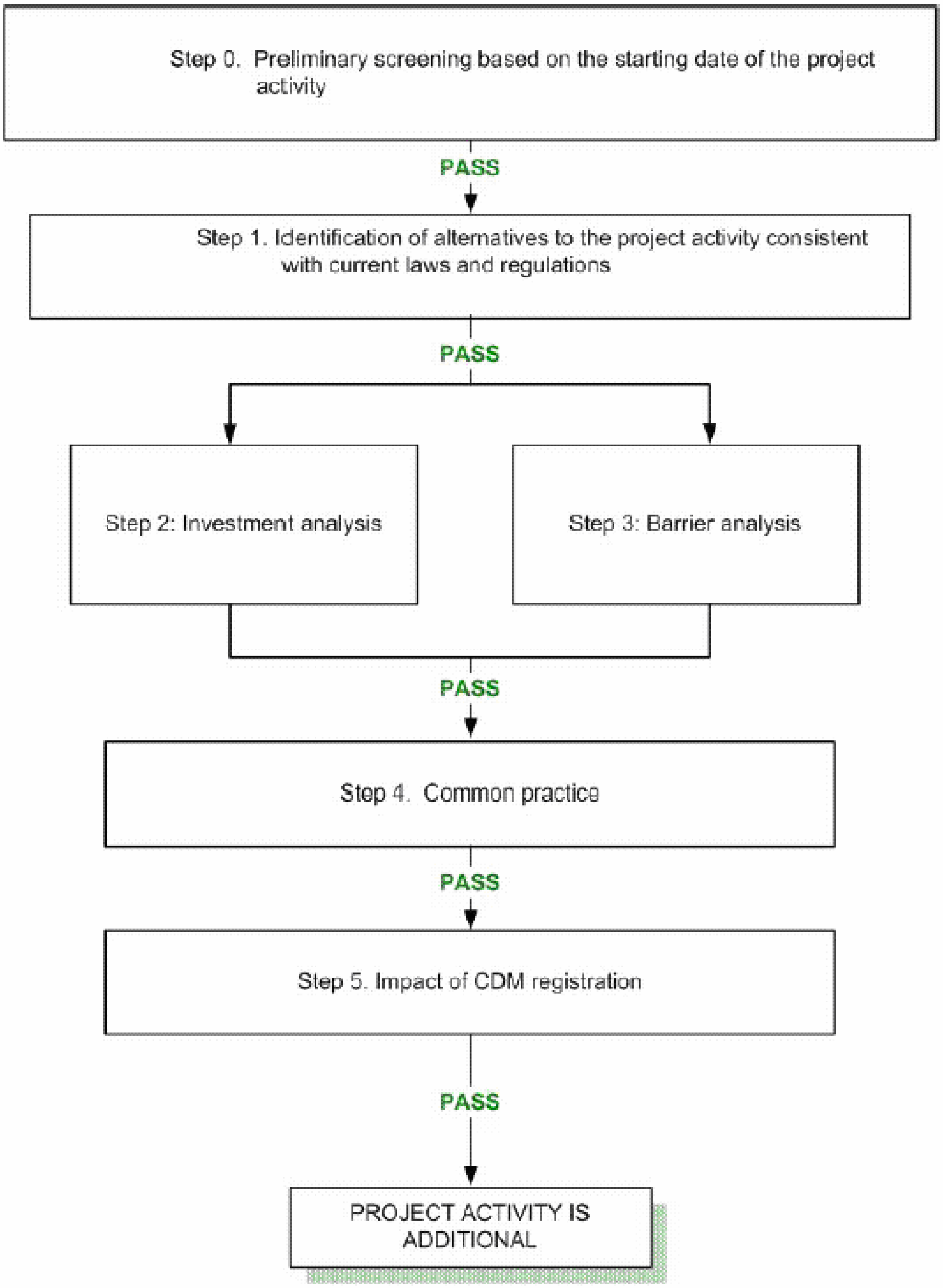

Fig 2: Flow chart for establishing additionality

Step 0. Preliminary screening based on the starting date of the project activity

1. If project participants wish to have the crediting period starting prior to the registration of their project activity, they shall:

(a) *Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration*:

The project proponent and sponsor Vandana Global Private Limited launched the project activity on waste heat recovery based captive power generation starting construction in 2003. VGL would provide sufficient evidences to establish the same.

(b) *Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity.*

As a responsible corporate citizen, VGL is committed to growth of business keeping in mind the environmental protection aspects both locally as well as globally. VGL is aware that the emergence of the concept of sustainable development in the recent years has brought in the general realization that environmental issues are inexorably linked with its development objectives and polices. All activities undertaken by VGL take into consideration the environmental, health and social assessment. Consequently, climate change issues are very much a part of VGL decision making covering all its proposed activities. VGL was aware of the number of investment and regulatory barriers it would face for entering into a domain of power generation which is not coming under its expertise. Despite these barriers, the Board Members of VGL decided to take up the project activity in view of the risk mitigation cover CDM would provide. The Board also decided to bear the costs for CDM documentation, registration and for adhering with the M&V protocol. Adequate evidence is available which shows that CDM benefits were seriously considered to proceed with project activity.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations
Sub-step 1a. Define alternatives to the project activity:
Sub-step 1b. Enforcement of applicable laws and regulations:

As discussed in section B2 above, there were five plausible alternatives available with the project proponent to provide the power requirement of the VGL iron and steel plant, among which three were feasible. They were:

Alternative 1: Import of power from grid– continuation of current scenario

Alternative 2: 4 MW Coal based CPP at VGL

Alternative 4: 4 MW light diesel oil or furnace oil based CPP at VGL

These alternatives are in compliance with all applicable legal and regulatory requirements. There is no legal binding on VGL to implement the project activity. In India it is not mandatory for sponge iron units to implement waste heat recovery based power generation plants from waste gases of the kilns. Neither are there any planned regulations for sponge iron manufacturing industries that will enforce them to implement project activity in India. The pollution control board does require sponge iron units to operate such that the dust levels of the waste gases to be emitted into the atmosphere should be less than $100mg/Nm^3$. These pollution control board norms were being met even in absence of the project. Though this alternative would bring down the SPM levels in the flue gas, there is no mandate by the Chattisgarh Pollution Control Board to implement the same.

Next the project proponent is required to conduct

Step 2. Investment analysis OR
Step 3. Barrier analysis.

VGL proceeds to establish project additionality by conducting the Step 3: Barrier Analysis.

The project proponent is required to determine whether the proposed project activity faces barriers that:

(a) Prevent the implementation of this type of proposed project activity; and
(b) Do not prevent the implementation of at least one of the alternatives through the following sub-steps:

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

The project activity had its associated barriers to successful implementation, which have been overcome by VGL to bring about additional greenhouse gas reductions. The barriers are detailed below:

1. Regulatory/Institutional barriers:

Regulatory barriers faced by VGL (the project proponent) are detailed below:

a. VGL, in early 2002, decided to take permission for setting up its captive power plant that included 4 MW from the waste heat utilization. The company had intended to reduce dependence on grid power once its captive power plant was commissioned. While granting permission, CSEB however put a condition that the VGL's contract demand of 7000kVA will not be reduced on account of installation of proposed captive power plant[7]. Hence, for VGL these demand charges turned out to be considerable recurring costs.

b. The project activity was conceived for in-house consumption and wheeling to its group companies. But as the mandatory contract demand of 7000kVA was catering to the power demand of VGL, the project would cater to the wheeling demand. VGL had applied for wheeling to CSEB on 6th Mar 2003 as per Chattisgarh state and Indian government policy. On 7th Mar 2003, CSEB issued No Objection Certificate to VGL on the condition that wheeling of power shall be commenced after obtaining the permission under Section 28 of Indian Electricity Act 1910. Moreover, under this Act, wheeling power to consumers shall not be permitted to reduce their contract demand and shall pay tariff minimum (TMM) charges as per the prevailing agreement between the consumers and the Board. Accordingly, again VGL applied on 8th March 2003 to the Energy Secretary, Government of Chattisgarh for permission to wheel to group companies. In the meantime, a new Act, called Electricity Act 2003 was passed in India wherein for getting the permission to wheel the company had to apply to the State Electricity Regulatory Commission under Section 42 of the new Act. However, this permission got delayed as Chattisgarh State Electricity Regulatory Commission (CSERC) was

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[7] Reference: CSEB Letter to VGL, dated 10th February, 2003, Letter from VGL to CSEB dated 6th March 2003, Letter from CSEB to VGL dated 7th March 2003, Letter from VGL to Energy Secretary, Govt. of Chattisgarh dated 8th March 2003 and Letter from CSERC to VGL dated 27th September 2003.

in a formatory stage at the time in the new state of Chattisgarh. Finally after the hearing of the petition, CSERC granted permission to VGL to wheel power on 27th September 2005.

Inspite of these unfavourable factors, VGL went ahead with the project, keeping their confidence in the Kyoto Protocol/ CDM process.

The above mentioned regulatory barriers were one of the major obstacles to project activity implementation.

2. Technological barriers:

Lack of relevant technical background

Energy generation is not a core business of VGL. The project participant belongs to the Vandana Group of Industries which has never before taken up a waste heat based power generation project. The Group is engaged mainly in manufacturing iron and steel products. The waste heat recovery based power project is a steep diversification from the core business fields to power generation where the project proponent had to meet challenges of captive power policies, delivery/non-delivery of power, wheeling of power and techno-commercial problems associated with electricity boards. The facility had to invite external parties to implement the project activity. Skilled professionals had to be employed and the employees of VGL were also required to develop expertise on design, construction and operation of heat recovery based power plant.

Other barrier(s) – due to lack of awareness about available technologies, products, financial support; limited dissemination of information on operation know how; limited managerial resources; organizational capacity

As mentioned earlier, the sponge-iron manufacturing sector belongs to steel industry sector with limited knowledge and exposure of complications associated with production of power. VGL personnel lacked the necessary technical background to develop and implement a waste heat recovery based power plant with technological innovation. They had to strengthen their internal capacity by inviting external expertise to implement the project activity. The VGL personnel at various levels lacked relevant managerial background for project activity implementation, operation and maintenance. They were provided with training to ensure smooth operation. They had no background strength in the power sector economics and power generation sector.

Sub-step 3b: ***Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (except the proposed project activity already considered in Step 3a).***

This is demonstrated in Table 1 of Section B.2 above. VGL's project activity is a waste heat recovery based power project utilizing waste heat from sponge iron rotary kiln that uses coal as fuel. VGL would not face any regulatory barrier in case it opted for import of power from grid since before project activity VGL was connected to the grid for power and it still imports power from the grid on a continuous basis. In this scenario it would not face the investment barrier as no special investments are required to meet the demand. Finally VGL would not face any technological barriers associated with generation and synchronization of waste heat based power, in case it continues to depend solely on power imported from grid. Therefore, it is most likely that in absence of the project activity VGL would opt for the business-as-usual scenario, i.e. letting off the waste heat into the atmosphere and importing equivalent amount of electricity from state grid to cater to its need.

Step 4: Common Practice analysis: Based on the information about activities similar to the proposed project activity, the project proponent is supposed to carry out common practice analysis to complement and reinforce the barrier analysis. The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

Step 4a: Analyze other activities similar to the proposed project activity

In the sponge iron sector of Chattisgarh State with similar socio economic, environment, geographic conditions and technological circumstances there were around 65 similar plants (i.e.sponge iron manufacturing units) operating when the project was in implementation stage. Of the 65 plants only seven plants had set-up waste heat recovery based CPPs. Among them three plants generated power to meet their in-house consumption alone thus not undertaking additional risks associated with wheeling power through the grid. VGL's project activity would be the fourth sponge iron plant in the state to set up WHR based CPP with a provision for feeding power to the grid.

These plants have been categorised as per Table 2 summarizing the common practices adopted by sponge iron manufacturing plants located in Chattisgarh state to meet their power requirements.

Table 2: Common Practise analysis

Alternatives	Description	No. of sponge iron plants
Scenario 1	Import of Power from Grid	58
Scenario 2	Waste heat recovery based CPP for in-house consumption	03
Similar Project Activity	Waste heat recovery based CPP feeding to grid (including VGL)	04
Total no. of Sponge Iron plants in Chattisgarh		**65**

Source: Chattisgarh Sponge Iron Manufacturers' Association

Step 4b: Discuss any similar options that are occurring

WHR based power generation feeding power to grid took place only at Jindal Steel and Power Limited (JSPL)[8], Godavari Power and Ispat Limited (GPIL) and HEG Ltd.[9] Other than the project activity at VGL. JSPL was exporting surplus power to the state grid and GPIL and HEG limited wheeled the surplus power to its group companies through the transmission and distribution lines of CSEB. This substantiates the fact that the project activity is not a widely observed and commonly carried out practice.

Step 5: Impact of CDM registration

The project activity was started in January 2003 and was commissioned in March 2005. As mentioned in Step 4, VGL is among the first few waste heat recovery power projects in the state of Chattisgarh that is undertaking power generation through waste heat recovery and corresponding reduction of GHG emissions in the CSEB grid. Project activity getting registered as CDM project would give instant visibility among the state utilities power ministries/departments, environment ministries/departments of the local and global benefits of the project, enabling VGL to face lesser governmental hurdles in future.

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[8] JSPL Annual Report 2001-02

[9] http://www.hegltd.com/heg_power.html

Successful implementation and running of the project activity on a sustainable basis requires continuous investments in technological up gradation. It also requires manpower training and skill development on a regular basis. The project proponent could get the necessary funding from selling the project related CERs. Apart from these, registration of the project under CDM would enhance the visibility and would aid CSEB in appreciating the GHG emission reduction efforts of the project proponent. This could lead to smoother wheeling transactions in future between the project proponent and utility. Further CDM fund will provide additional coverage to the risk due to regular and breakdown maintenance of waste heat recovery system, failure of project activity due to shut down of plant and loss of production in VGL.

It is ascertained that the project activity would not have occurred in the absence of the CDM simply because no policy or other incentives which exist locally to foster its development in Chattisgarh/India and without the proposed carbon financing for the project VGL would not have taken the investment risks in order to implement the project activity. Therefore the project activity is additional. Also, the impact of CDM registration is significant with respect to running the project activity on a sustainable basis.

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

According to the baseline methodology of ACM0004, the spatial extent of the project boundary comprises the waste heat or gas sources, captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the power plants connected physically to the electricity grid that the proposed project activity will affect.

This CDM project covers the activities carried on for generation of electricity at VGL facility from their waste heat based CPP. The activities include recovery and utilization of waste flues gases of sponge iron kiln of VGL after complete combustion, generation of steam, generating power in turbo generator sets and finally with evacuation of power from the power plant. The produced electricity by CPP is consumed in-house in the manufacturing facility and the surplus is wheeled to the group companies through the state grid.

There is no auxiliary fuel used in the waste heat recovery steam generation system.

Hence, drawing boundary line across the periphery of the above mentioned activities (those components affected by project activity) should be the project boundary for this waste heat recovery based CPP. Figure 3 shows graphical representation of the physical boundary of this project.

The boundary comprises of the WHRB unit, Economiser, Steam Turbine Generator, ESP, and Ash Removal System.

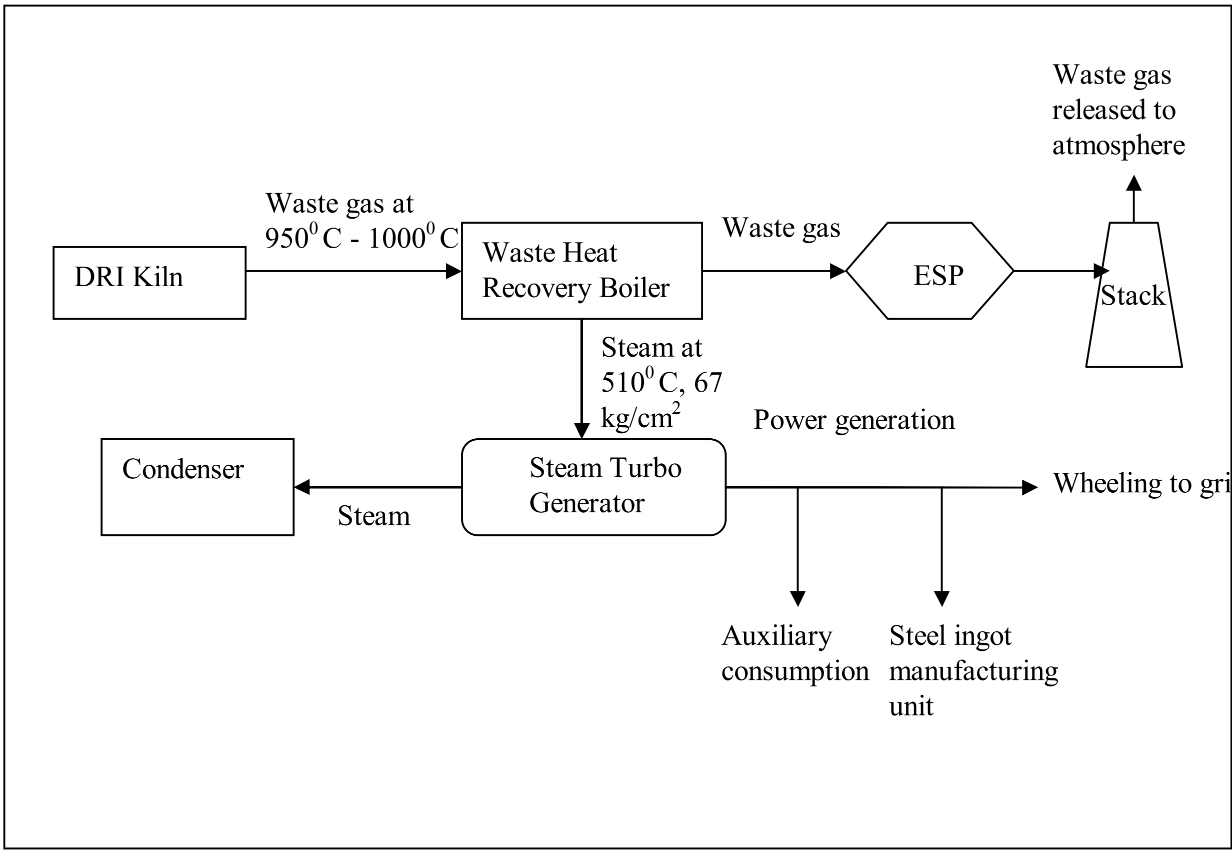

Figure 3: Project Boundary for VGL's Waste Heat based Power Project.

The project boundary starts from supply of waste flue gas at the boiler inlet to the point of evacuation of power either to the VGL facility itself or feeding surplus power to grid.

Further, for the purpose of calculation of baseline emission, CSEB grid has been considered within the system boundary. Estimation of baseline emissions has been done based on data and information available from CSEB and CEA sources as applicable.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Date of completing the final draft of this baseline selection: 21/10/05

Name of person/entity determining the baseline: Experts and Consultants of VGL.

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:

September 2003

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

25y

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

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date (DD/MM/YYYY):

01/04/2005

C.2.2.2. Length:

10 y

SECTION D. Application of a monitoring methodology and plan

The monitoring procedures define a project-specific standard against which the project's performance (i.e GHG reductions) and conformance with all relevant criteria will be monitored and verified. The aim is to enable this project have a clear, credible and accurate set of monitoring, evaluation and verification procedures. The purpose of these procedures would be to direct and support continuous monitoring of project performance/ key project indicators to determine project outcomes, greenhouse gas (GHG) emission reductions.

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

Title: Consolidated monitoring methodology for waste gas and/ or heat for power generation

Reference: Approved consolidated monitoring methodology ACM0004/ Version 01,
Sectoral Scope: 01, 8 July 2005

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

The approved consolidated monitoring methodology is designed to be used in conjunction with the approved consolidated baseline methodology. The applicability conditions of the monitoring methodology are identical with those for the baseline methodology. The project activity under consideration meets all the applicability conditions of the approved consolidated baseline methodology (please refer to Section B.1.1 for details).Hence it is justified to adopt the approved consolidated monitoring methodology for the project activity.

The monitoring methodology requires the project proponent to monitor the electricity generated using the waste gases of the DRI kiln in the WHR based power plant. The project activity's financial benefits under CDM are based on this parameter. The project activity is utilizing the heat energy in the waste gas for power generation and thereby displacing the grid electricity. The amount of electrical energy generated and substituted in the grid is directly controlled by the project proponent and will be under the purview of monitoring plan. Thus a detailed monitoring plan (as described in Annex 4: Monitoring Plan) is developed by VGL in line with the approved consolidated monitoring methodology.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data type	Data Variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic / paper)	For how long is archived data to be kept	Comment

As per the methodology, project emissions are applicable only if auxiliary fuels are fired for generation start up, in emergencies, or to provide additional heat gain before entering the WHRBs.

For the project activity, there is no provision for auxiliary fuel firing before the Waste Heat Recovery Boilers. Hence, there are no project emissions due to auxiliary fuel firing which means that no data needs to be monitored for this purpose.

For Electricity Generated by Project Activity

ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
1. EG_{GEN}	Quanti tative	Total Electricity Generated	MWh /year	Online measurement	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be measured by meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters. See Annex 4 for details
2. EG_{AUX}	Quanti tative	Auxiliary consumption of Electricity	MWh /year	Online measurement	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be measured by meters at plant and DCS. Manager In-charge would be responsible for regular calibration. See Annex 4 for details
3. EG_y	Quanti tative	Net Electricity supplied	MWh /year	Calculated (EG_{GEN}- EG_{AUX})	Continuously	100%	Electronic/paper	Credit Period + 2 years	Calculated from the above measured parameters.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

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Not Applicable

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :										
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
4. EF_y	Emission factor	CO_2 emission factor of the grid	tCO2/ MWh	Calculated	Simple OM, BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as weighted sum of OM and BM emission factors
5. $EF_{OM,y}$	Emission factor	CO_2 operating margin emission factor of the grid	tCO2/ MWh	Calculated	Simple OM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as indicated in the relevant OM baseline method above
6. $EF_{BM,y}$	Emission factor	CO_2 Build Margin emission factor of the grid	tCO2/ MWh	Calculated	BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as [∑I Fi,y*COEFi]/ [∑mGENm,y] over recently built power plants defined in the baseline methodology
7. $F_{i,j,y}$	Fuel Quantity	Amount of each fossil fuel consumed by each power	t or m^3/year	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :										
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
		source/ plant								
8. $COEF_{i,k}$	Emission factor coefficient	CO2 emission coefficient of each fuel type and each power source/plant	tCO_2/ t or m^3	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated based on the IPCC default value of the Emission Factor, Net Calorific Value and Oxidation Factor of the fuel used by the power plants feeding to CSEB.
9. $GEN_{j,y}$	Electricity quantity	Electricity generation of each power source/plant	MWh/ year	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics

D. 2.1.4. Description of formulae used to estimate baseline emissions (values should be consistent with those in section E).

Emission Factor of the Grid (EF_{Grid})

Electricity baseline emission factor of CSEB grid (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.

STEP 1. Calculate the Operating Margin emission factor

The Simple OM emission factor ($EF_{OM,simple,y}$) for CSEB is calculated as the weighted average emissions (in t CO_2equ/MWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \, x \, COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

where

$COEF_{i,j}$ is the CO_2 emission coefficient of fuel i (t CO_2 / mass or volume unit of the fuel), calculated as given below and

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y , calculated as given below

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from other grid

The Fuel Consumption $F_{i,j,y}$ is obtained as

$$\sum_{i} F_{i,j,y} = \left(\sum_{j} GEN_{j,y} \otimes 860 \Big/ NCV_i \otimes E_{i,j} \right)$$

where

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i

$E_{i,j}$ is the efficiency (%) of the power plants by source j

The CO_2 emission coefficient $COEF_i$ is obtained as

$$COEF_i = NCV_i \otimes EF_{CO2,i} \otimes OXID_i$$

where

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i

$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel i

$OXID_i$ is the oxidation factor of the fuel

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated separately for the most recent three years (2002-2003, 2003-2004 and 2004-05) and an average value has been considered as the OM emission factor for the baseline ($EF_{OM,y}$).

$$EF_{OM,y} = \sum_{y} EF_{OM,simple,y} / 3$$

where y represents the years 2002-2003 , 2003-2004 and 2004-05

STEP 2. Calculate the Build Margin emission factor

The Build Margin emission factor ($EF_{BM,y}$) has been calculated as the generation-weighted average emission factor (t CO_2/MWh) of a sample of power plants m of Chhattisgarh State grid. The sample group *m* consists of either

• the five power plants that have been built most recently, or

• the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project proponent should use from these two options that sample group that comprises the larger annual generation. The calculation for Build Margin emission factor is furnished below:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \, x \, COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

where

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ - Are analogous to the variables described for the simple OM method above for plants m.

Considered calculations for the Build Margin emission factor $EF_{BM,y}$ is updated annually ex post for the year in which actual project generation and associated emissions reductions occur. The sample group m for the most recent year consists of the 16 (six) power plants that have been built most recently, since it comprises of larger annual power generation.

STEP 3. Calculate the Emission Factor of the Grid (EF_{Grid})

The electricity baseline emission factor of CSEB, EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = W_{OM} \otimes EF_{OM,y} \oplus W_{BM} \otimes EF_{BM,y}$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in t CO_2/MWh.

(Please refer to "Annex 3: Baseline Information" for further details on grid analysis)

Baseline Emission Calculations

Net units of electricity substituted in the grid (EG_y) = (Total electricity generated-Auxiliary Consumption)

=

$$(EG_{GEN} - EG_{AUX})$$

where,

$EG_{inhouse}$ is the net Electricity used inhouse

EG_{EXP} is monitored

Therefore the Baseline Emission is calculated as,

$$BE_y = EG_y \otimes EF_y$$

where,

BE_y = Baseline Emissions due to displacement of electricity during the year y (in tons of CO_2)

EG_y = Net units of electricity substituted in the grid during the year y (in MWh)

EF_y = Emission Factor of the grid (in tCO_2/ MWh) and

y is any year within the crediting period of the project activity

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

There is no leakage associated with the project activity.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The leakage emissions due to project activity are emissions arising due to activities such as "power plant construction and associated activities" and "transportation of equipment to the site". As per the methodology these emissions may be considered as very negligible as compared to the baseline scenario and occur only during the setting up of the project infrastructure.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The emission reduction ERy by the project activity during a given year y is the difference between the baseline emissions though substitution of electricity generation with fossil fuels (BEy) and project emissions (PEy), as follows:

ERy = BE,y - PEy

Where,

ERy are the emissions reductions of the project activity during the year y in tons of CO2,

BE,y are the baseline emissions due to displacement of electricity during the year y in tons of CO2,

PEy are the project emissions during the year y in tons of CO2, and

CO_2 Emission Reduction Calculations				
Step 1	**:**	Baseline Emissions	-	Project Emissions

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored			
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
For electricity generation by the project activity			
1, 2 & 3	Low	Yes	These data would be required for the estimation of electricity generation and the net units of electricity replaced in the grid by the project activity.
For calculation of emission factor of the grid			
4, 5 & 6	Low	No	These data would be calculated, so does not require any QA procedure.
7, 8 & 9	Low	No	These data would be required for the calculation of baseline emission factor (for Chattisgarh State Grid) and would be obtained through published and official sources.
Note: The medium uncertainty level is applicable where the grid data is not readily available			

Note on QA/QC: The parameters related to the performance of the project will be monitored using meters and standard testing equipment, which will be regularly calibrated following standard industry practices.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

The Plant Manager is responsible for monitoring and archiving of data required for estimating emission reductions. He would be supported by the shift in-charge who would continuously monitor the data logging and would generate daily, monthly reports.

D.5 Name of person/entity determining the monitoring methodology:

Experts and consultants of VGL.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

As per ACM0004 the Project Emissions are applicable only if auxiliary fuels are fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler. The project activity utilizes the heat content of the waste gas available from the sponge iron kiln unit as its fuel source. Since the composition of the waste gas at the boiler inlet and the boiler outlet is identical and there are no other fuel source within the project boundary the project activity itself leads to zero net GHG on-site emissions. Therefore, no project emission is considered.

E.2. Estimated leakage:

There is no leakage activity, which contributes to the GHG emissions outside the project boundary.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

The net emission by project activity (E1+E2) is zero.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Algorithm used for calculation of Baseline emission has been provided in the section D.2.1.4

Sl. No.	Operating Years	Baseline Emission Factor (kg CO2 / kWh)	Baseline Emissions (tonnes of CO_2)
1.	2005-2006 [Apr-Mar]	0.820	20491.90
2.	2006-2007	0.820	20491.90
3.	2007-2008	0.820	20491.90
4.	2008-2009	0.820	20491.90
5.	2009-2010	0.820	20491.90
6.	2010-2011	0.820	20491.90
7.	2011-2012	0.820	20491.90

Sl. No.	Operating Years	Baseline Emission Factor (kg CO2 / kWh)	Baseline Emissions (tonnes of CO_2)
8.	2012-2013	0.820	20491.90
9.	2013-2014	0.820	20491.90
10.	2014-2015	0.820	20491.90

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

CO2 emission reduction per year = Baseline emission – Project Emission

Sl. No.	Operating Years	Baseline Emissions (tonnes of CO_2)	Project Emission (tonnes of CO_2)	CO_2 Emission Reductions (tonnes of CO_2)
1.	2005-2006 [Apr-Mar]	20491.90	0	20491.90
2.	2006-2007	20491.90	0	20491.90
3.	2007-2008	20491.90	0	20491.90
4.	2008-2009	20491.90	0	20491.90
5.	2009-2010	20491.90	0	20491.90
6.	2010-2011	20491.90	0	20491.90
7.	2011-2012	20491.90	0	20491.90
8.	2012-2013	20491.90	0	20491.90
9.	2013-2014	20491.90	0	20491.90
10.	2014-2015	20491.90	0	20491.90

Total Estimated Emission Reductions: **204919 t CO2 equivalent** over the 10 year crediting period.

E.6. Table providing values obtained when applying formulae above:

Formulae have been provided in Section D. The table above in Section E.5 presents the values obtained applying the said formulae. For detailed estimation of baseline emission factor and emission reductions please refer to Appendix III.

SECTION F. Environmental impacts

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

In the recent years, sustainable development has been emerging as an important concept that should be closely linked with the development objectives and policies of any project activity. Environmental performance forms an integral part of the project proponent's endeavor towards sustainable development. Any project activity can cause impacts on environment either positive or negative depending on the type of the activity, throughout the project lifetime. Therefore, it is important to discuss such aspects. It should also be noted that the facility has been constructed in an industrial area where other types of industry also exist and thereby it is very difficult to account for the exact magnitude of the impacts due to operation of the project activity on the environment. It is also difficult to quantify all impacts, as some of them, like social issues, are intangible.

After conceiving the project activity, it was found that the project returns benefits to the local, regional and global environment in various ways.

- Reduced additional GHG emission related to thermal power production, which includes a huge emission in percentage including carbon dioxide, sulphur dioxide, oxides of nitrogen, and particulate matter, which would have occurred in absence of this project in BAU case.

- Substantial reduction in thermal pollution. In absence of the project activity there would have been considerable amount of thermal pollution in the vicinity or additional cooling system needed to be incorporated with Sponge Iron kiln. CPP primarily utilizes the heat content of the waste flue gas and thereby takes care of thermal pollution. The flue gas of temperature 950^{o}C enters the boiler system and comes out with a reduced temperature after effective heat transfer. With reduction of temperature the corrosiveness of flue gas also reduces, thus protecting ESP from early wear and tear and increasing its lifetime. Work environment pollution due to thermal radiation is not significant.

- Negligible magnitude of the impacts during construction phase, taking into consideration the project life cycle. The impacts on air, water and land environment, exist for a temporary period of time till the end of construction phase. Therefore, it does not affect the environment considerably.

- Reduced adverse impacts related to air emission at coal mines, transportation of coal that would have been required to meet the capacity requirement of thermal power stations.

- It has also successfully conserved the non-renewable natural resource such as coal, oil and natural gas by reducing power demand by 25 Million kWh annually on Chhattisgarh state grid.

- Project activity has also enable VGL to save energy loss by utilizing waste heat energy of the flue gas of sponge iron kiln.

SECTION G. Stakeholders' comments

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

Identification of Stakeholders

VGL facility has incorporated the Power Plant Division with objective to recover and utilize heat content of waste flue gas from its own Sponge Iron kiln and generate steam to produce electricity.

The stakeholders identified for the project are as under.

- Local Authority
- Local community at Siltara and Raipur
- Chhattisgarh State Electricity Board (CSEB)
- Chhattisgarh State Electricity Regulatory Commission (CSERC)
- Chhattisgarh State Renewable Energy Development Agency (CSREDA)
- Chhattisgarh Environment Conservation Board
- Environment Department, Govt. of Chhattisgarh
- Ministry of Environment and Forest (MoEF), Govt. of India
- Ministry of Non-conventional Energy Sources (MNES)
- Ground water Department
- Non-Governmental Organizations (NGOs)
- Consultants
- Equipment Suppliers

Several government & non-government organisations got involved with the project activity during various stages of its implementation.

VGL shared the salient information of the project activity with all the stakeholders enlisted above. VGL communicated their plan to implement the project activity to the local villagers, Village Panchayat and the NGOs to receive their comments. VGL representative also met the local NGOs and apprised them about the project activity and sought their support for the project. VGL also sent applications to all the government parties to get their opinions on the project activity and attain the necessary approvals and clearances necessary for project implementation.

G.2. Summary of the comments received:

The project proponent has consulted the key local stakeholders to their project activity and has records of communication from several of these. The comments can be summarised as positive and encouraging in view of the environmental friendliness and reduced use of fossil fuel in power generation. Socio-economic benefits from the project activity has also been appreciated.

State Pollution Control Board and Environment Department of the Government of Chhattisgarh have prescribed standards of environmental compliance and monitor the adherence to the standards. The VGL waste heat based power plant is complying with all such set standards and is also monitoring the adherence to the standards on a regular basis.

Further, State's apex body of power is CSEB and they have issued consent for the installation and operation of the waste heat based power plant of 4 MW capacity under section 44 of the Electricity (Supply) Act, 1948.

CSERC is a major stakeholder in the project. They hold the key of the commercial success of the project. CSERC has already cleared the project and also has consented the wheeling of power to the group companies concerns of VGL.

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

The relevant comments and important clauses mentioned in the project documents / clearances like Detailed Project Report (DPR), environmental clearance, Wheeling of Power Agreement, local clearances *etc.* were considered while preparing the CDM Project Design Document.

As per UNFCCC requirement the PDD will be published at the validator's web site for public comments under international stakeholder consultation process.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Vandana Global Private Limited
Street/P.O.Box:	M.G.Road
Building:	Vandana Bhawan
City:	Raipur
State/Region:	Chhattisgarh
Postfix/ZIP:	492001
Country:	India
Telephone:	-
FAX:	-
E-Mail:	-
URL:	-
Represented by:	-
Title:	Director
Salutation:	Mr.
Last Name:	Agrawal
Middle Name:	P
First Name:	G
Department:	-
Mobile:	-
Direct FAX:	(0771) 535804
Direct tel:	(0771) 535405
Personal E-Mail:	-

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Till now funding from any Annex I country is not available.

Annex 3

BASELINE INFORMATION

DETERMINATION OF BASELINE EMISSIONS

For the project activity the baseline scenario was determined as import of power from grid as shown in Section B2 above. As per ACM0004 methodology, if the baseline scenario is grid power supply the Emission Factor for the displaced electricity is calculated as in ACM0002 baseline methodology. The project proponent proceeds to determine the Emission Factor for the electricity system it imports power from.

A) Choice of the grid that will be affected by the project activity

The Indian Power grid system is unique in itself. Under this system there are different load dispatch centers at state, regional and central levels. These load dispatch centres manage the flow of power in their jurisdiction. At present, the interregional flows of power are quite low. Hence, each region may be considered as an island due to which the power generated at each region is distributed in their jurisdiction only[10]. Furthermore as project generates only about 25 Million kWh annually [excluding auxiliary consumption] which is comparatively very small in size, it is less likely to considerably affect any regional power scenario. Hence, the state grid, Chhattisgarh State Electricity Board (CSEB) is the realistic grid representation w.r.t. the project activity. Also VGL is connected to CSEB for the times when the generation of their own CPP is not adequate for the entire plant. In absence of the project the CSEB would have catered the total electricity requirement of VGL facility (business-as-usual case). Hence, it can be concluded that CSEB grid is the most representative baseline system boundary for the project activity and

[10] http://www.uppcl.org; *UPPCL Statistics at a Glance-March 2002 and other available UPPCL documents*

would be considered for determination of the carbon intensity to arrive at the baseline emission factor for the project activity.

Chhattisgarh State Grid Scenario – the grid mix:

Strategically located in central India, Chhattisgarh has good connectivity for easy transmission to any of India's four grids. Chhattisgarh is in the chronically deficit western grid, and is linked to the southern and northern grids. A special high-tension line is being laid between Raipur and Rourkela, in the Eastern grid. Chhattisgarh has excellent power evacuation infrastructure. It can transport and sell power to deficit areas in any part of India.

Each state has their own power generation plants (State Government owned) managed by respective State Electricity Boards / Corporations. The institutional structure of the power sector in Chhattisgarh is a single vertically integrated entity i.e. Chhattisgarh State Electricity Board (CSEB).

State of Chhattisgarh came in existence on 01.11.2002. State Government constituted separate State Electricity Board vide notification No. 18 & 22/E. Dept/2000 dated 12.11.2000. C.S.E.B. became functional w.e.f. 01.12.2000 and governs all the segments (Generation, Transmission and Distribution) of the state sector.

In addition to the state government owned power generation plants, there are privately owned power generation plants and central government (Government of India) owned power generation plants managed by Government of India Enterprises like National Thermal Power Corporation Ltd., Nuclear Power Corporation Ltd., *etc.* exporting power to CSEB. Power generated by all generation units is being fed to the grid (Western Grid), which is accessible to all states forming part of the western grid. The grid supply mix comprise of thermal, hydro, wind, renewable and nuclear.

Power generated by state owned generation units and privately owned generation units is consumed totally by respective states. But the power generated by central sector generation plants is shared by all states forming part of the grid in fixed proportion.

- *State's own generation*

CSEB is responsible for the operation and maintenance of all the power generating stations in the state. CSEB has 1,360 MW of installed capacity of which more than 85% is accounted for by thermal power (coal) and the balance is hydro power.

- *Central share to CSEB*

CSEB get power from central government owed power plants such as NTPC Korba, Vindyachal, (Coal Based); Kawas, Gandhar (Gas Based); Kakrapara (Nuclear based) with total share of 498 MW out of which thermal mix is of 475 MW and rest is nuclear of 23 MW. Thus thermal has a percentage share of about 95% out of the total share central share allocated for Chhattisgarh.

- *Independent Power Plant (IPP)*

There are very few private power plants in the state contributing to the CSEB grid. Jindal Steel and Power Limited (JSPL) is the major private supplier to the State Grid. Power is sold from its 205MW captive based power plant that uses both coal (equivalent to 80%) and waste heat (remaining 20%) for power generation. A small amount of power is also supplied by private producers using renewable sources of energy (mainly rice husk based power plants)

B) Determination of the carbon intensity of the chosen grid

As per ACM0004 methodology, if the baseline scenario is grid power supply the Emission Factor for the displaced electricity is calculated as in ACM0002 baseline methodology. Complete analysis of the system boundary's electricity generation mix has been carried out for calculating the emission factor of CSEB as follows:

Combined Margin

The approved consolidated baseline methodology suggests that the project activity would have an effect on both the operating margin (*i.e.* the present power generation sources of the grid, weighted according to the actual participation in the state grid mix) and the build margin (*i.e.* weighted average emissions of recent capacity additions) of the selected CSEB grid and the net baseline emission factor would therefore incorporate an average of both these elements.

Step 1: Calculation of Operating Margin

As mentioned above the project activity would have some effect on the Operating Margin (OM) of the Chhattisgarh State Grid. The approved consolidated baseline methodology-ACM0004 requires the project proponent to calculate the Operating Margin (OM) emission factor following the guidelines in ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources).

As per Step 1 of ACM0002, the Operating Margin emission factor(s) ($EF_{OM,y}$) is calculated based on one of the four following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

As per the methodology 'Dispatch Data Analysis' (1c) should be the first methodological choice. However, this method is not selected for OM emission factor calculations due to non-availability of activity data.

'Simple OM' (1a) method is applicable to project activity connected to the project electricity system (grid) where the low-cost/must run[11] resources constitute less than 50% of the total grid generation in

1) average of the five most recent years, or

2) based on long-term normal for hydroelectricity production.

The Simple adjusted OM (1b) and Average OM (1d) methods are applicable to project activity connected to the project electricity system (grid) where the low-cost/must run resources constitute more than 50% of the total grid generation.

To select the appropriate methodology for determining the Operating Margin emission factor ($EF_{OM,y}$) for the project activity, VGL conducted a baseline study wherein the power generation data for all power sources in the project electricity system (i.e. CSEB) were collected from government/non-government organisations and authentic sources. The power generation mix of CSEB comprises of coal, gas, nuclear and hydro power generation as well as imports from other grids as shown in Table 3 below.

Table 3 - Power generation Mix of Chhattisgarh for last five years

Energy Source	2000-01*	2001-02*	2002-03	2003-04	2004-05

[11] The low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

Total Power Generation (Million kWh)	7354.54	8159.69	11214.45	10881.85	11894.82
Total Low Cost Power Generation (Million kWh)	215.38	403.25	821.84	625.96	1025.62
Total Thermal Power Generation (Million kWh)	7139.16	7756.44	10392.61	10157.24	10358.39
Other Grids (Million kWh)	-----	----	0.00	98.65	510.81
Low cost % of Total grid generation	2.92	4.94	7.33	5.75	8.62
Other Grid % of total	------	----	0.00	0.91	4.29
Thermal % of Total grid generation	97.07	95.05	92.67	93.34	87.09
Low Cost % of Total grid generation - Average of the three most recent years – 5.91%					

*Based on State generation figures only as information on Central share was not available for 1999-2000 and 2000 -2001. However, hydro power share for the state is usually accounted by the state generating plants itself which is represented for these years, hence there is no major change in low cost % of CSEB for the two years even if Central Share is accounted.

VGL has therefore adopted the 'Simple OM' (1a) method, amongst the 'Simple OM' (1a), 'Simple adjusted OM' (1b) and 'Average OM' (1d) methods to calculate the Baseline Emission Factor of the chosen grid.

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MU) taking into consideration the present power generation mix excluding low cost must run hydro-power projects of the selected grid, the design efficiency of the thermal power plants in the grid mix and the IPCC emission factors.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) *y*:

• A 3-year average, based on the most recent statistics available at the time of PDD submission, or

• The year in which project generation occurs, if $EF_{OM,y}$ is updated based on ex post monitoring.

VGL has calculated the OM emission factor as per the 3-year average of Simple OM calculated based on the most recent statistics available at the time of PDD submission.

Table 4 shows the power generation mix of CSEB grid for 2002-03 under different jurisdiction such as State, Central and Private power plants respectively. The identified plants have been categorically differentiated on the basis of their fuel source used for generation.

Table 4: Power Generation Mix of CSEB grid from the Own Generating Stations and Purchase from Central and Private Generating Stations for 2002-03

Name of the Power Plant	Capacity Generation (MW)	OwnGeneration / Purchase MU s 2002-03
COAL		
Coal Based State (CSEB)		
Korba East II (4x40)	160	6858.22
Korba East III (2 x 120)	240	
Korba West (4 x 210)	840	
Subtotal State (Coal)	**1240**	**6858.22**
Coal Based (Central)		
NTPC – Korba TPP	308	2855.93
NTPC- Vindhyachal TPP	106	
Subtotal Central (Coal)	**414**	**2855.93**
Coal Based Private		
Jindal Steel and Power Ltd	110	410.89
Subtotal Private (Coal)	**110**	**410.89**
Total Coal Based Thermal Power Plants		**10125.04**
GAS		
Gas Based (Central)		
NTPC- Kawas Gas based Combined Cycle	33	215.29
NTPC-Jhanor-Gandhar Gas based Combined Cycle	28	52.28
Subtotal Central (Gas)	**61**	**267.57**
HYDRO		
Hydro State (CSEB)		
Hasdeo Bango (3x40)	120	276.48
Subtotal (HYDRO)	**120**	**276.48**
NUCLEAR		
Nuclear Central		

Kakrapara Atomic Power Station	23	290.00
Subtotal (Nuclear)	**23**	**290.00**
RENEWABLE ENERGY / WASTE HEAT POWER		
Jindal Steel and Power Ltd (Waste heat based CPP)	40	149.41
Others		105.95
Subtotal Renewable / Waste Heat Power		**255.36**
GRAND TOTAL		**11214.45**

Table 5 shows the power generation mix of CSEB grid for 2003-04 and 2004-05 under different jurisdiction such as State, Central and Private power plants respectively. The identified plants have been categorically differentiated on the basis of their fuel source used for generation. Power was also imported from other grids during this period that have been shown as a separate category.

Table 5: Power Generation Mix of CSEB grid from the Own Generating Stations and Purchase from other State, Central and Private Generating Stations for 2003-04 and 2004-05.

Name of the Power Plant	Own Generation / Purchase Million kWhs 2003-04	Own Generation / Purchase Million kWhs 2004-05
COAL		
Coal Based State (CSEB)		
Korba East II (4x40)	6868.09	7142.16
Korba East III (2 x 120)		
Korba West (4 x 210)		
Subtotal State (Coal)	**6868.09**	**7142.16**
Coal Based (Central)		
NTPC – Korba TPP	2655.73	2172.96
NTPC- Vindhyachal TPP		
Eastern Region – NTPC	0.00	93.44
Subtotal Central (Coal)	**2655.73**	**2266.40**
Coal Based Private		

Jindal Steel and Power Ltd (110 MW in 2003-04 increased to 165 MW in 2004-05)	434.24	767.05
Subtotal Private (Coal)	**434.24**	**767.05**
Total Coal Based Thermal Power Plants	**9958.06**	**10175.61**
GAS		
Gas Based (Central)		
NTPC- Kawas Gas based Combined Cycle	199.18	182.78
NTPC-Jhanor-Gandhar Gas based Combined Cycle	0.00	
Subtotal Central (Gas)	**199.18**	**182.78**
HYDRO		
Hydro State (CSEB)		
Hasdeo Bango (3x40)	298.94	375.12
Gangarel (2.5x10)	0.00	7.52
Hydro (Inter state)*		
Interstate Generating Station	0.00	262.74
Subtotal (HYDRO)	**298.94**	**644.64**
NUCLEAR		
Nuclear Central		
Kakrapara Atomic Power Station	147.00	169.15
Subtotal (Nuclear)	**147.00**	**169.15**
OTHER GRIDS		
WBPDC	70.98	59.85
CSEB	0.00	287.50
DVC	0.00	40.05
Gujarat SEB	0.00	9.43
Assam	0.00	4.13
Tripura	0.00	5.67
APTRANSCO	0.00	104.18
Delhi Transco Limited	27.67	0.00
Subtotal Other grids	**98.65**	**510.81**
RENEWABLE ENERGY / WASTE HEAT POWER		

Jindal Steel and Power Ltd (Waste heat based CPP)	157.91	185.95
Others	22.12	25.14
Subtotal Renewable / Waste Heat Power	**180.03**	**211.09**
GRAND TOTAL	**10881.85**	**11894.82**

** Since the exact source of Interstate Generating station (ISGS) is not known for 2004-05, the source of power available from ISGS is taken to be completely coming from hydro for conservative estimates*

Calculation of Operating Margin Emission Factor

The following table gives a step by step approach for calculating the Simple Operating Margin emission factor for CSEB for the most recent 3 years at the time of PDD submission i.e.2002-2003, 2003-2004 & 2004-2005.

Table 6: Calculation of Simple Operating Margin

Parameter	2002--03	2003-04	2004-05
Total generation (Million kWh)	11214.45	10881.85	11894.82
Net generation excluding Hydro, Nuclear, CPP & RE plants (Million kWh)	10392.61	10157.24	10358.39
Total generation by coal out of total gen.excl. Hydro, Nuclear & RE plants (Million kWh)	10125.04	9958.06	10175.61
Total generation by gas out of total gen.exl. Hydro, Nuclear, & RE plants(Million kWh)	267.57	199.18	182.78
Simple Operating Margin			
Fuel 1: Coal			
Avg. efficiency of power generation with coal as a fuel, %	36.730	36.580	36.490
Avg. calorific value of coal used, kCal/kg	4171.000	3820.000	3750.000
Estimated coal consumption, tonnes/yr	5683470.667	6129420.544	6395710.072
Emission factor for Coal (IPCC),tonne CO2/TJ	96.10	96.100	96.100
Oxidation factor of coal (IPCC standard value)	0.98	0.980	0.980
COEF of coal (tonneCO2/tonne of coal)	1.642	1.503	1.476
Fuel 2: Gas			
Avg. efficiency of power generation with gas as a fuel, %	45.00	45.000	45.000
Avg. calorific value of gas used, kCal/kg	10000.00	10000.000	10000.000
Estimated gas consumption, tonnes/yr	47565.99	35408.283	32492.85
Emission factor for Gas (as per standard IPCC value)	56.10	56.100	56.100
Oxidation factor of gas (IPCC standard value)	0.995	0.995	0.995
COEF of gas(tonneCO2/tonne of gas)	2.508	2.508	2.508
EF (OM Simple, excluding imports from other grids), tCO2/Million kWH	909.219	917.418	926.237
EF (EREB) tCO2/Million kWH	1190.000	1190.000	1180.000
EF (WREB) tCO2/Million kWH	910.000	910.000	910.000
EF (SREB) tCO2/Million kWH	770.000	760.000	740.000
EF (NREB) tCO2/Million kWH	790.000	740.000	730.000

EF(North Eastern REB) tCO2/Million kWH	380.000	390.000	390.000
EF (OM Simple), tCO2/Million kWH	**909.219**	**917.418**	**926.237**
Average Simple OM, tCO2/Million kWH	**917.625**		
Simple OM (kg CO2 / kWh)	**0.917625**		

Step 2: Calculation of Build Margin

The project activity would have some effect on the Build Margin (BM) of the Chhattisgarh State Electricity Grid. The approved consolidated baseline methodology-ACM0004 requires the project proponent to calculate the Build Margin (BM) emission factor following the guidelines in ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources).

As per Step 2 of ACM0002, the Build Margin emission factor ($EF_{BM,y}$) is calculated as the generation-weighted average emission factor (tCO_2/Milion kWH) of a sample of power plants. The methodology suggests the project proponent to choose one of the two options available to calculate the Build Margin emission factor $EF_{BM,y}$

Option 1:

Calculate the Build Margin emission factor $EF_{BM,y}$ *ex ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either:

(a) The five power plants that have been built most recently, or

(b) The power plants capacity additions in the electricity system that comprise 20% of the system generation (in Million kWH) and that have been built most recently.

Project participants should use from these two options that sample group that comprises the larger annual generation.

Option 2:

For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ must be updated annually ex post for the year in which actual project generation and associated emission reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated ex-ante, as described in Option 1 above. The sample group m consists of either

(a) the five power plants that have been built most recently, or

(b) the power plants capacity additions in the electricity system that comprise 20% of the system generation (in Million kWH) and that have been built most recently.

Project participants should use from these two options that sample group that comprises the larger annual generation.

VGL has adopted Option 1, which requires the project participant to calculate the Build Margin emission factor $EF_{BM,y}$ ex ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m should consist of either (a) the five power plants that have been built most recently, or (b) the power plants capacity additions in the electricity system that comprise 20% of the system generation (in Million kWH) and that have been built most recently. Project participants are required to use from these two options that sample group that comprises the larger annual generation. As per the baseline information data the option (b) comprises the larger annual generation. Therefore for VGL project activity the sample group m consists of (b) the power plants capacity additions in the electricity system for 2004-05 that comprise 20% of the system generation (in Million kWH) and that have been built most recently.

The following Table presents the key information and data used to determine the BM emission factor for the most recent year 2004-05.

Table 7: Most recent capacity additions in CSEB for 2004-05 that comprise minimum 20% of gross generation for that year.

Calculation of Build Margin					
Sl.No.	Year of addition	Generating Station / Purchasing grid	Source	MW	Own Generation/Purchase for 2004-05 (MU)
1	2004	WREB	Grid		9.43
2	2004	Interstate generating Station	Hydro		262.74
3	2004	SREB	Grid		104.18
4	2004	ER-NTPC	Coal		93.44
5	2004	North Eastern REB	Grid		9.80
6	2004	Gangarel Hydro	Hydro	10	7.52
7	2004	JSPL expansion	Coal	55	255.68
8	2003	EREB	Grid		387.40
9	2003	Renewable sources	Renewable		25.14
10	2001	JSPL expansion	Coal	55	255.68
11	2000	NTPC Vindhyachal UnitVIII	Coal	500	498.39

12	1999	NTPC Vindhyachal UnitVII	Coal	500	
13	1999	JSPL expansion	Coal	55	255.68
14	1995	Kakrapara Nuclear Unit II	Nuclear	220	84.575
15	1995	Hasdeo Bango Unit III	Hydro	40	250.08
16	1994	Hasdeo Bango Unit III	Hydro	40	
Total Generation Considered					**2499.739**
Gross Generation					**11894.820**
20% of Gross Generation					**2378.964**
Coal based					**1358.874**
Gas Based					**0.000**
Hydro based					**520.340**
Nuclear Based					**84.575**
% of generation by coal out of total					**54.361**
% of generation by gas out of total					**0.000**
% of generation by hydro out of total					**20.816**
% of generation by nuclear out of total					**3.383**

Built Margin Emission Factor is calculated as shown in Table 8.

Table 8: Built Margin Emission Factor Calculation

Built Margin Factor		
Considering 20% of Gross Generation	**2378.964**	
Sector	mU	
Thermal Coal based(CSEB)	0.000	
Thermal Coal based(Central)	591.830	
CPP (Coal)	767.040	
Gas Based (Central)	0.000	
Hydro (CSEB+ Interstate generating station)	520.340	
Nuclear (Central)	84.575	
Renewable sources	25.140	
WREB	9.430	
SREB	104.180	
EREB	387.400	
North Eastern REB	9.800	
Total generation	**2499.735**	
Net generation excluding Hydro, Nuclear, other grid & RE plants	1358.870	
% of generation by coal out of total gen.excl. Hydro, Nuclear,other grid & RE plants	1358.870	**100.00**
% of generation by gas out of total gen.exl. Hydro, Nuclear, other grid & RE plants	0.000	**0.00**
Built Margin		
Fuel 1 : Coal		
Avg. efficiency of power generation with coal as a fuel, %	36.58	
Avg. calorific value of coal used in kcal/kg	3750.000	
Estimated coal consumption, tons/yr		852029.608
Emission factor for Coal (IPCC),tonne CO2/TJ	96.100	
Oxidation factor of coal (IPCC standard value)	0.980	

COEF of coal (tonneCO2/ton of coal)		1.476
EF (excluding imports from other grids), tCO2/MU	925.401	
EF (EREB) tCO2/MU	1180.000	
EF (WREB) tCO2/MU	910.000	
EF (SREB) tCO2/MU	740.000	
EF (NREB) tCO2/MU	390.000	
EF (tCO2 / MU)	**721.728**	
Combined Margin Factor (Avg of OM & BM) t CO2 / MU	**819.676**	
Baseline Emissions Factor (kgCO2 / kWh)		**0.820**

Step 3: Combined Margin

Therefore the NET BASELINE EMISSION FACTOR as per COMBINED MARGIN (OM + BM)/2 = 0.820 kg CO_2/kWh

C) Leakages

There is no considerable leakage potential identified from the project activity. There is no requirement to procure additional fuel and therefore no transportation liabilities faced. The project operates solely on waste heat recovery from the sponge iron kiln flue gases. Indirect GHG emissions outside the project boundary only arise from transportation related to operation of the project. The same is negligible compared to the emission reductions that accrue from the project activity. Waste heat energy of flue gas available from Sponge Iron kiln of VGL facility is utilized. Other infrastructure requirements for the project are also met from the VGL facility.

D) Baseline Emission

In absence of the project activity there will be emission as per the carbon intensity of the grid (0.820 kg CO_2/ kWh) from which the project activity would have drawn electricity to satisfy its total requirement of power. Based on the Combined Margin Method detailed above, (see section E for calculations) the project activity will reduce 204919 tonnes of CO_2 in the entire 10 year crediting period.

Data Source for grid emission factor calculation :

- Generation Figures: CEA General Review (2002-03 and 2003-04), WREB Annual Report (2004-05) and CSEB (www.cseb-powerhub.com)
- Regional Grid Emission Factor : MNES baseline data (http://mnes.nic.in/baselinepdfs/annexure5.pdf)
- Avg. Coal Calorific Value – CEA General Review (2002-03 and 2003-04) and CEA Report on Fuels - http://cea.nic.in/Rep_fuels_gen.pdf (2004-05)
- Efficiency Value of Coal based Thermal Power Plants from Regional Design Heat Rate Values for 2002-03 and 2003-04. For 2004-05 the conservative value of previous years is considered.
- Efficiency of Combined Cycle Gas Based Power Plants: http://www.cercind.org/pet22002407.html
- IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
- JSPL Annual Report 2002-03 and 2003-04 and Financial results 2004-05 www.jindalsteelpower.com

Detail Calculation in CER Calculation Sheet is given in Appendix III

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Annex 4

MONITORING PLAN

The monitoring plan for the CDM project activity has been developed in order to determine the baseline emissions and the project emissions (if any) over the entire credit period. The net units of electricity generated needs to be monitored by power meters at the plant. The monitoring and verification system mainly comprise of the meters as far as the wheeling power to grid is concerned. The instrumentation and control system for the power plant is designed with adequate instruments to control and monitor the various operating parameters for safe and efficient operation of the waste heat recovery boiler and the turbo generator unit. The project activity has employed the state of art monitoring and control equipment that will measure, record, report, monitor and control various key parameters like total power generated, power used for auxiliary consumption, flow rate, temperature and pressure parameters of the waste gas, steam generated and steam sent to turbine to generate power.

The instrumentation system comprises of microprocessor-based instruments of reputed make with the best accuracy available. All instruments are calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time. The calibration frequency too is a part of the monitoring and verification parameters.

The actual amount of CO_2 reduction however depends on the generation mix and production scenario of the grid that is taken into consideration in the grid emission factor calculation. The project does not have a direct control on the baseline. But since the baseline parameters like actual generation mix in million kWh and efficiency of thermal power plants will affect the actual emission reduction units that are attained during verification, they too will be included in the Monitoring and Verification procedure. CSEB monitors the performance of all power generation units. The transmission and distribution network of Chhattisgarh includes monitoring and control facilities at each generation unit level, at each voltage level, substation level and consumer level. Hence, the transparency of measurements, recording, monitoring and control of the generation mix of the CSEB is ensured all the time.

The CSEB report contains all information regarding type of generation like hydro, thermal etc., installed capacity, de-rated capacity, performance of generating unit, actual generation, capacity additions during the year, etc. which can be used for verification of the generation mix and emission factors for baseline calculation for a particular year.

Project Parameters affecting Emission Reduction Claims:

Monitoring:

The CDM mechanism stands on the quantification of emission reduction and keeping the track of the emissions reduced. The project activity would reduce the carbon dioxide whereas an appropriate monitoring system would ensure this reduction is quantified and helps maintaining the required level. Also a monitoring system brings about the flaws in the system if any are identified and opens up the opportunities for improvement.

The general monitoring principles are based on:

- Frequency
- Reliability
- Registration and Reporting

<u>Frequency of Monitoring</u>

Since the emission reduction units from the project activity would be determined by the number of electrical units generated, it becomes important for the project activity to monitor the net electricity production on the real time basis. An on-line monitoring system would be in place to monitor and record the net electricity generated. This would also ensure the smooth operation of the plant.

<u>Reliability</u>

The amount of emission reduction units is proportional to the net energy generation from the project activity. Since the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result.

- All measuring instruments must be calibrated by third party/ government agency once in a year for ensuring reliability of the system.
- The Standard Testing Laboratory (State Govt.) verifies the reliability of the meter reading; thereby ensuring the monitored results are highly reliable.

According to the state electricity board's (grid operator) regulations also, the annual calibration and verification of electricity meters is mandatory for all power generating units.

We may therefore conclude that the reliability of the results would be ensured by the project proponent both as a statutory requirement and for the project activity. Moreover, the net electricity generation value would be included in the financial audit report (statutory requirement) that would be published in the annual report of the company.

<u>Registration and Reporting:</u>

Registration of data would be on-line in the control cabin through a microprocessor. However, hourly data logging would be there in addition to software memory. Daily, weekly and monthly reports would be prepared stating the generation. In addition to the records maintained by VGL, CSEB would also monitor the power wheeled to the grid and certify the same.

No other project specific indicators are identified that affect the emission reductions claims.

Appendix I: Abbreviations

CM	Combined Margin
ABC	After Burning Chamber
BAU	Business as Usual
^oC	Degree Celsius
CDM	Clean Development Mechanism
CECB	Chhattisgarh Environment Conservation Board
CER	Certified Emission Reduction
Cm	Centimeter
CO	Carbon Mono-oxide
CO_2	Carbon di-oxide
CP	Crediting period
CPCB	Central Pollution Control Board
CPP	Captive Power Plant
CSEB	Chhattisgarh State Electricity Board
CSERC	Chhattisgarh State Electricity Regulatory Commission
DCS	Distributed Control System
DPR	Detailed Project Report
DRI	Direct Reduction Iron
EB	Executive Board
EF	Emission Factor
Equ	Equivalent
ESP	Electro Static Precipitator
EREB	Eastern Regional Electricity Board
GHG	Greenhouse Gas
GWh	Giga watt-hour
IEA	International Energy Agency
IPCC	Inter Governmental Panel on Climate change
kg	Kilogram
KP	Kyoto Protocol
kV	Kilo Volt
kVA	Kilo Volt Ampere
kW	Kilo-watt
km	Kilometer
kWh	Kilo-watt hour
M&P	Modalities and Procedures

M&V	Monitoring and Verification
MNES	Ministry of Non-conventional Energy Sources
MVA	Million Volt Ampere
MW	Mega-watt
MWh	Mega-watt hour
NGO	Non-governmental Organization
Nm^3	Normal meter cube
NOx	Oxides of Nitrogen
NREB	Northern Regional Electricity Board
NEREB	North Eastern Regional Electricity Board
OECD	Organization for Economic Co-operation and Development
PDD	Project Design Document
SEB	State Electricity Board
SI	Sponge Iron
SIMA	Sponge Iron Manufacturers Association (India)
SOx	Oxides of Sulphur
SPM	Suspended Particulate Matter
SREB	Southern Regional Electricity Board
STG	Steam Turbine Generator
T&D	Transmission and Distribution
tph	Tonnes per hour
UNFCCC	United Nations Framework Convention on Climate Change
VGL	Vandana Global Private Limited.
WHRB	Waste Heat Recovery Boiler
WREB	Western Regional Electricity Board

Appendix II: List of References

Sl. No.	Particulars of the references
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2.	Website of United Nations Framework Convention on Climate Change (UNFCCC), **http://unfccc.int**
3.	UNFCCC Decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol.
4.	Practical Baseline Recommendations for Green House Gas Mitigation Projects in the Electric Power Sector, OECD and IEA Information
5.	Various project related information / documents / data received from Vandana Global Private Limited.
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8.	http://www.cseb-powerhub.com/
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13.	Electricity Act 2003, Ministry of Power , Govt. of India http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp
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18.	http://powermin.nic.in/acts_notification/electricity_act2003/generation_electricity.htm