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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Title: Waste Heat Recovery Based Power Generation at Vision Sponge Iron Private Limited, West Bengal, India

Version: 03

Date: 19.05.2009

A.2. Description of the project activity:

Vision Sponge Iron Private Limited (VSIPL) has a sponge iron manufacturing facility with two direct reduction iron (DRI) kilns at Madhukunda, in the Purulia district of West Bengal. VSIPL proposes to expand its existing sponge iron manufacturing facility (2 X 100 tpd DRI kilns) by setting up 3 more DRI kilns (3 X 100 tpd). Along with the expansion of the sponge iron plant, VSIPL also proposes to set up a 15 MW captive power plant in order to cater partially to the in-house electricity requirements[1]. The process of sponge iron manufacturing generates waste gas (DRI kiln gas) with substantial sensible heat value. In absence of the project activity the waste gases would have passed through the After Burning Chamber (ABC) for complete combustion of the waste gases coming out of the DRI kilns, which is a part of the process and then would have been introduced into the Electrostatic Precipitator (ESP) for necessary cleaning followed by venting into the atmosphere. In the pre-project scenario the energy requirement of the two kilns were about 0.9 MW which were met through import of electricity from DVC and the in-house DG set[2]. The project activity aims at effective utilization of the heat content of the waste gas for generation of steam and subsequently power in a Captive Power Plant (CPP) to be installed within the plant premise. The power plant will be based on Rankine cycle with 5 Waste Heat Recovery Boilers (WHRBs) [one effectively being in stand-by mode] and one coal based fluidized bed combustion (AFBC) boiler.

Therefore the primary objective of the project activity can be summarized as:

- Conservation of energy through preventing the wastage of useful energy
- Effective utilization of the same for generation of steam and power

[1] The total power requirement of the manufacturing facility of VSIPL after the proposed expansion will be to the tune of 16 MW out of which 8.4 MW will be obtained from waste heat recovery based power generation, 6.6 MW from AFBC and the remaining from Damodar Valley Corporation (DVC).

- Catering partially to the in-house power requirement of the manufacturing facility of VSIPL at Madhukunda in Purulia district of West Bengal.

Furthermore, in absence of the project activity, the power demand of the manufacturing facility of VSIPL would have been catered to by setting up a coal based captive power plant[3]. Therefore the project activity will replace an equivalent quantum of power generation from a carbon intensive source resulting in an overall reduction of Greenhouse Gas (GHG) emissions.

The project activity will generate around 53.222 GWh[4] of net electrical energy per annum. In absence of the project activity the same electrical energy would have been generated by a coal based captive power plant. Therefore the project activity will replace generation of around 53.222 GWh of electrical energy per annum (*i.e.* 532.22 GWh over the entire crediting period of 10 years) from the coal based captive power plant and will eliminate emission of 593200 tonnes CO_2 of over the entire crediting period of 10 years.

Project's contribution to Sustainable Development

The project will lead to the sustainable development in and around the region and on a broader aspect it will have the influence on the country as a whole. Ministry of Environment and Forests (MoEF), Govt. of India has stipulated contribution to social well being, economic well being, environmental well being and technological well being as the four indicators for sustainable development.

Social Well Being	The plant site is an isolated rural area of Purulia with unemployment and poverty as prevailing problems. During construction, operational and maintenance phases, the project activity will generate employment for local people around the plant site and therefore will contribute towards improvement in the economic condition of the locality.
Economic Well Being	Indian power sector is primarily dominated by thermal power generated with coal. Thermal power plants are the major consumers of coal in India. Changing pattern of coal consumption requires a massive & integrated multi-pronged strategy for demand

[2] The energy bills *i.e.* electricity bills of DVC and the diesel receipts have been provided to the validator.

[3] Please refer to Section B.4 of the Project Design Document for details on identification of baseline scenario.

[4] It has been assumed that during any point of time any one of the DRI kiln will be under shutdown for maintenance purpose. So all the calculations as well as the financial computation in Section B.5 have been based on the fact that 4 DRI kilns will be operational at any point of time. The emission reduction has been done on a conservative basis by capping the baseline emissions based on actual production data which also takes into account the above assumption.

	management, energy conservation in industrial units and gradual change over to other alternative fuel options. The project activity will positively contribute towards reduction in (demand) use of finite natural resource coal, minimizing depletion and indirectly increasing its availability to other important processes. The project activity will also create business opportunities for local contractors, consultants and suppliers.
Technological Well Being	Waste heat recovery based captive power plant is a cleaner technology that uses the waste flue gases of sponge iron kilns which otherwise would have been emitted to the atmosphere leading to thermal pollution. The electricity generated by the power plant will be utilized for the DRI kilns emitting the hot gases and the proposed steel melting shop, which in the absence of the project would have been generated in a coal based captive power plant.
Environmental Well Being	The project will be saving the exploitation and depletion of conventional fuel and hence increasing its availability to other important processes. Since, the project avoids all the associated pollution occurring due to extraction, processing and transportation of natural resources, the project promotes environmental well being. The project activity is a GHG abatement project which will reduce the generation of Greenhouse Gases (primarily CO_2) resulting from fossil fuel based power generation and hence is an initiative to combat global warming.

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 proponent(Yes/No)**
India	Vision Sponge Iron Private 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.:

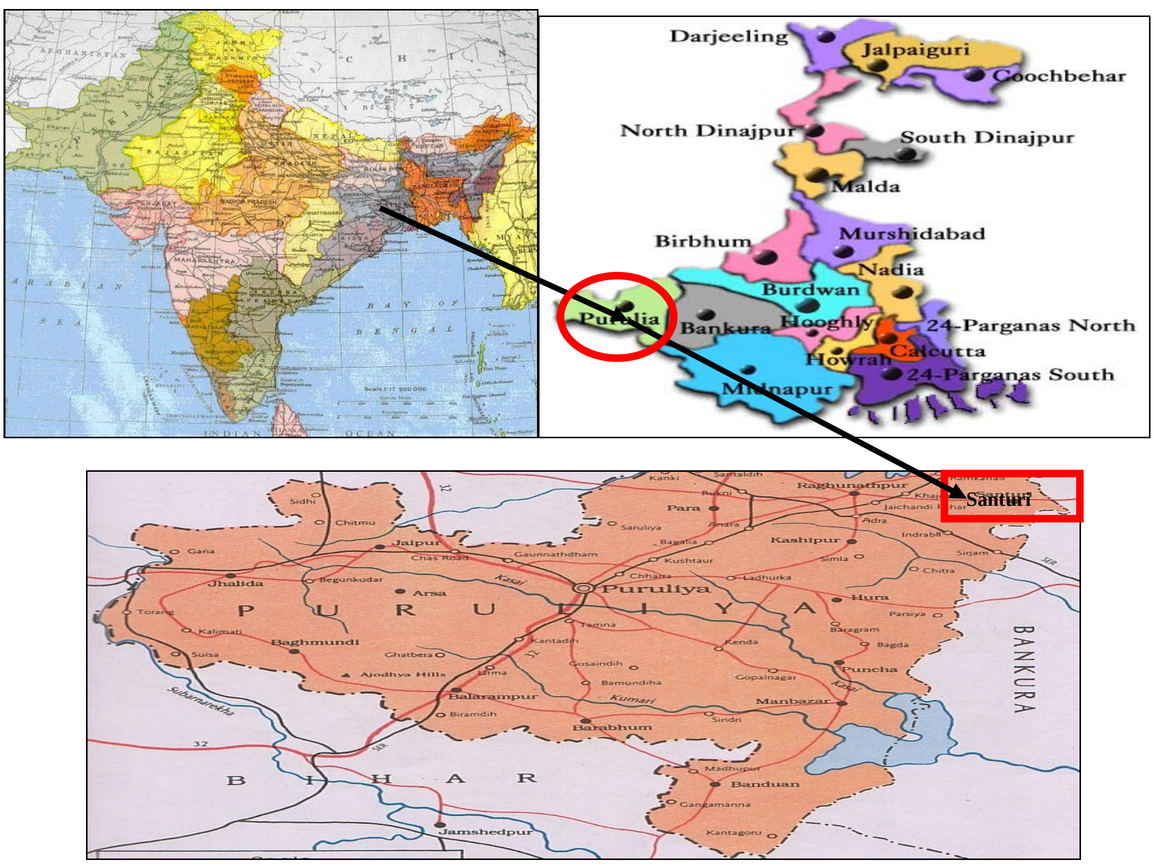
Eastern Region/West Bengal/Purulia

A.4.1.3. City/Town/Community etc:

Madhukunda

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

The project activity site is located at Rakta in Madhukunda, in the district of Purulia. Madhukunda is approximately at a distance of 250 km from Kolkata, the state capital and is well connected with Kolkata, through railways and road. The plant site is located at a distance 15 km from NH 60. The nearest international airport as well as seaport is located in Kolkata. The project site is bounded by latitude 23^0 $36^{'}59.38"$N and longitude $86^0 51^{'}36.61"$E.



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

As per the "Sectoral scopes related to approved methodologies and DOEs, the recommended Sectoral scope for the project activity are

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

Sectoral Scope 4 : Manufacturing industries

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

Pre-Project Scenario

In the pre-project scenario there were two DRI kilns of 100 tpd each. Each 100 tpd kiln can produce 30,000 tonnes of Sponge Iron Per annum.

The technical specifications of the existing kilns as well as the proposed future kilns are as below:

1. Rotary Kiln – 3.0 X 42 Metre Long
2. Rotary Cooler – 2.3 X 22 Metre Long

The technical specifications of the existing kilns are exactly similar to that of the proposed kilns.

Project Scenario

The project activity entails utilization of the heat content of the waste gas for generation of power in a waste heat recovery based power plant. Technology to be employed by the project activity is explained below:

The waste flue gas emanating from DRI kilns will be introduced into an After Burning Chamber (ABC) to ensure complete combustion. The waste gas, after complete combustion in the ABC, will attain a temperature of around 950^0C. The same will then be introduced into the Waste Heat Recovery Boilers (WHRBs) for generation of steam. The steam generated will be used for generation of power. In the process of heat extraction and its utilization, the waste gas will be cooled to a temperature of around 140°C which will then be introduced into the ESP and finally released to the atmosphere.

The project activity involves installation of a vertical single drum boiler consisting of membrane type Radiant chamber, Superheater, Evaporator and Economizer. Proper arrangements for integral piping and flue gas ducting will also be designed in the WHRB. The following table provides the technical specifications of the WHRBs.

Table-A.2: Technical specifications of WHRBs		
Parameter	Unit	Value
Steam output maximum continuous rating considering the operation of four WHRBs[5] (MCR)	Tonnes per Hour (TPH)	38
Steam pressure at super heater outlet	Kg/cm^2	88
Steam temperature at super heater outlet	^0C	520
Feed water temperature at economizer inlet	^0C	135
Gas temperature	^0C	950
Dust Content at outlet of ESP	mg/Nm^3	100
Exit Temperature of Waste gas from WHRB	^0C	140
Lifetime of the boiler	Years	25

Generation of power in Steam Turbo-Generator

The steam generated in the WHRBs will be fed into a common steam header. Steam from Atmospheric Fluidised Bed Combustion (AFBC) will also be fed to the common steam header. Then the steam will be fed to a 15MW Single Extraction-cum-Air Cooled type Steam Turbo Generator set for the purpose of generation of power. The technical specifications of the steam turbo-generator set are provided herein:

Table-A.3: Technical specifications of Steam Turbo-Generator		
Parameter	Unit	Value
Rated capacity of turbine	MW	15
Steam conditions at turbine inlet: Pressure Temperature	 kg/cm^2 ^0C	 85 510
Condenser pressure	kg/cm^2 (ata)	0.1
Lifetime of the turbine	Years	25

Baseline Scenario

In the baseline scenario the waste gases from the five DRI kilns would have been flared thus wasting the sensible heat of the waste gases. A power equivalent to 15 MW would have been generated using one AFBC boiler of MCR 75 tph[6]. The remaining power requirement would have been procured from the DVC.

[5] Since at any point of time 4 DRI kilns will be operational, hence 4 WHRBs will be operational at any point of time.

[6] Refer to the letter from Veesons Energy Systems Pvt. Limited. (dated 24.04.07)

Details of the monitoring equipments with their location

There will be six flow-meters each at the outlet of each boiler for the measurement of steam flow. Moreover there will be temperature and pressure gauge for the measurement of temperature and pressure of steam of each boiler. In addition to these there will also be a flow-meter for the measurement of waste gas at each boiler outlet. For the measurement of net energy generated from the project activity energy meters will be provided at each of the recipient in the facility where energy would be consumed. The same can be verified by the difference between the readings of gross energy generation meter and the auxiliary meter. For further details of the location of the monitoring equipments please refer to the project boundary diagram (Section B.3). In absence of the project activity the equivalent amount of power generated by the steam of WHRBs would have been generated by the steam of AFBC boiler.

Emission Sources

As far the project activity is concerned the emission sources will include the DG set/grid which will be used only under extreme emergency conditions (if any). Except the DG set/grid there is no other source of emission in the project activity. Thus it is evident from the above description that the technology used for the project activity is cleaner means of power generation utilizing the waste heat of the DRI kilns as compared to the baseline scenario and thus will contribute to the overall sustainability of the region.

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

Years	Annual estimation of emission reductions in tonnes of CO_2 e
April 2010 – March 2011	59,320
April 2011 – March 2012	59,320
April 2012 – March 2013	59,320
April 2013 – March 2014	59,320
April 2014 – March 2015	59,320
April 2015 – March 2016	59,320
April 2016 – March 2017	59,320
April 2017 – March 2018	59,320
April 2018 – March 2019	59,320
April 2019 – March 2020	59,320
Total estimated reductions(tonnes of CO_2 e)	**593,,200**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**59,320**

A.4.5. Public funding of the project activity:

No public funding from parties included in Annex-I is available to the project activity.

SECTION B. Application of a baseline and monitoring methodology

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

Title: Consolidated baseline and monitoring methodology for GHG emission reductions from waste energy recovery projects

Reference: Approved consolidated baseline methodology ACM0012/Version 03.1, Sectoral Scope 01 and 04, EB 44

Tools: -Tool for the demonstration and assessment of Additionality (Version 05.2)

- Tool to calculate the emission factor for an electricity system (Version 01.1)

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

As per the applicability conditions of the Approved Consolidated Baseline Methodology-ACM0012/Version 03.1, the same is applicable for the following type of project activities:

"Type-1: All the waste energy in identified WECM stream/s,that will be utilized in the project activity, is, or would be flared or released to atmosphere in the absence of the project activity at the existing or new facility. The waste energy is an energy source for:

- *Cogeneration; or*
- *Generation of electricity; or*
- *Direct use as process heat source; or*
- *For generation of heat in element process (e.g. steam, hot water, hot oil, hot air); or*
- *For generation of mechanical energy"*

The project activity entails recovery of the sensible heat content of the waste gas generated from the DRI kilns (both existing & new), utilization of the same in WHRB for generation of steam and subsequently electricity. In absence of the project activity the same would have been flared thereby wasting its energy content. Therefore the project activity falls under Type-1 category of the Approved Consolidated Methodology-ACM0012/Version 03.1.

Apart from the key applicability condition depicted above, the project activity is also required to meet the following applicability conditions in order to apply the baseline methodology:

"If the project activity is based on the use of waste pressure to generate electricity, electricity generated using waste pressure should be measurable" - The project activity does not involve the usage of waste

pressure to generate electricity. Therefore this applicability condition is not applicable for the project activity under consideration.

"Energy generated in the project activity may be used within the industrial facility or exported outside the industrial facility." – The net electricity generated from the project activity (*i.e.* after catering to the auxiliary power demand of the power plant equipment) will entirely be used to meet the in-house power requirement within the plant premises of VSIPL.

"The electricity generated in the project activity may be exported to the grid or used for captive purposes"- As stated above; the net electricity generated from the project activity (*i.e.* after catering to the auxiliary power demand of the power plant equipment) will entirely be consumed in-house and will not be exported to the grid. Therefore this condition is not applicable for the project activity under consideration.

"Energy in the project activity can be generated by the owner of the industrial facility producing the waste energy or by a third party (e.g. ESCO) within the industrial facility." – Waste gas with substantial heat content will be generated from the sponge iron manufacturing process at VSIPL. Electrical energy will be generated utilising the heat content of the waste gas by the owner of the plant *i.e.* VSIPL

"Regulations do not constrain the industrial facility that generates waste energy from using the fossil fuels being used prior to the implementation of the project activity."– There is no national or state-level regulation which would have prevented Vision Sponge Iron Private Limited from using fossil fuel for electricity generation.

"The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity. If capacity expansion is planned, the added capacity must be treated as a new facility." –The project activity will be undertaken in the plant premises of VSIPL. Two DRI kilns already exist and three more DRI kilns will be set up as an expansion to the existing facility. The waste gas generated from all the kilns will be used for power generation. The project activity thus satisfies the applicability criterion. Moreover also in accordance to AM_CLA_0141 the project activity satisfies the above applicability criterion.

"The emission reductions are claimed by the generator of energy using waste energy"- The project activity entails recovery of the sensible heat content of the waste gas generated from the DRI kilns (both existing & new), utilization of the same in WHRB for generation of steam and subsequently electricity and the emission reductions will be claimed by Vision Sponge Iron Private Limited *i.e.* generator of energy using waste energy.

"In cases where the energy is exported to other facilities, an official agreement exists between the owners of the project energy generation plant (henceforth referred to as generator, unless specified otherwise) with the recipient plant(s) that the emission reductions would not be claimed by recipient plant(s) for using a zero-emission energy source."- The project activity entails recovery of the sensible heat content of the waste gas generated from the DRI kilns (both existing & new), utilization of the same in WHRB for generation of steam and subsequently power. The emission reduction credits will solely be claimed by the project proponent *i.e.* Vision Sponge Iron Private Limited. Furthermore the entire power generated by the project activity will be consumed in-house without any export of power. Therefore there will be no other consumer who can claim for any emission reduction credits for using zero-emission electrical energy sources.

"*For those facilities and recipients, included in the project boundary, which prior to implementation of the project activity (current situation) generated energy on-site (sources of energy in the baseline), the credits can be claimed for minimum of the following time periods:*

(a) The remaining lifetime of equipments currently being used; and

(b) Credit period"

- Vision Sponge Iron Private Limited was not involved with power generation before the implementation of the project activity. The project activity will be implemented as a part of the 15 MW captive power plant to be set up in the premises of VSIPL. Therefore this condition is not applicable for the project activity under consideration.

"Waste energy that is released under abnormal operation (for example, emergencies, shutdown) of the plant shall not be accounted for." –Emission reductions will not be affected by the waste gas that will be released under abnormal operation (emergencies shut down).

Demonstration of use of waste energy in absence of CDM project activity

As per the requirement of the methodology, for Type-1 project activities:

"It shall be demonstrated that the waste energy utilized in the project activity was flared or released into the atmosphere (or wasted in case of project activity recovering waste pressure) in the absence of the project activity at the existing facility."

The waste gas produced does not have any other use in the plant of Vision Sponge Iron Private Limited. The same can be demonstrated by Energy bills (electricity) which indicates all the energy required for the process (e.g. based on specific energy consumption specified by the manufacturer) has been procured commercially. Therefore the waste gas to be utilized in the project activity would have been surplus and would have been flared in absence of the project activity.

Therefore the project activity under consideration meets all the applicability conditions of the Approved Consolidated Methodology-ACM0012/Version 03.1. This justifies the appropriateness of the choice of the methodology in view of the above project activity.

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

As per the methodology, the geographical extent of the project boundary shall include the following:

"1. The industrial facility where waste energy is generated, including the part of the industrial facility where the waste gas was utilized for generation of captive electricity prior to implementation of the project activity;

2. The facility where process heat in the element process/steam/electricity/mechanical energy is generated (generator of process heat/steam/electricity/mechanical energy). Equipment providing auxiliary heat to the waste energy recovery process shall be included within the project boundary; and

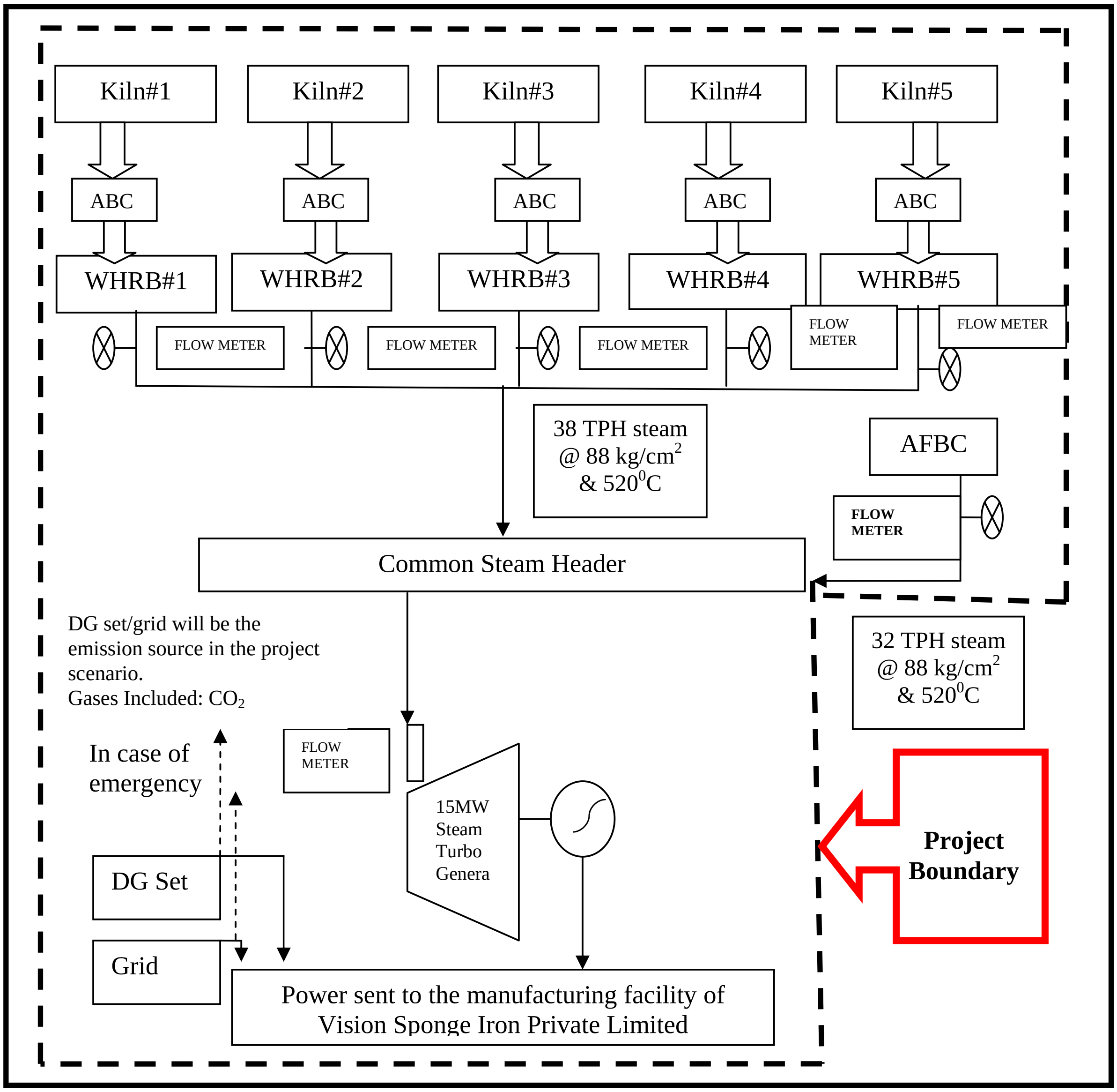
3. The facility(ies) where the process heat in element process/steam/electricity/mechanical energy is used (the recipient plant(s)) and/or grid where electricity is exported, if applicable."

In accordance with the guidance of the methodology, the project boundary will include:

1. The source of waste energy *i.e.* the project boundary will include DRI kilns of VSIPL along with the ducting system for transportation of waste gas from the ABC outlet to each of the Waste Heat Recovery Boiler (WHRB) in the power plant;

2. The power plant equipments where the heat content of the waste energy will be utilized for generation of steam and subsequently power. This will also include the auxiliary equipments of the power plant; and

3. The steel melting shop, DRI kilns and other equipments of the plant of VSIPL where the electricity will be consumed.



Legend
Pressure & Temperature Gauge- ⊗

In accordance with the methodology, the following emission sources are considered for the purpose of determination of baseline emissions and project emissions and hence the emission reductions that are resulting from the project activity:

Table-B.1: Overview on emission sources included in or excluded from the project boundary

	Source	Gas	Included	Justification/ Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption in boiler for thermal energy	CO_2	Excluded	Not applicable since the project activity will not cater to the thermal energy requirement of the plant of VSIPL.
		CH_4	Excluded	
		N_2O	Excluded	
	Fossil fuel consumption in cogeneration plant	CO_2	Excluded	Not applicable since the project activity does not entail installation of a cogeneration plant. *(Please refer to Section B.4 of this PDD).*
		CH_4	Excluded	
		N_2O	Excluded	
	Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Excluded	Not applicable since there is no steam requirement in the flaring process of the waste gas. *(Please refer to Section B.4 of this PDD).*
		CH_4	Excluded	
		N_2O	Excluded	
Proposed project activity	Supplementary fossil fuel consumption at the project plant	CO_2	Included	There will be no provision for auxiliary/supplementary fuel firing within the project boundary. However the same will be monitored during the proposed crediting period in case there is any supplementary fossil fuel consumption at the project plant and emissions from the same will be deducted.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Supplementary electricity consumption	CO_2	Excluded	Emission reductions for the project activity will be based on the net power generated (*i.e.* gross electricity generated – auxiliary consumption of the power plant). There will be no additional emission from consumption of supplemental electricity in the project scenario (in case there is any that will be accounted as project emissions.)
		CH_4	Excluded	
		N_2O	Excluded	
	Project emissions from cleaning of the gas	CO_2	Excluded	No additional cleaning of waste gas will be required in the project scenario compared to that in the baseline scenario. Therefore there will not be any additional energy consumption due to cleaning of waste gas in the project scenario. Hence there will not be any additional emissions.
		CH_4	Excluded	
		N_2O	Excluded	

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The methodology requires the project proponent to identify all the realistic and credible alternatives available to Vision Sponge Iron Private Limited in absence of the project activity. Realistic and credible alternatives have been identified individually for:

- Waste energy use in the absence of the project activity
- Power generation in the absence of the project activity

Alternatives for steam/heat generation and mechanical energy generation in the absence of the project activity have not been considered since the project activity will not involve generation of steam/heat and mechanical energy.

In accordance with the guidance of the methodology, the project proponent has excluded alternatives that

- Do not comply with legal and regulatory requirements; or
- Depend on fuels (used for generation of power) that are not available at the project site

The following section will elaborate on selection of baseline scenario for the project activity under consideration:

Step-1: Define the most plausible baseline scenario for the generation of heat and electricity using the following baseline options and combinations[7]

As per the guidance of the methodology,

"The baseline candidates should be considered for following facilities:

- *For the industrial facility where the waste energy is generated; and*
- *For the facility where the energy is produced; and*
- *For the facility where the energy is consumed"*

Baseline Analysis

Following the guidance of AM_CLA_0141 the project proponent has analyzed the baseline Potential Alternatives for waste energy use for the existing DRI kilns as well as new DRI kilns.

[7] The project activity does not entail generation of heat. Therefore realistic and credible alternatives for generation of heat energy in absence of the project activity have not been considered.

Potential Alternatives for waste energy use for the existing kilns:

W1: WECM[8] is directly vented to atmosphere without incineration or waste heat is released to the atmosphere or waste pressure energy is not utilized

As per the legal requirement, the waste gas is required to be combusted completely before the same can be discharged into the atmosphere since it contains high percentage of poisonous gas Carbon Monoxide. Therefore direct venting of waste gas to the atmosphere without incineration was not a feasible option for the project proponent in absence of the project activity. Moreover the in the pre-project scenario all the waste gas was flared as substantiated in Section B.2

W2- WECM is released to the atmosphere (for example after incineration) or waste heat is released to the atmosphere or waste pressure energy is not utilized.

In the pre-project scenario the waste energy *i.e.* the DRI kiln gas was flared following the conventional practice. The same was demonstrated by Energy bills (electricity) which indicates all the energy required for the process (e.g. based on specific energy consumption specified by the manufacturer) has been procured commercially. Therefore the waste gas was flared prior to the project activity

W3- Waste energy is sold as an energy source

There is no potential purchaser for the waste gas in the vicinity. Furthermore transportation of the waste gas over a long distance is hazardous considering its composition and high dust content. Moreover in the pre-project scenario all the waste gas was flared as substantiated in Section B.2

W4- Waste energy is used for meeting energy demand.

In the pre-project scenario the demand of energy being very low there was no scope for the project proponent to use the waste energy for meeting the energy demand. Hence this cannot be considered for arriving at the baseline scenario,

W5- A portion of the waste gas produced at the facility is captured and used for captive electricity generation, while the rest of the waste gas produced at the facility is vented/flared

In the pre-project scenario the demand of energy being very low there was no scope for the project proponent to use the waste energy for meeting the energy demand by setting up a captive electricity generation facility. Hence this cannot be considered for arriving at the baseline scenario,

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[8] Waste Energy Carrying Medium.

W6- All the waste gas produced at the industrial facility is captured and used for export electricity generation

Prior to the project activity all the waste gas was flared and no waste gas was captured for electricity generation.

Hence for the existing kilns analyzing the above scenarios, W2 is the baseline scenario which was also the pre-project practice.

The project proponent analyzed the baseline scenario for power generation based on the total power requirement of the entire facilities covered in the expansion project. Please refer to the table below for the same.

Table-B.2: Potential alternatives for waste energy use and power generation

Option	Description	Credibility	Conclusion
Utilization of the heat content of the waste energy (for the new kilns)			
W1	WECM[9] is directly vented to atmosphere without incineration or waste heat is released to the atmosphere or waste pressure energy is not utilized	As per the legal requirement, the waste gas is required to be combusted completely before the same can be discharged into the atmosphere. Therefore direct venting of waste gas to the atmosphere without incineration is not a feasible option for the project proponent in absence of the project activity.	Cannot be a part of the baseline
W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released to the atmosphere or waste pressure energy is not utilized.	In absence of the project activity, the project proponent would have flared (*i.e.* releasing after complete combustion) the waste gas into the atmosphere. In such a situation, the entire heat energy content of the waste gas would have been lost. This alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	May be a part of the baseline

[9] Waste Energy Carrying Medium.

Table-B.2: Potential alternatives for waste energy use and power generation			
Option	Description	Credibility	Conclusion
W3	Waste energy is sold as an energy source	There is no potential purchaser for the waste gas in the vicinity. Furthermore transportation of the waste gas over a long distance is hazardous considering its composition and high dust content level. Therefore this alternative can not be considered as a realistic and credible alternative for the project proponent in absence of the project activity.	Cannot be a part of the baseline
W4	Waste energy is used for meeting energy demand.	In absence of the project activity, the heat content of the waste gas could have been utilized for generation of electrical energy. Moreover there is no unit in the manufacturing facility of VSIPL where the waste gas can be used for meting thermal energy demand. However electricity generation from waste heat recovery would have faced all the investment related risks and barriers that the project activity is facing *(please refer to Section B.5 of the Project Design Document for details)*. Therefore in absence of CDM revenue, this alternative can not be considered as a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
W5	A portion of the waste gas produced at the facility is captured and used for captive electricity generation, while the rest of the waste gas produced at the facility is vented/flared	As explained above, utilization of the DRI kiln gas for power generation is exposed to all the investment risks as the project activity is facing (please refer to Section B.5 of the Project Design Document for details). Therefore partial utilization DRI kiln gas for generation of captive electricity can not be considered as a realistic and credible alternative for the project activity under consideration.	Cannot be a part of the baseline
W6	All the waste gas produced at the industrial facility is captured and used for export electricity generation	The project activity aims at utilization of the DRI kiln gas for power generation which will entirely be consumed in-house. There will not be any exportable electricity in the project scenario. Therefore this alternative can not be considered as a realistic and credible alternative for the project activity under consideration	Cannot be a part of the baseline
Power generation			
P1	Proposed project activity not undertaken as a CDM project activity.	In absence of the project activity, the project proponent could have utilized the heat content of the waste gas for generation of power. However this alternative entails certain investment related risks in its implementation *(please refer to Section B.5 of the Project Design*	Cannot be a part of the baseline

Table-B.2: Potential alternatives for waste energy use and power generation			
Option	Description	Credibility	Conclusion
		Document for details). In absence of CDM revenue, this alternative can not be considered as a realistic and credible alternative for the project proponent.	
P2	On site or off site existing/new fossil fuel powered cogeneration plant.	The project proponent does not have any requirement for steam. Therefore installation of an onsite new fossil fuel fired cogeneration plant in absence of the project activity is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
P3	On site or off site existing/new renewable energy based cogeneration plant.	The project proponent does not have any requirement for steam. Therefore installation of an onsite new renewable energy based cogeneration plant in absence of the project activity is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
P4	On site or off site existing/ new fossil fuel based existing captive or identified plant.	In absence of the project activity, the project proponent could have installed a fossil fuel fired captive power plant for generation of equivalent electrical energy equivalent to that generated in the project activity. The different options of fuels available have been discussed in details later in the section. This alternative is in compliance with all the legal and regulatory requirements of the country as well as the state and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	May be a part of the baseline
P5	On site or off site existing/new renewable energy or other waste energy based existing captive or identified plant.	This alternative is not a realistic and credible alternative for the project proponent in absence of the project activity considering limited availability of renewable resources in and around Purulia where the project activity plant is situated. [10]	Cannot be a part of the baseline

[10] http://mnes.nic.in/annualreport/2007_2008_English/Chapter%205/chapter%205_1.htm

http://www.geni.org/globalenergy/library/energytrends/currentusage/renewable/Renewable-Energy-Potential-for-India.pdf

Table-B.2: Potential alternatives for waste energy use and power generation			
Option	Description	Credibility	Conclusion
P6	Source Grid connected power plants	In absence of the project activity, the project proponent could have chosen not to generate any power. Under such a situation, electrical energy equivalent to that generated in the project activity would have been imported from DVC which is part of the thermal power dominated NEWNE grid and therefore would have been generated at power plants connected to the grid. This alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	May be a part of the baseline
P7	Captive electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity)	As discussed above, utilization of the heat content of the waste gas for power generation is not a realistic and credible alternative for the project proponent considering the investment related risks and barriers associated with the project activity *(please refer to Section B.5 of the Project Design Document for details)*. In absence of the project activity, the waste gas would have been flared without utilizing it for generation of electrical energy. Therefore the project activity does not entail any efficiency improvement in power generation from that in the baseline scenario and this alternative is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
P8	Cogeneration from waste gas (if project activity is cogeneration with waste gas, this scenario represents captive generation with lower efficiency than the project activity)	The project activity is not a cogeneration activity. Therefore this alternative is not applicable for the project proponent.	Cannot be a part of the baseline
P9	Existing power generating equipment (used previous to implementation of project activity for captive electricity generation from a	The project activity under consideration entails recovery of the sensible heat content of the waste gas generated from the DRI kilns (both existing & new), utilization of the same in WHRB for generation of steam and subsequently power. Before the commissioning of the project activity, the DRI kiln gas was flared without utilizing any portion of it for power generation. There is no existing equipment which will be modified or	Cannot be a part of the baseline

Table-B.2: Potential alternatives for waste energy use and power generation			
Option	Description	Credibility	Conclusion
	captured portion of waste gas) is either decommissioned to build new more efficient and larger capacity plant or modified or expanded (by installing new equipment), and resulting in higher efficiency, to produce and only export electricity generated from waste gas. The electricity generated by existing equipment for captive consumption is now imported from the grid	expanded under the project activity. Therefore this alternative is not a realistic and credible alternative for the project proponent	
P10	Existing power generating equipment (used previous to implementation of project activity for captive electricity generation from a captured portion of waste gas) is either decommissioned to build a new more efficient and larger capacity plant or modified or expanded (by installing new equipment), and resulting in higher efficiency, to produce electricity	The project activity under consideration entails recovery of the sensible heat content of the waste gas generated from the DRI kilns (both existing & new), utilization of the same in WHRB for generation of steam and subsequently power. Before the commissioning of the project activity, the DRI kiln gas was flared without utilizing any portion of it for power generation. There is no existing equipment which will be modified or expanded under the project activity. Therefore this alternative is not a realistic and credible alternative for the project proponent	Cannot be a part of the baseline

Table-B.2: Potential alternatives for waste energy use and power generation			
Option	Description	Credibility	Conclusion
	from waste gas (already utilized portion plus the portion flared/vented) for own consumption and for export		
P11	Existing power generating equipment is maintained and additional electricity generated by grid connected power plants.	There is no existing power generating equipment available with the project proponent *i.e.* Vision Sponge Iron Private Limited. Therefore this alternative is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline

From the above evaluation, it can be concluded that in absence of the project activity, the project proponent could have opted for the following two alternatives:

Table-B.3: Potential alternatives available to Vision Sponge Iron Private Limited in absence of the project activity			
Alternative	Baseline Alternatives		Description of Alternative
	Waste Energy	Power	
1	W2	P4	With this alternative in place, the waste gas generated from the DRI kilns at VSIPL would have been flared and the heat energy content of the waste gas would have been wasted. Power, equivalent to that generated in the project activity, would have been generated in a fossil fuel fired captive power plant[11]. As stated above, this alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.
2	W2	P6	With this alternative in place, the waste gas generated from the DRI kilns at VSIPL would have been flared and the heat energy content of the waste gas would have been wasted. Power, equivalent to that generated in the project activity, would have been generated at power plants connected to the grid where the project activity power plant is connected.

[11] Coal fines and char will be utilized as fuel.

Table-B.3: Potential alternatives available to Vision Sponge Iron Private Limited in absence of the project activity			
	Baseline Alternatives		
			As stated above, this alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable

Amongst the two alternatives identified above, Alternative-1 entails generation of power in a fossil fired captive power plant. With this alternative in place, the project proponent would have set up a fossil fuel fired captive power plant. Coal is considered as the most plausible fossil fuel option since it is available in abundance in the eastern region of the country where the project activity plant is situated. The availability of the baseline fuel *i.e.* coal near the project site can be justified from the following publicly available sources:

[http://www.mapsofindia.com/maps/minerals/coal-mines-map.html]

[http://www.mapsofworld.com/business/industries/coal-energy/india-coal-deposits.html]

The map clearly shows the locations Ranigunj, Jharia and Bokaro to be very close to the project site. Hence there is no supply constraint in the identified baseline fuel *i.e.* coal. Moreover the project proponent will be using char as a fuel along with coal fines since it is readily available within the plant premises and hence is a best economically available option. Furthermore the other options like,

- Diesel based electricity generation[12] is highly expensive[13] and is primarily used for as a back-up system; and

- Natural gas based electricity generation is not a feasible option for the project proponent considering the locational disadvantages[14] *i.e.* non-availability of natural gas in the eastern region of the country where the project activity plant is situated

Therefore in case of Alternative-1, the project proponent would have set up a coal based captive power plant to generate electrical energy equivalent to that generated in the project activity[15].

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[12] http://www.iea.org/textbase/work/2006/gb/papers/power_india.pdf

[13] A investment comparison has been provided to the validator

[14] http://www.mapsofindia.com/maps/oilandgasmaps/gaspipelines.htm

[15] This alternative entails 15 MW power from a coal based CPP and the remaining from the grid.

Alternative-2 entails generation of power at power plants connected to the grid where the project activity power plant is connected. Grid power consists of power generated with different fuels like fossil fuels (*e.g.* coal, diesel, natural gas *etc.*), renewable resources (*e.g.* hydro, wind, biomass *etc.*), nuclear power *etc.*.

Step 3: Step 2 and/or step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" shall be used to identify the most plausible baseline scenarios by eliminating non-feasible options

In accordance with the guidance of the methodology, VSIPL has carried out a investment analysis among the realistic and credible alternatives (as mentioned above) as given below:

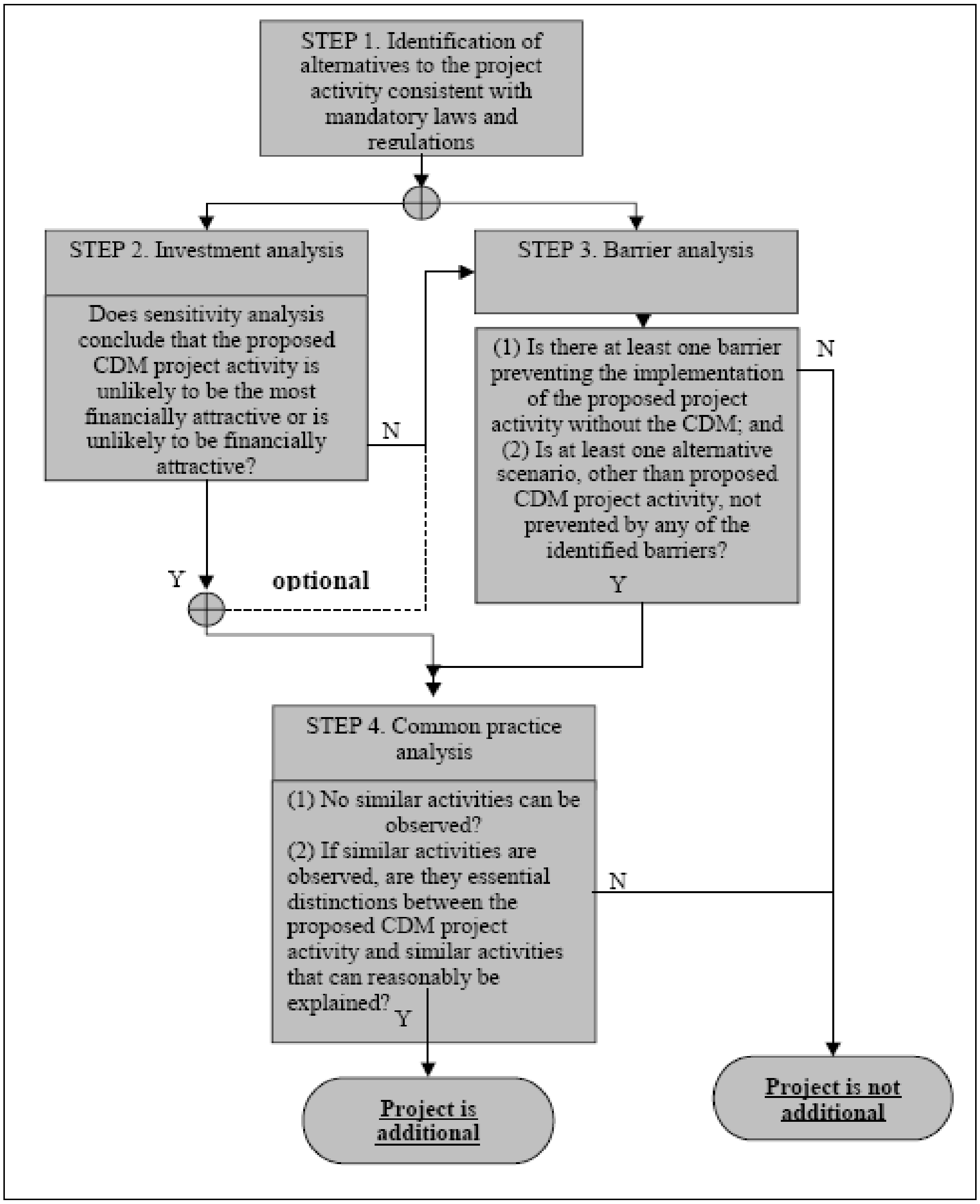
Table-B.4: Economic analysis of all the realistic and credible alternatives available with Vision Sponge Iron Private Limited		
Parameters	Generation of equivalent power in a coal based captive power plant	Import of power from the grid
Levelized cost of Generation (INR/kWh)	1.78	4.90
Comments on financial aspects	1. Higher capital investment, (*i.e.* fixed cost is higher) hence some financial assistance will be required from banks/ financial institutions. 2. The generation cost (*i.e.* operating cost) is low.	1. Negligible capital investment (*i.e.* fixed cost is nil) required. Electricity could be imported from the grid after the construction of the transmission lines requiring meagre amount of capital investment. 2. The power purchase cost (*i.e.* operating cost) is very high.
Conclusion	Considering all the points mentioned above, "Alternative-1: Generation of equivalent power in a coal based captive power plant" was found to be the most economically attractive option available to VSIPL in absence of the project activity and therefore, as per the methodology, this alternative option is the baseline scenario.	

The sensitivity analysis have been performed in Section B.5

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

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 the registered CDM project activity. The methodology requires the project proponent to determine its additionality based on the "Tool for the demonstration and assessment of additionality (Version 05.2)", agreed by the CDM Executive Board.

The flowchart presented in below provides a step-by-step approach to establishing additionality of the project activity:


STEP 1. Identification of alternatives to the project activity consistent with mandatory laws and regulations
STEP 2. Investment analysis
Does sensitivity analysis conclude that the proposed CDM project activity is unlikely to be the most financially attractive or is unlikely to be financially attractive?
STEP 3. Barrier analysis
(1) Is there at least one barrier preventing the implementation of the proposed project activity without the CDM; and (2) Is at least one alternative scenario, other than proposed CDM project activity, not prevented by any of the identified barriers?
N
Y
optional
N
Y
STEP 4. Common practice analysis
(1) No similar activities can be observed?
(2) If similar activities are observed, are they essential distinctions between the proposed CDM project activity and similar activities that can reasonably be explained?
N
Y
Project is additional
Project is not additional

The project activity was approved by the Board of Directors of M/s. Vision Sponge Iron Private Limited on 3rd May, 2007. Subsequent to the approval, the Management has proceeded with the implementation of the project activity as a climate change initiative. The following table gives the chronological events related to the project activity

Events	Date
Appointment of Technical Consultants for Project feasibility study	05.03.2007
CDM consideration by the Board of Directors of M/s Vision Sponge Iron Private Limited	03.05.2007
Appointment of CDM consultants	13.12.2007
Submission of PDD to Ministry of Environment & Forests, Government of India	07.03.2008
Presentation in front of the Ministry of Environment & Forests, Government of India	25.04.2008
Appointment of the Validator	27.06.2008
Web-Hosting of the PDD for Global Stakeholder Consultation	22.07.2008
Receipt of Host Country Approval	04.08.2008
Validation Site Visit	25.08.2008
Placement of first purchase order (Contract with M/s Triveni Engineering & Industries Limited (Project activity start date)	01.10.2008

Step1. Identification of alternatives to the project activity consistent with current laws and Regulations

Define realistic and credible alternatives to the project activity(s) through the following sub-steps:

Sub –step1a. Define alternatives to the project activity and Sub-step 1b. Consistency with mandatory laws and regulations:

All the plausible alternatives for waste gas utilization and power generation which are in compliance with the current laws and regulations have been dealt in details in the previous section (B.4) of the Project Design Document. The two options which available to the project proponent after the elimination of Alternative: 2 are “Generation of equivalent power in a coal based captive power plant” and the project option. The same is substantiated below through ‘Step-2: Investment Analysis’ and ‘Step-3: Barrier Analysis’

Step 2.Investment analysis

As per the investment analysis the project proponent is required to determine whether the project activity is economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). The project proponent has carried a detail investment analysis using the following sub-steps.

Sub-step 2a. Determine appropriate analysis method

The project activity will generate electricity for in-house consumption which will result in savings of electricity import from the grid. Therefore 'Option-I: Simple cost analysis' would not be an appropriate analysis method.

Amongst the other two options *i.e.* 'Option-II: Investment comparison analysis' and 'Option-III: Benchmark analysis', Vision Sponge Iron Private Limited has adopted the investment comparison analysis wherein the financial indicator is unit cost of electricity generation. So the two options were assessed based on unit cost of electricity. If at least one of the alternatives has a better indicator (*e.g.* higher project IRR / lower unit cost of service), then the project activity cannot be considered as the most financially attractive option.

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

The project proponent has carried out a unit cost of service comparison analysis as well as the levelized cost of electricity production in INR/kWh for the following alternatives to meet their in-house-requirement including the project activity. The options that were considered are:

"Generation of equivalent power in a coal based captive power plant" and "8.4 MW Waste heat recovery based power generation, 6.6 MW from AFBC and import of the remaining power from grid without the consideration of CDM revenues "

The unit cost of generation for each of the above alternatives has been evaluated for the investment comparison analysis.

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

<u>Assumptions for the Investment Comparison Analysis</u>

Baseline				
Sl. No.	**Parameter**	**Unit**	**AFBC- 15 MW**	**Assumptions/ Supporting**
1	Power generation capacity	MW	15	As per the details provided by the Engineering and Consultancy firm
2	Auxiliary consumption	%	10	As per the details provided by the Engineering and Consultancy firm
3	Number of Operating Days	Days/annum	330	With the assumption of 330 days of operation

Baseline				
Sl. No.	**Parameter**	**Unit**	**AFBC- 15 MW**	**Assumptions/ Supporting**
4	Design Station Heat Rate	kCal/kWh	3071	Highest of the two efficiency values has been taken as specified by the technical consultant ARK Engineering and Consultancy & turbine manufacturer Triveni Engineering & Industries Limited
5	Quantity of Coal in the fuel mix (Coal-Char mix)	%	38	As per the details provided by the Engineering and Consultancy firm
6	Quantity of Char in the fuel mix (Coal-Char mix)	%	62	
7	Net Calorific Value of Coal	kCal/kg	4491	The Calorific values has been taken from the DPR and can be verified with the certificate of analysis as provided by Mitra S.K. Private Limited
8	Net Calorific Value of Char	kCal/kg	1996	
9	Coal Cost	Rs/MT	1000	From the sale receipts of coal fines of Vision Sponge
10	Salaries	Rs/annum	13860000	As per the details provided by the Engineering and Consultancy firm
11	Maintenance Charges @ 2.5% of the total project cost	Rs/annum	13821225	As per the details provided by the Engineering and Consultancy firm
12	Building,Plant & Machineries	Rs/annum	3.34% of the – Building cost 5.28% of the-Plant & Machineries cost	The depreciation values has been taken as per Companies Act
13	Total Project Cost	Rs	552849000	As per the details provided by the Engineering and Consultancy firm
14	Rate of Interest	**%**	12.25	Structure of Interest Rate-Reserve Bank of India

Project activity					
Sl. No.	Parameter	Unit	AFBC- 6.6 MW	WHRB- 8.4 MW	Assumptions/ Supportings
1	Power generation capacity	MW	6.6	8.4	As per the details provided by the Engineering and Consultancy firm
2	Auxiliary consumption	%	12	12	As per the details provided by the Engineering and Consultancy firm
3	Number of Operating Days	Days/annum	330	300	With the assumption of 300 days of operation for the WHRBs and 330 days of operation of the AFBCs
4	Design Station Heat Rate	kCal/kWh	3071		Highest of the two efficiency values has been taken as specified by the technical consultant ARK Engineering and Consultancy & turbine maufacturer Triveni Engineering & Industries Limited
5	Quantity of Coal in the fuel mix (Coal-Char mix)	%	38		As specified by a Boiler Manufacturer
6	Quantity of Char in the fuel mix (Coal-Char mix)	%	62		
7	Net Calorific Value of Coal	kCal/kg	4491		The Calorific values has been taken from the DPR and can be verified with the certificate of analysis as provided by Mitra S.K. Private Limited
8	Net Calorific Value of Char	kCal/kg	1996		
9	Coal Cost	Rs/MT	1000		From the sale receipts of coal fines of Vision Sponge
10	Salaries	Rs/annum	4060000	20300000	As per the details provided by the Engineering and Consultancy firm
11	Maintenance Charges @ 3.5% of the total project cost	Rs/annum	9257500	14337750	As per the details provided by the Engineering and Consultancy firm
12	Building,Plant & Machineries	Rs/annum	3.34% of the – Building cost 5.28% of the-Plant & Machineries cost	3.34% of the – Building cost 5.28% of the-Plant & Machineries cost	The depreciation values has been taken as per Companies Act
13	Total Project Cost	Rs	267900000	406250000	As per the details provided by the Engineering and Consultancy firm
14	Rate of Interest	%	12.25	12.25	Structure of Interest Rate-Reserve Bank of India

Levelized cost of power generation in a coal based captive power plant *i.e.* baseline scenario is Rs 1.78/kWh
Levelized cost of power generation in the project scenario is Rs 2.03/kWh

As per the above investment comparison analysis of the financial indicator for the project activity and the project alternatives, it is found that "Generation of equivalent power in a coal based captive power plant" has a better financial indicator (*i.e.* it has the lower unit cost of electricity generation) than the project option. As per the "Tool for the demonstration and assessment of additionality (Version 04)", *"If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity can not be considered as the most financially attractive"*. It may therefore be concluded that the project activity can not be considered as the most financially attractive proposition.

Sub step 2d. Sensitivity analysis

The value of the unit cost of electricity generation is found to be sensitive to the following parameters:

- Coal price which will be directly affecting the cost implications of the AFBC
- Grid power purchase cost
- Plant Load Factor of WHRB
- Project Cost
- O&M Cost

The sensitivity analysis has been conducted for scenarios with variations in each one of the above-mentioned key factors in order

- ✓ to assess whether the conclusion regarding the financial attractiveness (of Alternative-1) is robust to reasonable variations in the critical assumptions.
- ✓ to assess whether the conclusion that the project activity is unlikely to be the most financially attractive is robust to reasonable variations in the critical assumptions

Table B-4. Sensitivity Analysis					
Sl. No.	Parameters	Variation	Levelized Cost of Electricity generation (INR/kWh)		Comment
			Generation of equivalent power in a coal based captive power plant	8.4 MW Waste heat recovery based power generation, 6.6 MW from AFBC and import from grid without the consideration of CDM revenues	
1.	Coal price	+10%	1.84	2.06	In both the situations, the levelized cost of electricity generation in the project scenario is higher than that for baseline
		-10%	1.72	2.01	
2.	Grid power purchase cost	+10%	1.84	2.12	In both the situations, the levelized cost of electricity generation in the project scenario is higher than that for baseline.
		-10%	1.72	1.95	
3	Project Cost	+10	1.78	2.07	In both the situations, the levelized cost of electricity generation in the project scenario is higher than that for baseline
		-10%	1.78	2.00	
4	O&M Cost	+10%	1.78	2.07	In both the situations, the levelized cost of electricity generation in the project scenario is higher than that for baseline
		-10%	1.78	2.00	
5.	Plant Load Factor	+10%	1.78	1.82	In both the situations, the levelized cost of electricity generation in the project scenario is higher than that for baseline.
		- 10%	1.78	2.25	

The results of the sensitivity analysis conducted substantiates that the levelized cost of electricity generation in case of baseline scenario comes closest the project option only on those case where the

WHR based power generation have increased by 10%. The PLF of WHR based power generation is directly proportional to the capacity utilization of the DRI kilns. Hence an increase of 10% of WHR based power generation would mean the DRI kilns would have to operate for about 330 days. However it is an unlikely scenario since already the project proponent assumed the maximum and conservative 300 days of operations based on the specification of the kiln manufacturer where the production figures of the existing DRI kilns suggests that the average capacity utilization over the last three years is only 51%. Hence a 10% increase in PLF of WHR based power generation is highly unrealistic.

Hence, it may be concluded that

(a) 'the project activity without CDM revenues not the most financially attractive option' is robust to reasonable variations in the critical assumptions and that

(b) the CDM revenue the project activity would obtain through sale of the emission reductions has been one of the most important driving force for Vision Sponge Iron Private Limited to opt for the project activity which is financially less attractive than Alternative-1.

Step 3.Barrier Analysis

The baseline Alternative-1, available to Vision Sponge Iron Private Limited, has been evaluated with respect to the risks that would be faced by the project activity. These barriers have been dealt with in Sub-Step 3a and the evaluation of the alternatives has been done in Sub-Step 3b.

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 would be overcome by project proponent through the revenue stream associated to additional green house gas emission reductions. The barriers are detailed below:

Other Barriers

a) Sponge iron industry in Bengal has been in crisis due to the increase in the raw material prices[16] which has affected the economy of the districts like Bankura, Purulia, Burdwan and other neighboring states. According to the sources of West Bengal Sponge Iron Manufacturing Association (WBSIMA), the operational loss of the sponge iron industry has reached Rs 1200-1400 per MT of sponge iron owing to the higher input costs. Under such circumstances for the core business operations of sponge iron

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[16] http://news.oneindia.in/2006/11/07/bengals-sponge-iron-industry-in-crisis-1162905455.html

manufacturing, it would not have been a financially viable option to set up a waste heat recovery based CPP (as elucidated above) without the consideration of CDM revenues.

b) SMS is the most power intensive unit in the manufacturing facility of VSIPL. Any fluctuation in the power generation would have a direct impact on the operation of steel melting shop. The production process of the SMS would be directly affected and may lead, not only to the loss of production and equipment, but also to the damage in the shop due the unexpected/forced shutdowns which can be attributed to some technical problems which have been elaborated below:

(i) Coal based sponge iron manufacturing involves reduction of iron ore with coal in a rotary kiln at a temperature of 850-1050^{0}C. The coal and iron ore to be used should conform to certain stipulated standards. The efficient operation of kiln, for example, requires coal with fixed carbon and low ash content. The fixed carbon content should be 40 – 45% while the ash content should be 20-24%. Use of coal with low ash fusion temperature leads to sticky mass and consequent unstable kiln operation by forming accretion inside the kiln and reducing the reduction rate by formation of slag layer on surface of the ore. Due to formation of accretion inside the kiln, the down time of kiln gets increased necessitating shutdown of kiln for cleaning. When the sponge iron plant is shutdown, the power generation from the WHRBs would also stop. Therefore reduced power generation from the WHRBs will negatively affect the operation of the SMS leading to production losses for VSIPL[17].

(ii) The operation of sponge iron kilns is also likely to have an impact on the project operation. The quantity and quality of steam being generated in each WHRB is dependent on the recovery of heat of waste flue gas generated from sponge iron kilns. The operation of five sponge iron kilns may not be constant during the operational period of project and the parameters of flue gas, such as temperature and flow may vary. Since the amount of recovery of heat from each WHRB is totally dependent on the parameters of waste flue gas generated from the respective sponge iron kiln, the effect would be on the quantity of steam generation and in turn power generation[18].

But this would not have been the case had VSIPL chosen coal based captive power project, as in the coal based power plant the boiler would acquire constant amount of heat energy as the energy input to the boiler is not subject to the vagaries of sponge iron plant.

Sub-step 3 b. 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):

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[17] The capacity of coal based power generation is 6.61 MW. Therefore grid and coal based power are not adequate to meet the power demand of the SMS.

[18] http://www.steelworld.com/outlook0107.pdf

It has been observed in Sub-step 3a that the project activity has its associated operational barriers to successful implementation which is attributed to insufficient power generation resulting from inadequate availability of waste gas and inconsistency in waste gas parameters[19]. The same can be verified from the production data of the existing kilns since the availability of the waste gas is directly dependant on the operation if the DRI kilns. The low production suggests that availability of the waste gas is inconsistent. In that case WHRB will stop operating which in turn will hamper the power generation. The downstream facilities such as the SMS will be affected leading to huge production loss as a result of loss of opportunity cost as already mentioned earlier. The baseline alternative (*i.e.* Alterative-1) has also been evaluated with respect to the operational barrier being faced by the project activity. But the baseline scenario would not have been exposed to the barriers being faced by the project activity. CDM revenues would help to alleviate the opportunity cost loss as faced due to the project activity but would not have been the case in case of baseline scenario since there is no disruption in power generation in the base case.

Step 4. Common practice analysis

The project proponent is further required to conduct the common practice analysis as a credibility check to complement the investment analysis (Step 2) and the barrier analysis (Step 3). The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

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

For assessing the common practice analysis, the sponge iron plants in the state of West Bengal has been considered. India being a large country, the government policies, subsidies, benefits, power and raw material costs, industrial and environmental policies are controlled and decided by the state authorities. Hence, the sponge iron plants in West Bengal operate under the same set of economical, environmental and political conditions which is different on state-to-state basis. Hence, the sponge iron plants in West Bengal has been considered for the common practice analysis.

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[19] Refer to communication from DRI kiln Consultant

Sub-step 4b. Discuss any similar options that are occurring:

The common practice scenario discussed below further substantiates the fact that the project activity faces barriers to implementation and is therefore not a widespread proposition for similar manufacturing sectors under similar socio-economic environment in India. Moreover power generation by utilizing the waste gases from the sponge iron kiln is not an economically attractive scenario especially for plants less than 200,000 tpa capacity.[20].

In similar project sector, socio-economic environment, geographic conditions and technological circumstances there are about 42 units[21] in West Bengal. But majority of them meets their power requirement through import from the grid. Few of them are having their own captive power plant and even less number of units have installed WHRB[22]. Nearly all the projects having WHRB have already entered into the CDM cycle. However following to the guidelines the same have been excluded from the Common Practice Analysis. An analysis of approximate power requirement through the assessment of the kind of downstream facilities present has been done for all the remaining 27 units. It has been observed about 12 sponge iron units having downstream steel ingot or other energy intensive facilities also does not have any power plant. The supporting of the same has been provided to the validator.

Please refer to the table below for a detailed analysis of the Sponge Iron Plants in the state of West Bengal

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
1	Ma Chandi Durga Ispat Limited	No	No	1. Sponge Iron Power Requirement: Low	As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://www.wbidc.com/about_wb/projects_implemented.htm

20 http://books.google.co.in/books?id=PBvJ6Jf8nxQC&pg=PA22&lpg=PA22&dq=DRI+Kiln+gas+based+power+plant&source=web&ots=m78g4OwfzD&sig=-56kCDWNVfar64ybqoM2gq1vlYI&hl=en&sa=X&oi=book_result&resnum=10&ct=result)

21 West Bengal Sponge Iron Manufacturers Association member list

22 The detailed analysis has been provided to the validator.

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
2	Ritesh Tradefin Ltd	No	No	1. Sponge Iron Power Requirement: Low	As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://snsvo1.seekandsource.com/spongeiron/
3	Haldia Steels Ltd	No	No	1. Integrated Steel Plant Power Requirement :High	As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://www.ultraplus.in/brandgroup.htm [Integrated Steel Plant]
4	Sova Ispat Alloys Ltd	No	No	1. Sponge Iron 2. M.S Ingot Power Requirement : High	As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://www.wbpcb.gov.in/html/eia_A_to_be_held/EIA_sova_ispat.pdf http://www.sovaispat.com/ [Refer to the products section] [Energy intensive downstream operations are there since the ultimate products include steel ingots]
5	Howrah Gases Ltd	No	No	1. Sponge Iron 2. Steel Ingots Power Requirement : High	As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://money.newkerala.com/company-profile-id-15510031.00.html http://www.mspsteel.com/co_howrah_gas.htm [Energy intensive downstream operations are there since the ultimate products include steel ingots]

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
6	Shree Gopal Govind Sponges Pvt Limited	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20080620_17_sponge_iron_units.pdf http://siadipp.nic.in/policy/iem060603.htm Only Sponge Iron Unit
7	Dhanbad Fuels Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070906_dhanbad_fuels.pdf http://www.hotfrog.in/Companies/Dhanbad-Fuels Only Sponge Iron Unit
8	Satyam Iron & Steel Pvt Limited	No	No	1. Sponge Iron 2. Steel Ingots Power Requirement : High	As per WEST BENGAL POLLUTION CONTROL BOARD (Department of Environment, Govt. of West Bengal) Paribesh Bhawan. MEMO NO.: 1754 - WPBA-RED(BWN)/CONT(339)/02 http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070906_satyam_iorn&steel.pdf http://shivamiron.com/satyam.html [Energy intensive downstream operations are there since the ultimate products include steel ingots]
9	Savitri Sponge Iron Pvt Limited	No	No	1. Sponge Iron 2. Steel Ingots Power Requirement : High	As per the report on “Sponge Iron Industry”, published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://www.indiamart.com/company/1162774/ [Energy intensive downstream operations are there since the ultimate products include steel products]

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
10	Divya Jyoti Sponge Pvt Limited	No	No	1. Sponge Iron 2. Induction Furnace 3. Steel Ingots Power Requirement : High	Source: http://www.wbpcb.gov.in/html/eia_A_conducted/divya_jyoti_p_h.pdf http://enviswb.gov.in/Env_application/GO/uploads/DIVYA_JYOTI.pdf [Even though SMS is not present the power requirement is high due to the presence of Induction furnaces]
11	M.B Ispat Corporation Ltd	No	No	1. Sponge Iron 2. Ferro Alloy Power Requirement : High	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20080620_17_sponge_iron_units.pdf http://www.environindia.org/projects.html [Even though SMS is not present it is having a ferro-alloy plant which is highly energy intensive]
12	Amiya Steels Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.calcuttayellowpages.com/adver/104956.html As per the report on “Sponge Iron Industry”, published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070905_amiya_steel.pdf http://www.calcuttayellowpages.com/adver/104956.html
13	Maithon Steel and Power Ltd	No	No	1. Sponge Iron 2. Steel Melting Shop 3. Other downstream facilities Power Requirement : High	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20080616_maithon_steel_&_power.pdf Presence of SMS : Yes http://www.wbpcb.gov.in/html/eia_A_to_be_held/EIA_maithan.pdf [A number of downstream facilities are present]

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
14	Bisco Sponge Iron Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India Presence of SMS: No http://www.wbidc.com/about_wb/projects_implemented.htm
15	Shiv Shankar Sponge Iron	No	No	1. Sponge Iron Power Requirement: Low	As per WEST BENGAL POLLUTION CONTROL BOARD (Department of Environment, Govt. of West Bengal) Paribesh Bhawan. MEMO NO.: 0292 -136-WPB-SEE-K.O.-GEN/2003 http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070419_shivshankarspongeiron.pdf http://enviswb.gov.in/Env_application/GO/uploads/SHIV_SANKAR.pdf
16	Ma Chinnamastika Power and Steel Pvt Ltd	No	No	1. Sponge Iron 2. Steel Melting Shop 3. Other downstream facilities Power Requirement : High	http://mcgroup.co.in/ Presently power plant is not present. http://mcgroup.co.in/ A number of downstream facilities including rolling mills are present.
17	Mark Steel Ltd	No	No	1. Sponge Iron Power Requirement: Low	As per WEST BENGAL POLLUTION CONTROL BOARD (Department of Environment, Govt. of West Bengal) Paribesh Bhawan. MEMO NO.: 3360 -111-WPB-SEE-K.O.-GEN/2003 http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070309_mark_steels_ltd.pdf http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20080722_mark_steels_ltd.pdf

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
18	ASL Iron & Steel Co Pvt.Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20071205_asl_iorn_&_steel.pdf http://www.wbidc.com/about_wb/projects_implemented.htm
19	Rishabh Sponge Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20080108_rishabh_sponge_pvt_ltd.pdf As per the report on "Sponge Iron Industry", published by Central Pollution Control Board, Ministry of Environment & Forests, Government of India http://www.wbidc.com/about_wb/projects_implemented.htm
20	Bravo Sponge Iron Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070816_bravo_sponge_iron.pdf http://www.wbidc.com/about_wb/projects_implemented.htm
21	Concast Bengal	Yes	No	Power Requirement: High	http://www.wbpcb.gov.in/html/eia_A_conducted/concast_bengal_p_h.pdf Only 4 MW power is being availed through WHRB. Majority of the power about 20.5 MW will come from a stable coal based CPP which will help in stabilizing the power supply to the facilities
22	Ma Amba Sponge Iron Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070910_ma_amba_sponge.pdf http://www.wbidc.com/about_wb/projects_implemented.htm

List of Sponge Iron Plants and their power generation practice in West Bengal, India					
Sl. No	Name of the Sponge Iron Plant	Presence of WHRB	Availing CDM benefits	Facilities present and power requirement	Source of Information/Remarks
23	Rabindra Enterprises Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070503_rabindra_enterprise.pdf
24	Vijaya Sponge Ltd	No	No	1. Sponge Iron 2. TMT Bars 3. Billets Power Requirement: High	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20070712_viyaya_sponge_&_ispat.pdf http://vijayaa.com/billets.htm
25	Sen Ferro Alloys Pvt Ltd	No	No	1. Sponge Iron Power Requirement: Low	Only 50 tpd kiln is present. Hence presence of WHRB is not possible. http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20080523_six_sponge_iron_units_pc.pdf http://www.wbidc.com/about_wb/projects_implemented.htm
26	Govinda Impex Private Ltd	No	No	1. Sponge Iron 2. Other downstream facilities Power Requirement : High	http://www.wbpcb.gov.in/html/annualreps/ar0405/chapter_7.pdf http://www.indiaresources.com.au/files/IRL_signs_Heads_of_Agreement_to_develop_a_Coal_Mine.pdf [A number of downstream facilities are present for the production of steel ingots] Presently there is no WHRB.
27	Bhagwati Sponge Ltd	No	No	1. Sponge Iron Power Requirement: Low	http://www.wbpcb.gov.in/html/orderdirections/pubgriev/20071105_bhagwati_sponge_iron.pdf http://www.indiaresources.com.au/files/IRL_signs_Heads_of_Agreement_to_develop_a_Coal_Mine.pdf

As per the above analysis among all the sponge iron plants in West Bengal there is only one sponge iron plant where WHRB is present. All the other plants where WHRB is present have entered into the CDM cycle. Therefore the common practice scenario demonstrates that there is a poor penetration of this

technology which can be attributed to the various investment risks or barriers associated with the project activity implementation. It is thus clearly established that the project activity would not have occurred in absence of CDM because of the existing financial and technical barriers and without the proposed carbon financing for the project, VSIPL would not have taken the investment risks related to the project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

As per the selection of the baseline scenario conducted in Section B.4 of this PDD, 'Alternative-1: Generation of equivalent power in a coal based captive power plant' is found to be the baseline scenario. Therefore following the guidance of the methodology, the baseline emissions is computed by quantifying the emissions related to flaring of waste gas (if any) and the emissions related to generation of power (equivalent to the net power generated in the project activity) in a coal based captive power plant. Project emissions are applicable only if auxiliary fuels are fired for supplementing the heat content of the waste gas and in case of electrical energy consumption for waste gas cleaning prior to its utilization for power generation. The methodology does not require the project proponent to consider any leakage emissions. Therefore the emission reduction resulting from the project activity is computed as a difference between the baseline emissions and the project emissions.

Computation of Baseline Emissions

As per the baseline scenario (*i.e.* Alternative-1), electricity equivalent to the net power generated through waste heat recovery, would have been generated in a coal based captive power plant. Therefore following the guidance of the methodology, the baseline emission will be computed as:

$$BE_y = BE_{En,y} + BE_{flst,y}$$

Where:

BE_y = Baseline emissions during the year y (in tonnes of CO_2)

$BE_{En,y}$ = Baseline emissions from electrical energy generated by project activity during the year y (in tonnes of CO_2)

$BE_{flst,y}$ = Baseline emissions from generation of steam, if any, using fossil fuel, that would have been used for flaring the waste gas in absence of the project activity (in tonnes of CO_2).

'y' is any year within the proposed crediting period of the project activity.

However, as stated above in Section B.3 of the PDD, there would not be any steam requirement in order to flare the waste gas generated from the DRI kilns at VSIPL in absence of the project activity *i.e.*,

$$BE_{flst,y} = 0$$

Therefore the baseline emissions resulting from the project activity can be considered as:

$$BE_y = BE_{En,y}$$

In accordance with the guidance provided in the methodology *(please refer to 'Baseline emissions for Scenario 1')*, the baseline emissions from electrical energy generated by the project activity will be computed as:

$$BE_{En,y} = BE_{Elec,y} = [f_{cap,1,2} \times f_{wcm,1,2} \times \sum_j \sum_i (EG_{i,j,y} \times EF_{Elec,i,j,y})] + [f_{cap,3,4,5} \times f_{wcm,3,4,5} \times \sum_j \sum_i (EG_{i,j,y} \times EF_{Elec,i,j,y})]$$

Where:

$BE_{En,y}$ = Baseline emissions from electrical energy generated by project activity during the year y (in tonnes of CO_2)

$BE_{Elec,y}$ = Baseline emissions from electricity during the year y (in tonnes of CO_2)

$EG_{i,j,y}$ = Quantity of electricity supplied to the recipient *j* by generator which in the absence of the project activity would have been sourced from the i^{th} source (*i.e.* the coal based captive power plant) during the year y (in MWh)

$EF_{elec,i,j,y}$ = CO_2 emission for the electricity source *i* (*i.e.* the coal based captive power plant), displaced due to the project activity during the year y (in tonnes CO_2/MWh)

$f_{WCM,1,2}$ = Fraction of total electricity generated by the project activity using waste gas of the existing facilities i.e 1st & 2nd DRI kilns

$f_{WCM,3,4,5}$ = Fraction of total electricity generated by the project activity using waste gas of the new facilities i.e 3rd,4th and 5th DRI kilns

$f_{cap,1,2}$ = Energy that would have been produced in project year y using waste gas of the existing facilities i.e 1st & 2nd DRI kilns generated in base year expressed as a fraction of total energy produced using waste gas in year y, determined as given below.

$f_{cap,3,4,5}$ = Energy that would have been produced in project year y using waste gas of the new facilities i.e 3rd,4th and 5th DRI kilns generated in base year expressed as a fraction of total energy produced using waste gas in year y, determined as given below

'y' is any year within the proposed crediting period of the project activity.

Determination of f_{wcm}

For the project activity under consideration,

- Steam generated with waste gas of the DRI kilns from five number of WHRBs[23]and
- Steam generated from the Atmospheric Fluidized Bed Combustion Boiler

will be fed to a common steam header and there from to the steam turbo-generator set for generation of power. Therefore f_{WCM} will be determined following the guidance of the methodology *(please refer to Situation 2 of "Calculation of the energy generated in units supplied by waste gas/heat and other fuels")* as given below:

Situation 1 is not applicable since no other fossil fuel(s) along with waste gas will be used for energy generation.

The fraction of electricity generation from the waste heat of the existing DRI kilns and the proposed DRI kilns have been apportioned. This is due to the fact that f_{cap} has been determined separately for the existing and the future DRI kilns.

$$f_{wcm},_{1,2} = \frac{ST_{whr,1.2,y}}{ST_{whr,y} + ST_{other,y}}$$

$$f_{wcm},_{3,4,5} = \frac{ST_{whr,3,4,5,y}}{ST_{whr,y} + ST_{other,y}}$$

Where:

f_{WCM} = Fraction of total electricity generated by the project activity using waste gas of the DRI kilns

$f_{WCM,1,2}$ = Fraction of total electricity generated by the project activity using waste gas of the 1st & 2nd DRI kilns

$f_{WCM,3,4,5}$ = Fraction of total electricity generated by the project activity using waste gas of the 3rd,4th and 5th DRI kilns

$ST_{whr,1,2,y}$ = Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the 1st & 2nd DRI kilns and fed to turbine via common steam header (in kCal)

$ST_{whr,3,4,5,y}$ = Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the 3rd,4th and 5th DRI kilns and fed to turbine via common steam header (in kCal)

[23] Considering at any point of time only 4 WHRBs would be operational and one will be under shutdown

$ST_{whr,y}$ = Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the DRI kilns and fed to turbine via common steam header (in kCal)

$ST_{other,y}$ = Energy content of steam generated in other boilers fed to turbine via common steam header (in kCal)

'y' is any year within the proposed crediting period of the project activity.

Situation 2 requires that:

- All the boilers have to provide superheated steam- This is justified since the temperature and pressure of the steam coming from the WHRB and the AFBC boilers will be around 520^0C and 88kg/cm^2. Hence all the boilers provide superheated steam
- The calculation should be based on the energy supplied to the steam turbine. The enthalpy and the steam flow rate must be monitored for each boiler to determine the steam energy content- The temperature and the pressure of steam will monitored at the outlet of each boiler by temperature and pressure gauges. The steam flow rate will also be monitored at each boiler outlet with the help of steam flow meter.

The calculation implicitly assumes that the properties of steam (temperature and pressure) generated from different sources are the same. The enthalpy of steam and feed water will be determined at measured temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter.

- Any vented steam should be deducted from the steam produced with waste gas/heat- There will be a separate flow meter just before the inlet of the TG. So if any steam is vented it will be automatically taken into account (difference between the flow meter reading at the TG inlet and the sum of the flow meter reading at each boiler outlet).

Determination of f_{cap}

In accordance with the guidance of the methodology *(please refer to Method 2 of "Capping of baseline emissions")*, the baseline emissions will be capped at the maximum quantity of waste energy that would have been generated before the implementation of the project activity.

Since two of the DRI kilns are existing and three will be coming up in future separate capping values have been considered for the existing kilns and the future kilns. Historical production figures has been considered to determine the f_{cap} of the existing kilns and manufacturer's data for normal operating

conditions has been considered to calculate the f_{cap} for the upcoming kilns. With this consideration, f_{cap} will be determined as given below:

$$f_{cap},_{1,2} = \frac{Q_{WCM,BL},_{1,2}}{Q_{WCM,y,1,2}}$$

$$f_{cap},_{3,4,5} = \frac{Q_{WCM,BL},_{3,4,5}}{Q_{WCM,y,3,4,5}}$$

Where:

$Q_{WCM,BL,1,2}$ = Quantity of waste energy generated prior to the start of the project activity in the 1st & 2nd DRI kilns calculated as given below (Nm^3)

$Q_{WCM,,y,1,2}$ = Quantity of waste energy used for energy generation in the 1st & 2nd DRI kilns during year y (Nm^3)

$Q_{WCM,BL,3,4,5}$ = Quantity of waste energy generated prior to the start of the project activity in the 3rd & 4th & 5th DRI kilns calculated as given below (Nm^3)

$Q_{WCM,,y,1,2}$ = Quantity of waste energy used for energy generation in the 3rd & 4th & 5th DRI kilns during year y (Nm^3)

'y' is any year within the proposed crediting period of the project activity.

The quantity of waste energy that would have been generated prior to the start of the project activity *i.e.* $Q_{WCM,BL}$ will be calculated as:

$$Q_{WCM,BL,1,2} = Q_{BL,product,1,2} \times q_{wcm,product,1,2}$$

$$Q_{WCM,BL,3,4,5} = Q_{BL,product,3,4,5} \times q_{wcm,product,3,4,5}$$

Where,

$Q_{WCM,BL,1,2}$ = Quantity of waste energy generated in the 1st & 2nd DRI kilns prior to the start of the project activity (Nm^3)

$Q_{BL,product,1,2}$ = Production by process that most logically relates to waste energy generation in baseline in the 1st & 2nd DRI kilns (in tonnes)-Historical production figures have been considered

$q_{wcm,product,1,2}$ = Amount of waste energy the industrial facility generates per unit of product generated by the process that generates waste energy *i.e.* in the 1st & 2nd DRI kilns (Nm^3/ton)

$Q_{WCM,BL,3,4,5}$ = Quantity of waste energy generated in the 3rd & 4th & 5th DRI kilns prior to the start of the project activity (Nm^3)

$Q_{BL,product,3,4,5}$ = Production by process that most logically relates to waste energy generation in baseline in the 3rd & 4th & 5th DRI kilns (in tonnes)-Manufacturer's data have been considered

$q_{wcm,product,3,4,5}$ = Amount of waste energy the industrial facility generates per unit of product generated by the process that generates waste energy *i.e.* in the 3rd & 4th & 5th DRI kilns (Nm^3/ton)

Hence, $f_{cap,1,2}$=0.51 and $f_{cap,3,4,5}$=1

<u>Determination of $EF_{elec,i,j,y}$</u>

The CO_2 emission for the coal based captive power plant which otherwise would have been set up in absence of the project activity will be calculated following the guidance of the methodology as given below:

$$EF_{Elec,is,j,y} = \frac{EF_{CO2,is,j}}{n_{Plant,j}} \times 3.6 * 10^{-3}$$

Where,

$EF_{elec,i,j,y}$ = CO_2 emission for the electricity source *i* (*i.e.* the coal based captive power plant), displaced due to the project activity during the year y (in tonnes CO_2/MWh)

$EF_{CO2,is,j}$ = CO_2 emission factor per unit of energy of the fossil fuel (coal) used in the baseline generation source i (in tCO_2 / TJ), obtained from reliable local or national data if available, otherwise, taken from the country specific IPCC default emission factors

$n_{Plant,j}$ = Overall efficiency of the existing plant that would be used by j^{th} recipient in the absence of the project activity

Efficiency of the power plant ($n_{plant,j}$) will be determined following Option (ii) of the methodology *i.e.* highest of the efficiency values provided by two or more manufacturers for power plants with specifications similar to that which would have been required to supply the recipient with electricity that it receives from the project activity.

<u>Computation of Project Emissions</u>

As per the guidance of the methodology, project emissions will include:

- Emissions from consumption of auxiliary fuel to supplement the heat content of the waste gas and
- Emissions from consumption of electrical energy for cleaning of waste gas prior to its utilization for generation of electrical energy or other supplementary electricity consumption

Therefore following the methodological guidance, the project emissions will be computed as:

$$PE_y = PE_{AF,y} + PE_{EL,y} + PE_{EL,Import,y}$$

Where:

PE_y = Project emissions during the year y (in tonnes of CO_2)

$PE_{AF,y}$ = Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste gas to the project activity or due to any other reason (in tonnes of CO_2)

$PE_{EL,y}$ = Project activity emissions from on-site consumption of electricity for gas cleaning equipment (in tonnes of CO_2)

$PE_{EL,Import,y}$= Project activity emissions from import of electricity replacing captive electricity generated in the absence of the project activity for Type-2 project activities

However the project activity falls under Type-1 project activity. Hence $PE_{EL,Import,y}$ need not be taken into account.

'y' is any year within the proposed crediting period of the project activity.

However, as stated above in Section B.3 of the PDD, no additional waste gas cleaning will be required in the project scenario than that in the baseline scenario. Therefore there will not be any additional energy consumption due to cleaning of waste gas in the project scenario. However provision has been kept in the monitoring section for emissions resulting from supplementary electricity consumption.

$$PE_{EL,y} = EC_{PJ,y} \times EF_{CO2,EL,y}$$

Where:

$EF_{CO2,EL,y}$ = CO_2 emission factor for electricity consumed by the project activity in year *y* (t CO_2/MWh)

A default emission factor of 1.3tCO_2/MWh will be used as per the methodology

In case electricity is consumed from the in-house DG set, the CO_2 emission factor for electricity consumed will be taken as specified in the methodology *i.e.* default emission factor of 1.3 t CO_2/MWh will be considered.

The project emissions from on-site fossil fuel consumption will be computed following the guidance of the methodology as given below:

$$PE_{AF,y} = \sum FF_{i,y} \times NCV_i \times EF_{CO2,i}$$

Where:

$PE_{AF,y}$ = Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste gas to the project activity or due to any other reason (in tonnes of CO_2)

$FF_{i,y}$ = Quantity of fossil fuel type *i* combusted to supplement waste gas in the project activity during the year y, (in tonnes)

NCV_i = Net calorific value of the fossil fuel type *i* combusted as supplementary fuel, (in TJ/ton)

$EF_{CO2,i}$ = CO_2 emission factor per unit of energy of the fuel type i (in tonnes of CO_2/TJ)

'y' is any year within the proposed crediting period of the project activity.

For the project activity under consideration, there is no provision for auxiliary fossil fuel firing in the ABC to supplement the heat content of the waste gas. Therefore no project emission is considered while computing the ex-ante emission reductions resulting from the project activity.

Computation of Leakage Emissions

The methodology does not require the project proponent to consider any leakage emissions.

Computation of Emission Reductions

As per the methodology, the emission reductions resulting from the project activity will be computed as

$$ER_y = \left(BE_y - PE_y\right)$$

Where,

ER_y = Emission reductions resulting from the project activity during the year y (in tonnes of CO_2)

BE_y = Baseline emissions during the year y (in tonnes of CO_2)

PE_y = Project emissions during the year y (in tonnes of CO_2)

'y' is any year within the proposed crediting period of the project activity.

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

The following parameters, required for the computation of baseline emissions and project emissions (and hence emission reductions resulting from the project activity), are standard parameters which will not be monitored during the crediting period and will remain fixed for the entire crediting period. The same will be provided to the Validator during validation of the project activity.

Fixed parameters for the computation of Baseline Emissions

1.Parameters related to computation of $f_{cap,1,2}$

Data / Parameter:	$q_{wcm,product,1,2}$
Data unit:	Nm^3/ton
Description:	Amount of waste energy the industrial facility generates per unit of product (*i.e.* DRI) generated by the process (*i.e.* sponge iron manufacturing) that generates waste energy
Source of data used:	Manufacturer's Data.
Value applied	6240
Justification of the choice of data or description of measurement methods and procedures actually applied :	Manufacturer's Specification.
Any comment:	Consideration of manufacturer's data will ensure the reliability of the parameter.

Data / Parameter:	$Q_{BL,product,1,2}$
Data unit:	tonnes/annum
Description:	Production by process (*i.e.* sponge iron manufacturing) that most logically relates to waste gas generation in the 1st & 2nd DRI kiln in baseline
Source of data used:	Actual Production Data
Value applied	30445
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on actual plant production data
Any comment:	-.

Data / Parameter:	$Q_{WCM,BL,1,2}$
Data unit:	Nm^3
Description:	Quantity of waste energy generated in the 1st & 2nd kiln prior to the start of the project activity
Source of data used:	Manufacturer's Specification
Value applied:	189977337

Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated based on: ▪ Production by process that most logically relates to waste energy generation in baseline ▪ Amount of waste energy the industrial facility generates per unit of product generated by the process that generates waste energy
Any comment:	

2. Parameters related to computation of $f_{cap,3,4,5}$

Data / Parameter:	$q_{wcm,product,3,4,5}$
Data unit:	Nm^3/ton
Description:	Amount of waste energy the industrial facility generates per unit of product (*i.e.* DRI) generated by the process (*i.e.* sponge iron manufacturing) that generates waste energy
Source of data used:	Manufacturer's Data.
Value applied	6240
Justification of the choice of data or description of measurement methods and procedures actually applied :	Manufacturer's Specification.
Any comment:	Consideration of manufacturer's data will ensure the reliability of the parameter.

Data / Parameter:	$Q_{BL,product,3,4,5}$
Data unit:	tonnes/annum
Description:	Production by process (*i.e.* sponge iron manufacturing) that most logically relates to waste gas generation in the 3rd, 4th,& 5th DRI kiln in baseline
Source of data used:	Manufacturer's Data
Value applied	90000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on the Manufacturer's specification of the DRI kiln
Any comment:	-.

Data / Parameter:	$Q_{WCM,BL,3,4,5}$
Data unit:	Nm^3
Description:	Quantity of waste energy generated in the 3rd, 4th,& 5th DRI kiln prior to the start of the project activity
Source of data used:	Manufacturer's Specification

Value applied:	561600000
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated based on: ▪ Production by process that most logically relates to waste energy generation in baseline ▪ Amount of waste energy the industrial facility generates per unit of product generated by the process that generates waste energy
Any comment:	

3. Parameters related to computation of f_{WCM}

The parameter will be monitored during the proposed crediting period of the project activity. Please refer to Section B.7.1 of the PDD for further details.

4. Parameters related to computation of $EG_{i,j,y}$

The parameter will be monitored during the proposed crediting period of the project activity. Please refer to Section B.7.1 of the PDD for further details.

5. Parameters related to computation of $EF_{elec,i,j,y}$

Data / Parameter:	$n_{Plant,j}$
Data unit:	-
Description:	Overall efficiency of the existing plant that would be used by j^{th} recipient in the absence of the project activity
Source of data used:	Manufacturers Data
Value applied	28%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Efficiency of the power plant will be determined as the highest of the efficiency values provided by two or more manufacturers for power plants with specifications similar to that which would have been required to supply the recipient with electricity that it receives from the project activity.
Any comment:	.

Fixed parameters for the computation of Project Emissions

The parameters required for the computation of project emissions will be monitored during the proposed crediting period of the project activity. Please refer to Section B.7.1 of the PDD for further details.

B.6.3 Ex-ante calculation of emission reductions:

Ex-ante Calculation (Please refer to Section B.6.1 for units and detailed description)

$$\mathrm{BE}_{y} = \mathrm{BE}_{En,y} + \mathrm{BE}_{flst,y}$$

$$BE_{flst,y} = 0$$

$$BE_{En,y} = BE_{Elec,y} = [f_{cap,1,2} \times f_{wcm,1,2} \times \sum_{j}\sum_{i}(EG_{i,j,y} \times EF_{Elec,i,j,y})] + [f_{cap,3,4,5} \times f_{wcm,3,4,5} \times \sum_{j}\sum_{i}(EG_{i,j,y} \times EF_{Elec,i,j,y})]$$

Therefore, $BE_y = BE_{En,y}$

Determination of f_{cap}

$$f_{cap,1,2} = \frac{Q_{WCM,BL,1,2}}{Q_{WCM,y,1,2}}$$

$$Q_{WCM,BL,1,2} = Q_{BL,product,1,2} \times q_{wcm,product,1,2}$$

$$Q_{WCM,BL,1,2} = 30445 \times 6240 = 189977337$$

$$f_{cap,1,2} = \frac{189977337}{374400000}$$

Therefore, $f_{cap,1,2}$=0.51

$$f_{cap,3,4,5} = \frac{Q_{WCM,BL,3,4,5}}{Q_{WCM,y,3,4,5}}$$

$$Q_{WCM,BL,3,4,5} = Q_{BL,product,3,4,5} \times q_{wcm,product,3,4,5}$$

$$Q_{WCM,BL,3,4,5} = 90000 \times 6240 = 561600000$$

$$f_{cap,3,4,5} = \frac{561600000}{561600000}$$

$f_{cap,3,4,5}$=1

Determination of f_{wcm}

$$f_{wcm,1,2} = \frac{ST_{whr,1.2,y}}{ST_{whr,y} + ST_{other,y}}$$

$$f_{wcm},_{1,2} = \frac{78745947034}{3.67012 \times 10^{11}} = 0.215$$

$$f_{wcm},_{3,4,5} = \frac{ST_{whr,3,4,5,y}}{ST_{whr,y} + ST_{other,y}}$$

$$f_{wcm},_{3,4,5} = \frac{1.18119 \times 10^{11}}{3.67012 \times 10^{11}} = 0.375$$

$EG_{i,j,y}$=99222

$$EF_{Elec,is,j,y} = \frac{EF_{CO2,is,j}}{n_{Plant,j}} \times 3.6 * 10^{-3}$$

$$EF_{Elec,is,j,y} = \frac{96.1}{0.28} \times 3.6 * 10^{-3} = 1.236$$

Therefore applying the above values, $BE_{en,y}$=59320

BE_y=59320

$$PE_y = PE_{AF,y} + PE_{EL,y}$$

$$PE_{EL,y} = EC_{PJ,y} \times EF_{CO2,EL,y}$$

and

$$PE_{AF,y} = \sum FF_{i,y} \times NCV_i \times EF_{CO2,i}$$

For the project activity under consideration, there is no provision for auxiliary fossil fuel firing in the ABC to supplement the heat content of the waste gas. Therefore no project emission is considered while computing the ex-ante emission reductions resulting from the project activity. However the same will be monitored during the proposed crediting period and in case of any consumption of auxiliary fuel for supplementing the heat content of the waste gas/supplementary electricity consumption, emission from the same will be determined as given above and will be accounted for during the computation of emission reductions, annually on an ex-post basis.

$$ER_y = \left(BE_y - PE_y\right)$$

Therefore ER_y=59320

The project activity thus results in an emission reduction of 59320tCO_2/annum

Ex-ante estimation of Project Emissions

As described above in Section B.6.1 above, there will be no project emission from the project activity and hence the project proponent will not consider any project emission for ex-ante computation of emission reductions resulting from the project activity (please refer to 'Annex-3: Baseline Information' for detail computation). Therefore,

$PE_y = 0$

Where,

PE_y = Project Emissions in the year y (tCO_2)

However the combustion of fossil fuel during generation start up or in emergencies in the project activity will be monitored and the project emission will be computed on the basis of the fossil fuel combustion during any year within the proposed crediting period. The same will be up-dated annually on an ex-post basis.

Ex-ante estimation of Emission Reductions

The ex-ante computation of emission reductions resulting from the project activity (please refer to 'Annex-3: Baseline Information' for detail computation) is tabulated below:

Sl. No.	Operating Year	Emission Reduction (tonnes of CO_2 e)
1	April 2010 – March 2011	59,320
2	April 2011 – March 2012	59,320
3	April 2012 – March 2013	59,320
4	April 2013 – March 2014	59,320
5	April 2014 – March 2015	59,320
6	April 2015 – March 2016	59,320
7	April 2016 – March 2017	59,320
8	April 2017 – March 2018	59,320
9	April 2018 – March 2019	59,320
10	April 2019 – March 2020	59,320
Total		**593,200**

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

Year	Estimation of Proposed project activity Emission reductions (tonnes of CO_2 e)	Estimation of baseline Emissions reductions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of emission reductions (tonnes of CO_2 e)
April 2010 – March 2011	0	59,320	0	59,320
April 2011 – March 2012	0	59,320	0	59,320
April 2012 – March 2013	0	59,320	0	59,320
April 2013 – March 2014	0	59,320	0	59,320
April 2014 – March 2015	0	59,320	0	59,320
April 2015 – March 2016	0	59,320	0	59,320
April 2016 – March 2017	0	59,320	0	59,320
April 2017 – March 2018	0	59,320	0	59,320
April 2018 – March 2019	0	59,320	0	59,320
April 2019 – March 2020	0	59,320	0	59,320
Total (tonnes of CO_2 e)	**0**	**593,200**	**0**	**593,200**

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

Title: Consolidated baseline and monitoring methodology for GHG emission reductions from waste energy recovery projects

Reference: Approved consolidated baseline methodology ACM0012/Version 03.1, Sectoral Scope 01 and 04, EB 44

B.7.1 Data and parameters monitored:

The approved consolidated monitoring methodology requires the project proponent to monitor the following parameters for the computation of baseline emissions, project emissions and hence the emission reductions resulting from the project activity. The parameters and the monitoring procedures are detailed below:

Parameters to be monitored for the computation of Baseline Emissions

1. Parameters related to computation of f_{cap}

Data / Parameter:	$Q_{WCM,,y,1,2}$
Data unit:	Nm^3
Description:	Quantity of waste energy used for energy generation in the 1st & 2nd DRI kilns during year y
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	374400000
Description of measurement methods and procedures to be applied:	The parameter will be monitored continuously with flow meter. The flow meter will be placed between WHRB outlet and ESP inlet since it is technically not feasible to measure the waste gas at the inlet of WHRB[24]. The same will also be available in the power plant Distributed Control System (DCS).
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration *i.e.* calibration of the flow meter will be performed once a year. The flow meter would be calibrated according to the temperature and pressure of waste gas at the monitoring point.
Any comment:	The data will be archived both electronically and in paper till two years after the crediting period.

[24] Justification of the same has been provided to the validator.

Data / Parameter:	$Q_{WCM,y,3,4,5}$
Data unit:	Nm^3
Description:	Quantity of waste energy used for energy generation in the 3rd, 4th & 5th DRI kilns during year y
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	561600000
Description of measurement methods and procedures to be applied:	The parameter will be monitored continuously with flow meter. The flow meter will be placed between WHRB outlet and ESP inlet since it is technically not feasible to measure the waste gas at the inlet of WHRB[25]. The same will also be available in the power plant Distributed Control System (DCS).
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration *i.e.* calibration of the flow meter will be performed once a year. The flow meter would be calibrated according to the temperature and pressure of waste gas at the monitoring point.
Any comment:	The data will be archived both electronically and in paper till two years after the crediting period.

2. Parameters related to computation of f_{WCM}

Data / Parameter:	$ST_{whr,y}$
Data unit:	kCal/kg
Description:	Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the DRI kilns and fed to turbine via common steam header
Source of data to be used:	Plant Records and Steam Tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Specific energy content-821.98 Total energy content- 196864867584 kCal
Description of measurement methods and procedures to be applied:	The parameter will be determined based on ▪ Steam flow from the Waste Heat Recovery Boilers- The parameter will be monitored with flow meter provided with an totalizer that will be integrated with the power plant Distributed Control System (DCS). ▪ Enthalpy of steam generated- The parameter will be determined based on temperature and pressure of steam generated from the Waste Heat Recovery Boiler using Steam Tables. The temperature of steam generated will be monitored with temperature gauge and the pressure of steam generated will be monitored with pressure gauge.

[25] Justification of the same has been provided to the validator.

	▪ Recording Frequency: Hourly basis. ▪ Shift wise average values will be considered for generating the daily reports.
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration *i.e.* calibration of the of the temperature and pressure gauges. will be performed once a year.
Any comment:	The data will be archived both electronically and in paper till two years after the crediting period..

Data / Parameter:	$ST_{whr,1,2,y}$
Data unit:	kCal/kg
Description:	Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the 1st & 2nd DRI kilns and fed to turbine via common steam header
Source of data to be used:	Plant Records and Steam Tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Specific energy content-821.98 Total energy content- 78745947034
Description of measurement methods and procedures to be applied:	The parameter will be determined based on ▪ Steam flow from the Waste Heat Recovery Boilers- The parameter will be monitored with flow meter provided with an totalizer that will be integrated with the power plant Distributed Control System (DCS). ▪ Enthalpy of steam generated- The parameter will be determined based on temperature and pressure of steam generated from the Waste Heat Recovery Boiler using Steam Tables. The temperature of steam generated will be monitored with temperature gauge and the pressure of steam generated will be monitored with pressure gauge. ▪ Recording Frequency : Hourly basis. ▪ Shift wise average values will be considered for generating the daily reports.
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration *i.e.* calibration of the temperature and pressure gauges will be performed once a year.
Any comment:	The data will be archived both electronically and in paper till two years after the crediting period..

Data / Parameter:	$ST_{whr,3,4,5,y}$
Data unit:	kCal/kg
Description:	Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the 3rd,4th,& 5th DRI kilns and fed to turbine via common steam header
Source of data to be used:	Plant Records and Steam Tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Specific energy content-821.98 Total energy content- 1.18119 X 10^{11}
Description of measurement methods and procedures to be applied:	The parameter will be determined based on ▪ Steam flow from the Waste Heat Recovery Boilers- The parameter will be monitored with flow meter provided with an totalizer that will be integrated with the power plant Distributed Control System (DCS). ▪ Enthalpy of steam generated- The parameter will be determined based on temperature and pressure of steam generated from the Waste Heat Recovery Boiler using Steam Tables. The temperature of steam generated will be monitored with temperature gauge and the pressure of steam generated will be monitored with pressure gauge. ▪ Recording Frequency : Hourly basis. ▪ Shift wise average values will be considered for generating the daily reports.
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration of the temperature and pressure gauges.
Any comment:	The data will be archived both electronically and in paper till two years after the crediting period..

Data / Parameter:	$ST_{other,y}$
Data unit:	kCal/kg
Description:	Energy content of steam generated in other boilers fed to turbine via common steam header
Source of data to be used:	Plant Records and Steam Tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Specific energy content-821.98 Total energy content- 1.70147 X 10^{11}
Description of measurement methods and procedures to be applied:	The parameter will be determined based on ▪ Steam flow from the AFBC boiler- The parameter will be monitored with flow meter and will be available in the power plant Distributed Control System (DCS). The Head (Power Plant) will be responsible for regular calibration of the flow meter. ▪ Enthalpy of steam generated- The parameter will be determined based on

	temperature and pressure of steam generated from AFBC boiler using Steam Tables. The temperature of steam generated will be monitored with temperature gauge and the pressure of steam generated will be monitored with pressure gauge. ▪ Recording Frequency: Hourly basis. ▪ Shift wise average values will be considered for generating the daily reports.
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration of the temperature and pressure gauges. The data will be archived both electronically and in paper till two years after the crediting period.
Any comment:	The uncertainty level of the parameter will be low since the same will be determined with parameters monitored with calibrated meters.

3. Parameters related to computation of $EG_{i,j,y}$

Data / Parameter:	$EG_{i,j,y}$
Data unit:	MWh
Description:	Net quantity of electricity from the 15 MW turbogenerator and supplied to the manufacturing facility of VSIPL.
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	99222
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously (online measurement) with energy meter provided with totalizer. The same can be verified by the difference between the readings of gross energy generation meter and the auxiliary meter as well as the energy meters provided in the recipient(s)
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration of the energy meter.
Any comment:	The data will be archived both electronically and in paper for the entire crediting period and two years after

4.Parameters related to computation of $EF_{elec,i,j,y}$

Data / Parameter:	$EF_{CO2,is,j}$
Data unit:	tCO_2 / TJ
Description:	CO_2 emission factor per unit of energy of the fossil fuel (coal) used in the baseline generation source i
Source of data used:	IPCC value has been considered for ex-ante calculation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	96.1(as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories)
Description of measurement methods and procedures to be applied:	The parameter will be determined following the standard testing practice.
QA/QC procedures:	The data will be monitored using sample analysis using standard national or international procedures or IPCC value will be considered for the same in this order of preference. Calorific Value as well as carbon percentage will be monitored for both coal & char. $EF_{CO2,is,j}$ will be determined in the following manner for both coal and char $EF_{CO2,is,j}$ = (44/12) X Carbon Percentage/(Calorific Value X 4.186 X 10^{-9}) Where, Carbon Percentage is in % C per kg Calorific Value is in kCal/kg
Any comment:	The aforementioned equation will be followed for measuring $EF_{CO2,is,j}$ of coal and char. The most conservative value will be considered for emission reduction computation

Data / Parameter:	$EF_{elec,i,j,y}$
Data unit:	tCO_2/ MWh
Description:	CO_2 emission for the electricity source *i* (*i.e.* the coal based captive power plant), displaced due to the project activity during the year y
Source of data used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.236
Description of measurement methods and procedures to be applied:	The parameter will be calculated based on: ▪ CO_2 emission factor per unit of energy of the fossil fuel (coal) used in the baseline generation source i and ▪ Overall efficiency of the existing plant that would be used by j^{th} recipient in the absence of the project activity Monitoring Frequency: Yearly

QA/QC procedures:	The Head (Power Plant) will be responsible for the checking and the archiving of the data
Any comment:	

Parameters to be monitored for the computation of Project Emissions

Data / Parameter:	$EC_{PJ,,y}$
Data unit:	MWh
Description:	Additional electricity consumed in year *y* as a result of the implementation of the project activity (MWh).
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 (assumed ex-ante)
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously (online measurement) with energy meter provided with totalizer and the same will be available in the plant's Distributed Control System (DCS). The same can be verified by the difference between the readings of gross energy generation meter and the auxiliary meter as well as the energy meters provided in the recipient(s)
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for regular calibration of the energy meter.
Any comment:	The data will be archived both electronically and in paper for the entire crediting period and two years after

Data / Parameter:	$EF_{CO2,EL,y}$
Data unit:	tCO_2 / MWh
Description:	CO_2 emission factor for electricity consumed by the project activity in year y (t CO_2/MWh) (Electricity may be purchased from the grid or from the in-house DG set)
Source of data used:	Default value taken from the methodology
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.3 (The same will be taken during the crediting period to be on the conservative side)
Description of measurement methods and procedures to be applied:	Default value taken from the methodology
QA/QC procedures:	Conservative value will be taken from the methodology
Any comment:	N/A

Data / Parameter:	FF_i
Data unit:	tonnes
Description:	Quantity of fossil fuel type *i* combusted to supplement waste gas in the project activity during the year y
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously (*i.e.* whenever auxiliary fuel will be consumed) with a properly calibrated flow meter/weighing system. The data will be aggregated monthly. The data will be archived both electronically and in paper for the entire crediting period and two years thereafter.
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for the checking and the archiving of the data
Any comment:	Regular calibration of the flow meter/weighing system will ensure the reliability of the parameter. If possible, fuel purchase receipt will also be used to cross-verify the data.

Data / Parameter:	NCV_i
Data unit:	GJ/ton
Description:	Net calorific value of the fossil fuel type *i* combusted as supplementary fuel
Source of data to be used:	Plant Records/ National Sources/ 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The parameter will be determined following the standard testing practice. In absence of plant specific data, country specific data or IPCC default values will be used.
QA/QC procedures to be applied:	The Head (Power Plant) will be responsible for the checking and the archiving of the data
Any comment:	Determination of the parameter following the standard testing practice will ensure the reliability of the parameter. In absence of authentic plant specific data, country specific data or IPCC default values will be used to ensure reliability of the parameter.

Data / Parameter:	$EF_{CO2,I}$
Data unit:	tCO_2 / TJ
Description:	CO_2 emission factor per unit of energy or mass of the fuel type *i*
Source of data used:	The source of data will be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain. For ex-ante IPCC values have been considered.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The parameter will be determined following the standard testing practice. In absence of plant specific data, country specific data or IPCC default values will be used.
QA/QC procedures:	--
Any comment:	IPCC guidelines/Good practice guidance provide for default values where local data is not available

B.7.2 Description of the monitoring plan:

The CDM mechanism stands on the quantification of emission reductions and keeping the track of the emissions reduced. The proposed project activity reduces the carbon dioxide whereas an appropriate monitoring system ensures this reduction is quantified and helps maintaining the required level. The monitoring system 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.

Objective

- To ensure proper monitoring and recording of all the parameters required for the computation of emission reductions from the project activity (as mentioned in Section B.7.1 of the PDD)
- To ensure proper evaluation of the project activity performance at regular intervals
- To identify the discrepancies in the data monitoring, recording and archiving system and to open up the opportunities for future improvement

Instrumentation and Control System

The instrumentation and control system is the key aspect for salubrious functioning of any monitoring and verification system of a project activity. 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 net power generated, flow rate, temperature and pressure parameters of the waste gas, steam generated and steam sent to turbine to generate power. The flow-meters and the energy meters will be calibrated on a yearly basis. The instrumentation and control system for the power plant is designed with microprocessor-based instruments having adequate provisions to control and monitor the various operating parameters for safe and efficient operation of the Waste Heat Recovery Boilers and the Steam Turbo-generator unit.

Fuel Management

There will be a separate fuel log book maintained for ABFC boilers where the amount of coal fines & char consumed will be logged. The fuel bunker in the AFBC boiler will have two partitions to store and feed coal and char separately to the boiler. For this purpose, at the outlet of the each partition of the bunker, rotary airlock feeders are to be provided. These are basically volumetric feeders discharging constant volume of fuel for each rotation. The weight of fuel discharged for each rotation of the feeder is calibrated and recorded. The speed of rotation of these feeders will constantly monitored in the central DCS control station and the speed totalizer will also be provided in the DCS. Once the total number of rotations is known, the actual weight of coal & char that has been fed into the boiler is known as the feeders are calibrated. This will be cross checked the ratio of coal fines to char used in the AFBC boiler as mentioned is in the Project Design Document.

Roles and Responsibilities

The project proponent has developed a ‘CDM Team’ who will be involved in monitoring, reporting and verification of all the GHG performance related parameters. The following schematic diagram will explain the individual roles and responsibilities of all the members of the ‘CDM Team’:

Personnel	**Responsibility**
Shift Operator	Monitoring and reporting the GHG performance related parameters following the guidance provided in the Project Design Document.
Shift In-charge	Reviewing the GHG performance related parameters as recorded by the Shift Operator in every shift. Implementation of appropriate corrective measures in case any discrepancies are identified in the

Personnel	Responsibility
	reported parameters. Preparation of daily and monthly reports.
Head (Power Plant)	Reviewing the daily and monthly reports in consultation with the Shift In-charge. Implementation of appropriate corrective measures in case any discrepancies are identified in the daily and monthly reports. Ensuring calibration of the monitoring equipments as and when required.
Management Representative(s)	Reviewing the monthly and annual production statistics. Evaluating the GHG performance of the project activity. Identify opportunities for further improvement

Maintenance of the monitoring system

Internal Audit will be conducted once in a year in order to assess the monitoring system and thus the GHG performance of the project activity. Auditors will consist of people from different departments of Vision Sponge Iron Private Limited. The audit findings and the necessary corrective actions will be documented and reported to the Management Representative(s) for their immediate actions for proper maintenance of the monitoring system. The Plant Management will also be informed on the same. Compliance with the audit findings and evaluation of implementation of the corrective actions will be a part of the subsequent audit.

Emergency Preparedness Plan

The total power generating system of power plant of VSIPL will be equipped with an 'Automatic Alarming System' which helps the operators to take necessary preventive actions before any kind of non-functioning of the power plant.

VSIPL will also develop an Emergency Fire Hydrant System throughout the plant with the help of electrical equipment and diesel generator. When there is a fire, the fire hydrant pump will be started by the security people (properly trained with fire fighting activities) with the help of electrical motors, if electricity is available at that point of time. However, if electricity is not available at that instant, the fire hydrant pump fitted with diesel generator set is activated. The fire is extinguished subsequently.

In case of failure of the monitoring system like the failure of the energy meters and the flow meters the readings of the back up meters will be considered for that particular period. In case back-up metering system is not provided VSIPL will not claim for the emission reduction for that particular period.

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

Parameter	Details
Date of completing the final draft of this baseline selection and monitoring plan	22/11/2008
Name of person/ entity determining the baseline and establishing the monitoring plan	Vision Sponge Iron Private Limited (Project Participant)

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:

01.10.2008 (Date of Contract for the supply of Turbo-generator with Triveni Engineering & Industries Limited)

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

25 y 0 m

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:

Not Applicable

C.2.1.2. Length of the first crediting period:

Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/04/2010 or the date of registration of the project activity whichever is later

C.2.2.2. Length:

10 y 0 m

SECTION D. Environmental impacts

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

As per the requirements of Indian Government policy under the Environmental (Protection) Act 1986 promulgated a notification on 27 January 1994 (amended on 04/05/1994, 10/04/1997, 27/01/2000and 13/12/2000), VSIPL has conducted an Environmental Impact Assessment (EIA) study in order to predict the cause-condition effect-relationship of the project activity on the environment. EIA study helps in justifying projects sustainability as well as provides with mitigation and management plan to abet the negative impact and enhance the positive ones. The project activity is located within the plant premises of VSIPL. The electricity generated from the project activity will be consumed within the manufacturing facility of VSIPL only.

The study primarily includes identifying the key environmental parameters and evaluating the impact of the project activity on these parameters throughout its lifetime. The same has been broadly classified during three distinct phases of the project activity implementation namely,

- Impacts during Construction Phase
- Impacts during Operational Phase
- Impacts during Maintenance Phase

Construction Phase: During this phase, erection of the equipments such as Boiler, Steam turbo generator, installation of other equipments of the power plants takes place which will have minor impact on the following parameters as mentioned below.

Parameters	Impacts	Remedial Measures
Air	During this phase there will be marginal increase in the dust emission level due to the installation and erection of the equipments.	This will be of very short term, confined to the plant site and can be kept under control.
Soil	The construction activity will involve site levelling operations, site preparation and erection of utilities which will result in a minimal quantum of soil movements. However the same	These minor impacts are expected to stabilize during the operational phase of the project activity. So specific remedial measures need not be taken.

	will be for a very short spell of time and therefore the impacts are not considered to be significant.	
Noise	Site preparatory work and erection of various equipments will slightly increase the soil level to some extent. But the same will be confined to the plant premises.	The power house building will be constructed with sound proof walls to keep the noise within acceptable limits. Furthermore the equipments will be provided with silencers to keep the noise level within permissible limits.

Operational Phase: During operational phase, the project activity will utilise the heat content of the waste gas of the DRI kilns to generate power. The following impacts are envisaged during the operational phase of the project activity.

Parameters	Impacts	Remedial Measures
Air Quality	The project activity envisages generation of power through utilization of heat content of the waste gases of the DRI kilns. This will replace fossil fuel combustion and hence emissions related to it thus improving the Air Quality. Sufficient amount of ash will be generated which will affect the air quality to some extent.	An electrostatic precipitator is envisaged to reduce the outlet dust concentration to 100 mg/Nm^3. Furthermore to take care of the SO_2 emissions the stack height has been arrived as per the pollution control board norms based on the sulphur content in the fuel used in the AFBC boiler. Provisions have also been made for disposal of ash generated.
Solid Waste Management	All solid wastes will be dumped in a systematic manner and hence the land will not be polluted by the project activity.	Systematic dumping will result in minimal influence on the land environment.

Noise Generation	Due to the presence of rotating equipments like the turbo generator, ID, FD and PA fans the noise level is expected to rise. However the same is likely to be confined within the plant premises thereby minimizing the impacts on the local habitat.	The rotating equipment in the plant is designed in such manner so as to keep the noise level upto 85 to 90 db as per the requirements of Occupational Safety and Health Administration Standards. In addition to this the start-up vent, safety valve outlets and the hogging ejector will be provided with silencers. The turbine will also be provided with acoustic enclosure.
Water Pollution	Water generated from the plant will be utilized in the plant premises itself. Surface water contamination may take place from the effluents of the water treatment plant, boiler blowdown and sewage from power plant buildings.	Drained water from the water treatment plant will be pumped to a neutralization pit so that the resulting PH is 7.0 *i.e.* the water let out is neutral. Continuous as well as intermittent blowdown is done to maintain the quality of boiler feed water. Sewage from various buildings in the plant will be conveyed through separate drains to the septic tank. The effluents from the septic tank will be disposed off into soil by providing disposing trenches thereby restricting the possibility of ground water contamination.

Maintenance Phase: : An annual shut down of the power plant will be planned every year for ensuring proper maintenance of the power plant equipment. Since this will be for a very short span of time of about 35 days a year, hence no significant environmental impacts are envisaged during this phase.

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

The above evaluation clearly describes that the project activity is a cleaner mean of power generation which will reduce the dependency of VSIPL on fossil fuel (coal) based power generation. Furthermore, by utilising the heat content of waste gas, which otherwise would have been wasted, the project activity will reduce thermal pollution of the local environment. Therefore the project activity primarily has only positive environmental impacts. However the project performance will be monitored as a part of the regular Environmental Management Plan of VSIPL and negative impacts, if any, will immediately be taken care off.

SECTION E. Stakeholders' comments

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

Stakeholder consultation is an integral part of every project activity. The management of VSIPL being responsible citizens of India carried out the stakeholder consultation in a phased manner as follows:

1. Identification of stakeholders
2. Notification to the stakeholders
3. Compilation of the comments

All the possible stakeholders have been identified and have been communicated about the project activity through written notification and requested to provide their feedback for the same. Their comments have been addressed at the Management level and appropriate measures have been undertaken. VSIPL identified the following stakeholders for their project activity.

- Village Panchayet
- Employees of VSIPL
- Local Trade Union

E.2. Summary of the comments received:

Table-E.1: Summary of Stakeholder Consultation

Sl No.	Name of Stakeholders	Feedback	Status
Comments received from Non-Governmental Parties			
1.	Village Panchayat	The Village Panchayat has acknowledged the positive socio-economic and environmental impacts of the project activity. They commended VSIPL's initiative of implementing the project activity without causing any population dislocation and their role in generating local employment opportunities. They have assured their support to the Management of VSIPL.	VSIPL Management has received a written consent from the Village Panchayet for the project activity.

Table-E.1: Summary of Stakeholder Consultation			
Sl No.	Name of Stakeholders	Feedback	Status
2.	Employees of VSIPL	The employees have realized the positive attributes of the project activity. They have appraised the Management's decision to implement the project activity and assured their support for the same.	The VSIPL Management has received a written consent from the employees for the project activity.
3.	Local Trade Union	The trade union has appreciated the initiative of VSIPL towards socio-economic development of the locality and their commitment towards developing an environment friendly manufacturing process.	VSIPL Management has received a written consent from the trade union for the project activity.

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

Vision Sponge Iron Private Limited (VSIPL) has so far received only positive feedbacks on the project activity from all the stakeholders. All the comments received, so far, have been positive and given due consideration while preparing the CDM Project Design Document.

Furthermore, as per the requirement of UNFCCC, the CDM Project Design Document will be web-hosted on the DOE's (Designated Operational Entity) website for a period of one month for global stakeholder consultation. The comments received by the Validator during the period of global stakeholder consultation will be properly addressed as a part of CDM process.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Vision Sponge Iron Private Limited
Street/P.O.Box:	227, A.J.C Bose Road, Kolkata-700020
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Telephone:	+91-33-2287 1180/2287 5487
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E-Mail:	visionsponge@yahoo.co.in
URL:	
Represented by:	
Title:	Director
Salutation:	Mr
Last Name:	Jhunjhunwala
Middle Name:	
First Name:	Sandeep
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for the project activity.

Annex 3

BASELINE INFORMATION

Computation of Emission Reductions				
Parameter	Parameter	Unit	Value	Comments/ Assumptions
Computation of Baseline Emissions				
Determination of f_{cap}				
Production by process (i.e. sponge iron manufacturing) that most logically relates to waste gas generation in baseline for the 1st & 2nd kiln	$Q_{BL,product,1,2}$	Tonnes/annum	30445	Actual Production Data
Amount of waste gas the industrial facility generates per unit of product (i.e. DRI) generated by the process (i.e. sponge iron manufacturing) that generates waste gas	$q_{wcm,product,1,2}$	Nm^3/tonne	6240	Considering waste gas flow of 26000Nm^3/Hr per kiln Manufacturer's Specification
Quantity of waste gas generated prior to the start of the project activity for the 1st & 2nd kiln	$Q_{WCM,BL,1,2}$	Nm^3	189977337	
Quantity of waste gas used for energy generation during year y in the 1st & 2nd kiln	$Q_{WCM,y,1,2}$	Nm^3	374400000	Maximum waste gas production possible from the two kilns assumed ex-ante
Energy that would have been produced in project year y using waste gas generated in base year expressed as a fraction of total energy produced using waste gas in year y	$f_{cap,1,2}$		0.51	
Production by process (i.e. sponge iron manufacturing) that most logically relates to waste gas generation in baseline for the 3rd, 4th & 5th kiln	$Q_{BL,product,3,4,5}$	Tonnes/annum	90000	Considering a capacity of 100 tpd and 300 working days of DRI kiln based on Manufacturer's Specification

Computation of Emission Reductions				
Parameter	Parameter	Unit	Value	Comments/ Assumptions
Amount of waste gas the industrial facility generates per unit of product (i.e. DRI) generated by the process (i.e. sponge iron manufacturing) that generates waste gas	$q_{wcm,product,3,4,5}$	Nm^3/tonne	6240	Considering waste gas flow of 26000Nm^3/Hr per kiln Manufacturer's Specification
Quantity of waste gas generated prior to the start of the project activity for the 3rd, 4th & 5th kiln	$Q_{WCM,BL,3,4,5}$	Nm^3	561600000	
Quantity of waste gas used for energy generation during year y in the 3rd, 4th & 5th kiln	$Q_{WCM,y,3,4,5}$	Nm^3	561600000	Maximum waste gas production possible assumed ex-ante
Energy that would have been produced in project year y using waste gas generated in base year expressed as a fraction of total energy produced using waste gas in year y for the 3rd, 4th & 5th kiln	$f_{cap3,4,5}$		1	
Determination of f_{WG}				
Capacity of the TG		tonnes/MWh	4.5	TG specification
Gross power generation from WHRB		kWh/annum	53222400	Considering a capacity of 8.4MW and 300 operational days
Gross power generation from AFBC		kWh/annum	45999360	Considering a capacity of 6.6MW and 330 operational days
Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of all the DRI kilns and fed to turbine via common steam header	$ST_{WHR, y}$	kCal	196864867584	Considering a steam temperature of 520^{0}C and a pressure of 88kg/cm^2
Energy content of steam generated in AFBC boiler fed to turbine via common steam header	$ST_{AFBC,y}$	kCal	1.70147E+11	Considering a steam temperature of 520^{0}C and a pressure of 88kg/cm^3
Total quantity of steam (in kCal) enterimg into	ST_{tot}	kCal	3.67012E+11	

Computation of Emission Reductions				
Parameter	Parameter	Unit	Value	Comments/ Assumptions
the common header				
Energy content of the steam generated in each Waste Heat Recovery Boiler with the heat content of the waste gas of the DRI kilns and fed to turbine via common steam header		kCal	39372973517	
Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the DRI kilns (1&2) and fed to turbine via common steam header	$ST_{WHR\ 1,2,y}$	kCal	78745947034	
Energy content of the steam generated in Waste Heat Recovery Boilers with the heat content of the waste gas of the DRI kilns(3,4&5) and fed to turbine via common steam header	$ST_{WHR\ 3,4,5,y}$	kCal	1.18119E+11	
Fraction of total electricity generated by the project activity using waste gas from the 1st & 2nd DRI kilns	$f_{wcm1,2}$		0.215	
Fraction of total electricity generated by the project activity using waste gas from the 3rd, 4th & 5th DRI kiln	$f_{wcm3,4,5}$		0.375	
Determination of $EF_{Eleci,j,y}$				
CO_2 emission factor per unit of energy of the fossil fuel (coal) used in the baseline generation source i	$EF_{CO2,is,j}$	tCO_2/TJ	96.1	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Overall efficiency of the existing plant that would be used by jth recipient in the absence of the project activity	$n_{Plant,j}$		0.28	Highest of the efficiency values provided by two or more manufacturers for power plants with specifications similar to that which would have

Computation of Emission Reductions				
Parameter	Parameter	Unit	Value	Comments/ Assumptions
				been required to supply the recipient with electricity that it receives from the project activity
CO_2 emission for the electricity source i (i.e. the coal based captive power plant), displaced due to the project activity during the year y	$EF_{elec,i,j,y}$	tCO_2/MWh	1.236	
Determination of $EG_{i,j,y}$				
Quantity of electricity supplied to the recipient *j* by generator which in the absence of the project activity would have been sourced from the i^{th} source (*i.e.* the coal based captive power plant) during the year y	$EG_{i,j,y}$	MWh	99222	
Baseline Emissions during the year y attributable to the waste heat of the 1st & 2nd DRI kiln		tCO_2	13347	
Baseline Emissions during the year y attributable to the waste heat of the 3rd, 4th & 5th DRI kiln		tCO_2	45973	
Total Baseline Emission during the year y	BE_y	tCO_2	59320	
Project Emissions during the year y	PE_y	tCO_2/annum	0	
Emission Reductions resulting from the project activity during the year y	ER_y	tCO_2/annum	59320	

Annex 4

MONITORING INFORMATION

Please refer to Section B.7.2