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

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

>>

The title of the project activity: Direct reduction iron production by utilising Coke Oven Gas (COG) in Hebei Province, China
The current version number of the document: Version 1.0
The date of the document was completed: 13/02/2009

A.2. Description of the project activity:

>>

Project Summary

Beris Engineering and Research Corporation has been conducting technological development to utilize waste coke oven gas (COG), with the background that China has promoted policies on energy efficiency and environmental protection. With an advantage of abundant natural resources that lie in Hebei Province, the company focused on developing a technology for iron & steel sector, the key industry in the Province, to improve energy efficiency and mitigate greenhouse gas emissions, which was successfully developed.

Specifically, and firstly, the technology replaces reducing agent in iron-making process from coke, the agent used for integrated blast furnace-converter approach which is most common in China, to waste COG. Direct reduced iron reduced with any reducing agent including COG is also known as sponge iron and used as raw material for crude steel production with electric arc furnace (EAF). Therefore, this project establishes a direct-reduced iron manufacturing factory with annual production of 170 kt, in cooperation with a private company in Tangshan City, Hebei Province, whose coke production is 1,200 kt/yr. This plant size is adequately determined based on COG supply volume. Sponge iron produced in this factory is taken to an EAF to be used as raw material for crude steel production.

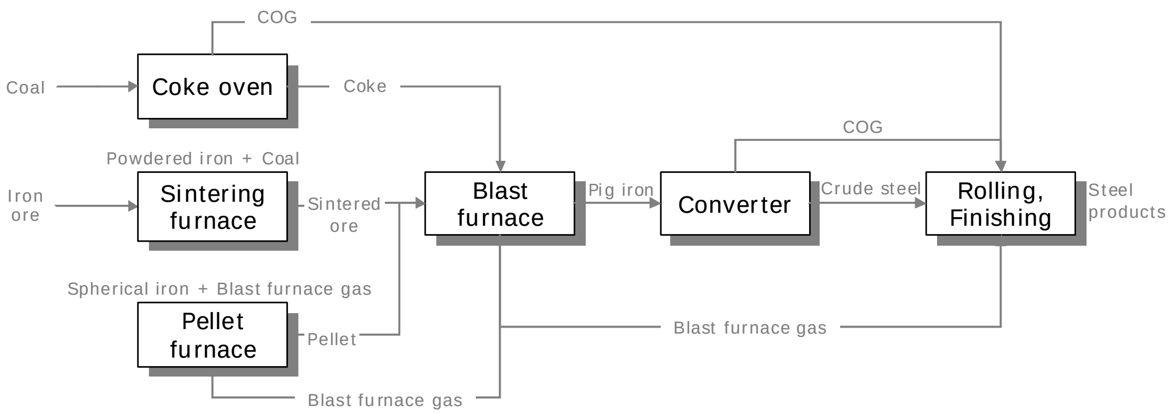

Figure 1 Integrated blast furnace-converter steelmaking process

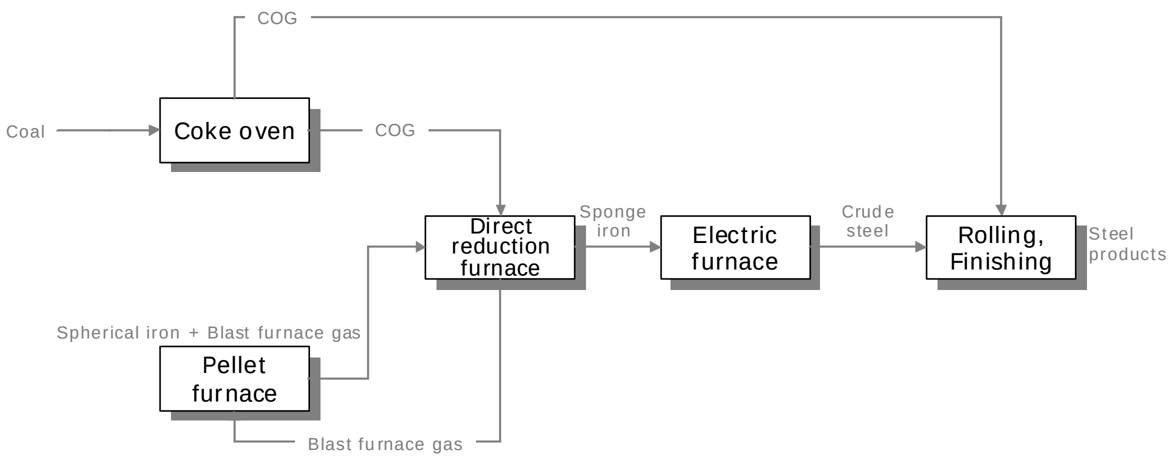

Figure 2 Direct reduction furnace-electric arc furnace steelmaking process

Secondly, in addition to replacement of reducing agent from coke to COG, this technology changes production method from integrated blast-furnace-converter steelmaking to more energy-efficient direct reduction furnace (DRF)-EAF steelmaking. Integrated blast furnace-converter steelmaking approach is the most common one in the host country and emits 1,818 kgCO2 per ton of crude iron production. On the other hand, with DRF-EAF approach reduces CO2 emission by half to 1,099 kgCO2 per ton of crude iron production: a reduction of 719 kgCO2/t can be expected. Therefore, this project will achieve an emission reduction from the difference of emission intensities and the crude steel production. With the assumption that DRF produces 170 kt/yr of direct reduction iron, considering COG generation to be supplied, 111,114 tCO2/yr can be expected in this project.

This project is to produce crude steel with more environmentally-efficient DRF-EAF steelmaking approach by utilizing COG. It will also contribute to save coke resource, to reduce energy consumption and emissions of polluting agents in crude steel production processes, as well as for China's sustainable development.

Background

In China, energy consumption has rapidly grown in recent years, which is far beyond the growth of energy sources development. China has been a net-importer since early 1990s and energy self-sufficiency in 2005 is approx. 92%. The Government of China strengthens development of energy sources in the country along with promoting energy efficiency: such policies were presented in the Eleventh Five-year Plan, released in March 2006, putting considerable emphasis on energy saving and environmental protection.

As for iron & steel industry, significant increase of production has been observed in China in recent years. Crude steel production in 2007 was increased by 15.7% from the previous year to 489 Mt, which accounts for 36.4% of world total. Hebei Province, where this project site is located, is the centre of crude steel production in China, with 74.25 Mt of production in 2005, which is the largest share of crude steel production in the country.

Integrated BF-converter steelmaking dominates crude steel production in China and thus demand for coke, a common reducing agent for this approach, has also been on upward trend. Hebei Province where project site is located is in chronic shortage in coke: in 2007, demand for coke (52.4 Mt) exceeded coke production (39.39 Mt), and thus coke is purchased from neighbouring provinces to offset the shortage. Moreover, as for EAF steelmaking which uses no coke but iron scrap as raw material, it has been difficult to obtain iron scrap in the market due to lack of scrap supply. Considering such situations, this project, in terms of using COG that remains unused in the industry, will contribute to improve the current situations in energy scarcity and the shortages of coke for BF-converter steelmaking and raw material for EAF steelmaking.

Pellet is reduced with COG to produce sponge iron that is used for crude steel production in EAF. Advantages of EAF steelmaking, comparing with converter steelmaking, are to take shorter time for production, less energy consumption, less pollutant generation, and lower environmental cost.[1] Reflecting this fact, EAF steelmaking has been increasing globally in recent decades, which now accounts for 33% of iron & steel production in the world.[2] However, in China, EAF steelmaking is not well disseminated due mainly to lack of raw materials, with the share of below 16% of national total.

Under such situations, Beris Engineering and Research Corporation has continued to conduct R&D and successfully developed direct reduction approach that uses waste COG as reducing agent for pellet.

As for COG, the reducing agent which Beris Engineering and Research Corporation focused on, most part is treated by flaring and not effectively utilized in China. This technology replaces the traditional reducing agent (coke) to COG, which improves environmental advantages in EAF steelmaking. In terms of effective resources use, direct reduction iron-making process using DRF approach is a matured technology in which considerable volume of COG is utilized. Therefore, this technology will also contribute China's sustainable development in its economy.

Method of CO2 Reduction

This project intends to reduce CO2 emissions by improving intensity in crude steel production. Currently, integrated blast furnace-converter steelmaking is the most common approach in China, including Hebei Province. Replacing it to less CO2 emitting approach, i.e. direct reduction furnace (DRF) method, will contribute to reduce CO2 emissions in this project.

Figure 3 shows specific energy consumption for each process of integrated blast furnace-converter steelmaking and DRF approach. If converted the values into CO2, emissions are 1,818 kgCO2/t-crude steel for integrated steelmaking and 1,099 kgCO2/t-crude steel for DRF approach: overall, CO2 emission reduction under this project can be assumed as 719 kgCO2/t-crude steel.

---

[1] According to a statistics, EAF steelmaking is more environmentally beneficial by 60% in energy consumption, 40% in water consumption, 86% in waste gas emissions, 76% in waste water discharge, and 97% in slag emissions, than converter steelmaking.

[2] Ratio of electric arc furnace to national total of crude steel production by country: USA: 50%, Korea: 45%, Germany: 30%, Japan: 28%, India: 46%

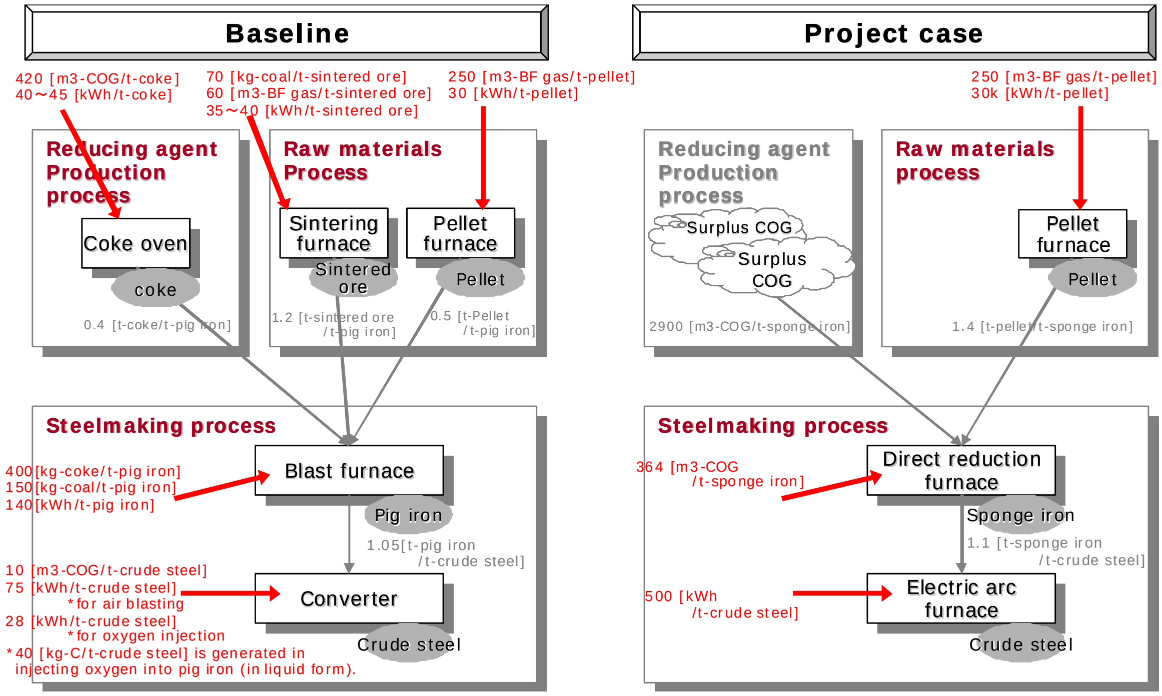

Figure 3 Comparison of energy consumptions between baseline and project case[3]

Environmental Impact and Sustainable Development

The purpose of this project is to introduce direct reduction furnace approach which has less CO2 emission in crude steel production. This approach also leads to improve recycling rate of iron pellet generated from integrated blast furnace-converter steelmaking and to effectively utilize coke oven gas (i.e. coke resource).

Besides conservation of natural resources, some positive effects can be expected in this project to improve the environment. In integrated BF-converter approach, there are emissions of sulphur dioxide (SO2), nitrogen oxide (NOx) and dust, usually in the air, in iron-ore sintering and coke production processes, which are eliminated in this project. Moreover, in DRF approach, sulphur content emitted from operation stays inside of sponge iron, making final disposal easier. Therefore emissions of these pollutants are expected to be reduced. In addition, integrated BF-converter approach needs considerable volume of water in pig iron production process, which will also be improved in this project.

Moreover, this project has received positive comments from Hebei Province Department of Environment Protection, the China Iron & Steel Association and Hebei Coke Industry Association, which administer this project, saying that they consider this project well efficient in terms of subsidiary use of COG as reducing agent in addition to its conventional usage as energy sources, and are willing to give their supports.

[3] Based on the data provided by a local counterpart.

A.3. Project participants:

>>

Table 1 Project participants

Name of Party involved	Private and/or public entity (ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as a project participant
China (host)	Private entity: Tangshan City Zhengnan Burut Limited Company	No
China (host)	Public entity: Beris Engineering and Research Corporation	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

The project activity takes place inside of the Zhengnan Burut site with new build-up furnace. The location of the Zhengnan Burut is outlined below:

Zhengnan Burut:
Houyujiadiancun, Yuehezhen, Kaiping, Tangshan City, Hebei Province, P.R. China

A.4.1.1. Host Party(ies):

>>

P.R. China

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

>>

Hebei Province

A.4.1.3. City/Town/Community etc.:

>>

Houyujiadiancun, Yuehezhen, Kaiping, Tangshan City

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

>>

This project will be implemented at Tangshan City Zhengnan Burut Limited Company in Tangshan City, approx. 150 km east from Beijing. The project starts with construction of a direct reduction furnace. Coke oven gas (COG) will be supplied from Tangshan City Zhengnan Burut Limited Company which is to be the project site.

In the meantime, sponge iron to be produced in this project site will be provided to an electric arc furnace located nearby to be used as raw material for crude steel production.

Figure 4 Project location

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

>>

The project activity is a steel sector specific project activity. The project activity is categorized in

Category 4: Manufacturing Industries.

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

>>

This project is characterized by utilizing coke oven gas (COG) for iron-making process to reduce iron pellet in a direct reduction furnace (DRF). Direct Reduction Iron (DRI), the product from this DRF process, is also called as sponge iron. This project includes the processes up to production of crude steel by using DRI as its boundary. The DRF process using COG as reducing agent, which characterizes this project, is as described below:

Constituents of COG are H_2 (58-60%), CO (6-8%), CH_4 and C_mH_n (25-28%) and small amount of N_2, CO_2 and H_2O. In order to simplify the production process, only CO and H_2 contained in COG are to be used in the basic method, without conducting thermal decomposition of CH_4 in COG.

COG, after being pressurized to 0.2-0.25MPa in a pressurizer, is heated to 950℃in a ball-type hot oven and then, via thermal gas pipe, sent to a circular pipe at the bottom of DRF. This circular pipe has a lot of nozzles on the surface from which COG flows into DRF to reduce pellet.

After reducing, top gas is at a temperature of approx. 400℃and pressure of 0.04MPa. It flows through ascending and descending pipes of DRF to gravity dust remover where dust contained is removed, and then is cleared in a Venturi tube. When dust content reaches 10mg/m3 of and temperature at 30℃-40℃, most of the H2O, generated during reducing process in the top gas, is condensed and precipitated: H2O content at this stage is equivalent to saturated water content at the temperature of 30℃. Top gas is used partly for combustion of the hot stove or flowed back to coke oven to heat it, while some other part flows through piping network to be used for fuel of industrial furnace.

Raw material for reducing process is pellet with 66% of iron content. Iron pellet is charged into DRF from top of the furnace with hoist crane. Taking for approx. six hours in reducing process in the DRF, the iron pellet transforms to direct reduced iron (DRI), which is treated with cutting machine and put into a tundish. At the bottom of the tundish there is upper sealing valve: open the valve when molten DRI reaches 600-700℃ to charge DRI into a cooling tank, and then turn it off. At the same time, cleaned and cooled top gas is input from lower part of the cooling tank. When the gas reaches approx. 400℃, exhaust it from top of the tank and then cleaned in Venturi tube.

In the meantime, the DRI is cooled in the cooking tank and reaches 100℃or lower, shut both valves from which top gas is charged/discharged, open the lower sealing valve at bottom of the cooling tank to discharge the cooled DRI to outside of DRF. The DRI is transported to an electrical furnace for crude steel production.

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

>>

In this CDM project, the renewable crediting period has been chosen. Estimated amount of emission reductions over the crediting period are as follows:

Table 2 Estimated amount of emission reductions over the chosen crediting period

Years	Annual estimation of emission reductions in tonnes of CO2e
2010	111,114
2011	111,114
2012	111,114
2013	111,114
2014	111,114
2015	111,114
2016	111,114
2017	111,114
2018	111,114
2019	111,114

Total estimated reductions (tonnes of CO2e)	111,1136
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	111,114

In addition, as the crediting period will be from 01/01/2010 or after the date of registration (whichever is later) to 31/12/2019.

A.4.5. Public funding of the project activity:

>>
No public funding or official development assistant (ODA) has been used on this 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:

>>
The approved methodology applied by this project is referenced as AMxxxx (Version 01), “Consolidated Baseline Methodology for xxxx” and “Consolidated Monitoring Methodology for xxxx”.

According to the requirements of AMxxxx / Version 01, “Tool for the demonstration and assessment of additionality (Version 04)” and “Tool to calculate the emission factor for an electricity system” agreed by CDM Executive Board is used during the baseline identification process and the baseline and project emission calculation process in the project activity.

For more information please refer to the UNFCCC CDM-Executive Board website under the following link: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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

>>
This methodology is applicable to projects that COG is utilized as reduction agent in iron-making process and transfer to Direct-Reduction process with high energy-efficiency from Blast-Furnace / Converter process. The methodology is applicable under the following conditions:

- The project activity is using sponge iron through direct reduction approach using coke oven gas as a reducing agent. (Condition 1)
- Sponge iron, produced with a direct reduction approach, is utilized for producing crude iron with an electric furnace. (Condition 2)
- When there is no project activity, COG, which is to be used for the project activity, should have been flared or used as an alternative of city gas. (Condition 3)

When flared, this shall be proven by one of the following:

a. By direct measurements of the amount of COG flared for at least three years prior to the start of the project activity, or as long as the coke plant has been in operation.

b. Energy balance of relevant sections of the coke plant to prove that the COG supplied to the project activity is not a source of energy before the implementation of the project activity. For the energy balance the representative process parameters are required. The energy balance must demonstrate that the COG is not used and also provide conservative estimations of the energy content and amount of COG released.

c. Process plant manufacturer’s original specification/information, schemes and diagrams from the construction of the facility, if endorsement is obtained from a third party expert, can be used as an estimate of quantity and energy content of surplus COG produced for rated plant capacity/per unit of product produced.

When COG is utilized as energy, either of those below should be adopted:

a. After COG is utilised for producing sponge iron with direct reduction approach, it is used for energy resource.

b. After COG is utilised for producing sponge iron with direct reduction approach, it is delivered to energy supplier in the region as an energy resource such as city gas.

That the actual situation corresponds to the specifications must be ascertained through on site checks by a DOE prior to project implementation.

In the producing process of crude steel in the region where the project is conducted,

▪a blast furnace and converter are connected in a single process is adopted in general, or the processes of producing pig iron and crude steel and steelmaking are implemented in a single premises or a single industrial estate. (Condition 4)
▪in a single province or a designated region, the production rate of crude steel with a single process of a blast furnace and converter, connected is over 50%. (Condition 5)

The demonstration below justifies the choice of AMxxxx / Version 01 for this project activity. China is a huge country, and it is difficult to understand the situation of the entire country about steel industry and the COG usage in the project activity in full detail. Moreover, as described later, the steel demand / production in Hebei Province is very large, and enough for considering it as one country. It is the current status that there is little importing/exporting steel from/to the other provinces or the other countries. Therefore, the demonstration below justifies the applicability condition in Hebei Province.

▪ The project activity is using sponge iron through direct reduction approach using coke oven gas as a reducing agent. (Condition 1)

This project is to utilize COG which is generated in and provided by Tangshan City Zhengnan Burut Limited Company as a reducing agent to produce direct reduction iron (sponge iron) in DRF. Therefore, this project satisfies this condition.

▪ Sponge iron, produced with a direct reduction approach, is utilized for producing crude iron with an electric furnace. (Condition 2)

This project is to utilize sponge iron, produced in DRF process, as a raw material for crude steel production in an electrical furnace. Therefore, this project also satisfies this condition.

▪ When there is no project activity, COG, which is to be used for the project activity, should have been flared or used as an alternative of city gas. (Condition 3)

When flared, this shall be proven by one of the following:

a. By direct measurements of the amount of COG flared for at least three years prior to the start of the project activity, or as long as the coke plant has been in operation.

b. Energy balance of relevant sections of the coke plant to prove that the COG supplied to the project activity is not a source of energy before the implementation of the project activity. For the energy balance the representative process parameters are required. The energy balance must demonstrate that the COG is not used and also provide conservative estimations of the energy content and amount of COG released.

c. Process plant manufacturer's original specification/information, schemes and diagrams from the construction of the facility, if endorsement is obtained from a third party expert, can be used as an estimate of quantity and energy content of surplus COG produced for rated plant capacity/per unit of product produced.

When COG is utilized as energy, either of those below should be adopted:

a. After COG is utilised for producing sponge iron with direct reduction approach, it is used for energy resource.

b. After COG is utilised for producing sponge iron with direct reduction approach, it is delivered to energy supplier in the region as an energy resource such as city gas.

That the actual situation corresponds to the specifications must be ascertained through on site checks by a DOE prior to project implementation.

When there is no project activity, COG, which is to be provided by Tangshan City Zhengnan Burut Limited Company for a use in this project, should have been used for energy source as an alternative of city gas.

When COG is used as an alternative of city gas, approx. 3,800 kcal/m3 is required. On the other hand, in this project activity, only H2 contained in COG is mainly used as a reducing agent, so that there would basically be no thermal reduction occurred. Therefore, this project also satisfies this condition.

▪ a blast furnace and converter are connected in a single process is adopted in general, or the processes of producing pig iron and crude steel and steelmaking are implemented in a single premises or a single industrial estate. (Condition 4)

In Tangshan area, Hebei Province, China, where the project activity is implemented, Tangshan Iron & Steel is the giant of the industry, enjoying largest share of production in the Province. Tangshan Iron & Steel adopts the integrated blast furnace-converter steelmaking process under which pig iron, crude steel are produced within the same premises of the company. Therefore, this project also satisfies this condition.

▪ in a single province or a designated region, the production rate of crude steel with a single process of a blast furnace and converter, connected is over 50%. (Condition 5)

Hebei Province is the center for crude steel production in China, as its richness in mineral reservoirs such as iron ore and coal. Hebei's crude steel production in 2005 was 74.25 Mt/yr, which is the largest share in China.

Table 4 shows production volume by process of crude steel production. As for crude steel production process, converter approach accounts for approx. 90% of total, which suggests that this is the most common steelmaking approach in China. Therefore, this project also satisfies this condition.

Table 3 Production of crude iron and pig iron by province

Province	Crude iron [10,000ton]				Pig iron [10,000ton]			
	2004		2005		2004		2005	
Hebei	5,641	*21%*	7,425	*21%*	5,284	*21%*	6,841	*20%*
Changsu	2,223	*8%*	3,301	*9%*	1,664	*7%*	2,697	*8%*
Shandong	1,855	*7%*	3,188	*9%*	1,874	*7%*	3,217	*9%*
Liaoning	2,596	*10%*	3,059	*9%*	2,526	*10%*	3,114	*9%*
Other	14,965	*55%*	18,606	*52%*	13,837	*55%*	18,604	*54%*
Total	27,280	-	35,579	-	25,185	-	34,473	-

Source: China Iron & Steel Industry 2008

Table 4 Production of crude iron by making process in China

Process	2000	2001	2002	2003	2004	2005
Converter	-	12,602	15,168	18,332	23,272	31,350
Electric furnace	-	2,401	3,049	3,906	4,167	4,179
Other	-	5.3	6.7	3.7	31.8	50.5
Total	12,850	15,163	18,225	22,234	27,280	35,579

Source: China Iron & Steel Industry 2008

Table 5 Production, sales and import of Cokes in Hebei Province (2007)

Cokes	Production [kt/yr]	Sales [kt/yr]			Import [kt/yr]	
		Hebei Province	Other Provinces	International Export	Other Provinces	International Import
2005	24,853	24,842	-	11	-	-
2006	32,091	31,987	-	104	-	-
2007	39,389	39,337	-	52	-	-

Source: Websites of Office of Statistics and Office of Commerce, Hebei Province, China

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

>>

The project boundary includes CO2 only generated in coke production process and iron-making process.

The table below describes which emission sources and gases are included in the project boundary for the purpose of calculating project emissions and baseline emissions.

For reference, there is no leakage in the project boundary.

Table 6 Sources and gases included in the project boundary

Source		Gas	Included?	Justification / Explanation
Baseline	Coke oven	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Sintering furnace	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Pellet furnace	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Blast furnace	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Converter	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	Pellet furnace	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source will be negligible.
		N_2O	No	Excluded for simplification. This emission source will be negligible.
	Direct reduction furnace	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source will be negligible.
		N_2O	No	Excluded for simplification. This emission source will be negligible.
	Electric arc furnace	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source will be negligible.
		N_2O	No	Excluded for simplification. This emission source will be negligible.

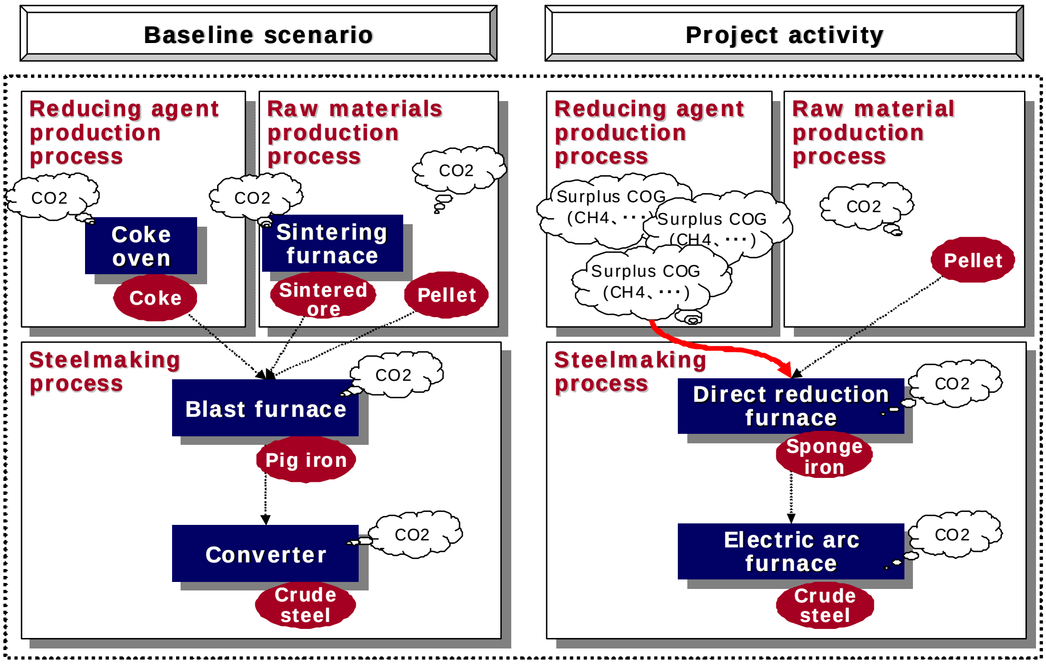

Figure 5 Project boundary

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

>>

Identification of the baseline scenario

In this section, all candidates are listed for selection of the most realistic and plausible baseline scenario for this project. Baseline scenario for COG utilization and that for crude steel production methodology are considered separately, listing candidates for each respectively.

Baseline scenario related to the use of COG

In China, COG is flared or utilized as secondary energy, while being subject to regulation for non-treatment discharge to the air. Therefore, possible options for baseline scenario related to the use of COG are as shown below:

COG-A: Continued flaring of COG at the coke producing facilities.
COG-B: Recovery, processing and distribution of COG outside the project boundary into a fuel/a useful product other than DME (e.g. methanol, ammonia, hydrogen, town gas, SNG)
COG-C: COG used for energy purposes (alternative of city gas, power generation, etc.) (continuation of present COG use)
COG-D: COG used as a reducing agent for the production of sponge iron (not as the CDM project activity)

COG generated from Tangshan City Zhengnan Burut Limited Company has been supplied as an alternative of city gas (COG-C) to gas operators in exchange of money. Therefore, flaring (COG-A), which brings no benefit, is not attractive from economic viewpoint, so that there is no factor to assume it as a future baseline scenario.

In the meantime, as for DME alternative (COG-B), there is no facility or infrastructure established for COG reformation near the project site. Even if reformation can be done in future, it basically needs higher cost comparing to another energy-use option with no reformation (COG-C), which means that COG-B is less attractive in an economic sense under the situation whereCOG-C is feasible. Therefore, COG-B cannot be adopted as a baseline scenario.

As for COG-D, a financial analysis indicates that this option is not worth investing as long as no revenue is generated from selling credits (see B.5). Therefore, this option cannot be a baseline scenario.

As described above, regarding utilization of COG, the option COG-C is identified as the baseline scenario. For reference, emissions from energy use outside the project boundary are not calculated because there is no difference in calculated results between baseline scenario and project scenario.

Baseline scenario related to the methodology of producing crude steel

In general, the following three options are candidates for the scenario of steelmaking (production of crude steel):

CSTL-A: steelmaking by blast furnace-converter (BF-C) approach using coke;
CSTL-B: steelmaking by electric arc furnace (EAF) with iron scrap as raw material; and
CSTL-C: direct reduction steelmaking (using natural gas as reducing agent).

The majority of China's crude steel production is from integrated BF-C steelmaking method (CSTL-A). Iron scrap, the major raw material for EAF steelmaking process (CSTL-B) is something that is difficult to obtain in the market due to excess demand. Moreover, direct reduction steelmaking (CSTL-C) accounts for a small portion of production due mainly to technological barriers.

Table 7 Production of crude iron by making process in China (reshown)

Process	2000	2001	2002	2003	2004	2005
Converter	-	12,602	15,168	18,332	23,272	31,350
Electric furnace	-	2,401	3,049	3,906	4,167	4,179
Other	-	5.3	6.7	3.7	31.8	50.5
Total	12,850	15,163	18,225	22,234	27,280	35,579

Source: China Iron & Steel Industry 2008

Tangshan City Zhengnan Burut Limited Company supplies 90% of coke production to Tangshan Iron & Steel which conducts integrated BF-C steelmaking by using the coke supplied. (The rest 10% is sold to relatively small-scale iron & steel manufacturers which utilize the coke for reduction in blast furnaces). As described, in the region near the project site, too, integrated BF-C steelmaking (CSTL-A) is the dominant approach for steelmaking.

Taking such situations into account, regarding steelmaking (production of crude steel), CSTL-A is identified as the baseline scenario.

Description of the identified baseline scenario

As described above, BF-C steelmaking using coke (CSTL-A), and utilization of COG as energy outside the project boundary (COG-C), constitute the baseline scenario.

BF-C steelmaking using coke (CSTL-A) is a series of iron- and steel-making process, combining productions of reducing agent (in coke oven), raw materials for steel (in pellet furnace and sintering furnace), pig iron (in blast furnace) and crude steel (in converter).

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):

>>

This section describes reasoning and its basis to prove additionality by using an additionality tool. The additionality tool used is the “Tool for the demonstration and assessment of additionality (version 05.2)”, developed by CDM Executive Board (EB).

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

The most realistic and plausible alternative option for a project activity was identified based on the following Sub-steps.

Sub-step 1a: Define alternatives to the project activity:

Define the most realistic and plausible alternative which is acceptable to project participants or project developers who provide goods and services, as an option comparable to the proposing CDM project activity. As mentioned in B.4., acceptable alternatives are limited to the followings:

- Project activity proposed in the state not being registered as a CDM project activity; or
- BF-C steelmaking using coke (CSTL-A) and COG use as energy (COG-C).

As fore-mentioned, COG use as energy (COG-C) is outside the project boundary so that project activity and its alternative give no effects on COG utilization/disposal methodology, which is therefore not included in investment analysis. Investment analysis here is conducted concerning sponge iron production which is the core of this project activity (Step 2).

Sub-step 1b: Consistency with mandatory laws and regulations:

In Hebei Province, China, general processes of coke production and steelmaking should satisfy all relevant laws and regulations, which means that it is not excluded as the baseline scenario.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

The alternative, which was identified with CDM project activity and the above “Step 1”, generates economic benefit other than revenues related to the CDM. Therefore, “the simple cost analysis (Option I)” cannot be applied to it.

In this case, the benchmark analysis (Option III) is applied.

Sub-step 2b: Option III. Apply benchmark analysis

Upon application of the benchmark analysis (Option III), IRR is selected as the financial/economic indicator, for construction/operation of a direct reduction furnace with which project operators make decisions on whether they would invest the project. For benchmark of IRR, an industrial indicator for decision-making on construction ("Methods and Data about Economic Assessment of Construction Projects") is used.

This case refers the following benchmarks.

Table 8 Benchmark for investment decision-making in China's iron & steel industry

Investment recovery period	within 6 years
IRR	Above 20%

Source: Coke Industry Association

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

For construction a plant to produce 170,000 t/yr of sponge iron, it is expected that approx. 36 million Yuan would be needed for initial investment excluding land cost, and that approx. 6 million Yuan for land acquisition.

Table 9 Initial investment

Item	Amount (10,000 Yuan)
Construction works	1,195
Equipment expenses	1,215
Installation works	64
Other	510
Land acquisition	600
Total	3,584

Source: Beris Engineering and Research Corporation

What accounts for a large portion of the production cost is pellet purchase cost which changes depending on supply/demand balance of steel and supply/demand of raw materials in China. Currently, unit price of 1,720 Yuan/t-pellet is assumed reasonable.

Meanwhile, regarding COG that heat quantity remains intact even after utilized as reducing agent, COG purchase cost can be recovered by selling COG for energy purpose, except for a part of COG which is utilized as energy in direct reduction furnace.

Production cost, including other than those aforementioned, is as shown in the table below:

Table 10 Production cost

Item	Unit price	Input usage per unit of sponge iron (/t-sponge iron)	Total (Million Yuan)
Pellet	1,720 Yuan/t	1.4 t	409
COG	0.42 Yuan /m^3	2,900 m^3	207
Electricity	35 Yuan/t-sponge iron	--	6
Water	4 Yuan/t-sponge iron	--	1
Personnel expenses	80 Yuan/t-sponge iron	--	14
Selling, general and administrative expenses	102 Yuan/t-sponge iron	--	17
Total	--	--	654

Source: Beris Engineering and Research Corporation

Seles price of sponge iron is basically lower than prices of pig iron and scrap.

Based on the prices of pig iron and scrap in China before December 2007, specifically 3,400-3,500 Yuan/t and 2,900-3,100 Yuan/t respectively, price of sponge iron is assumed as 3,000 Yuan/t.

After used as reducing agent, COG is partly utilized as energy source while the rest is sold as energy source.

Table 11 Seles price

Item	Unit price	Sales per unit if sponge iron (/t-sponge iron)	Total (Million Yuan)
Sponge iron	3,000 Yuan/t	--	510
COG	0.42 Yuan/m^3	2,080 m^3	149
Total	--	--	659

Source: Beris Engineering and Research Corporation

Financial analysis, based on the above-mentioned values, shows that it will take 8.6 years for recovery of initial investment, despite showing a slight surplus as a project.

In general, the local iron & steel company has their threshold for investment decision-making as “investment recovery within 6 years” or “IRR = 20%,” which means that this project would be determined as “low profitability” under the current situation.

Table 12 Profitability of this project

Initial investment	35.84 M-Yuan
Production	654 Million Yuan/Year
Sales	659 Million Yuan/Year
Profit (before tax)	4.52 M-Yuan/Year
Profit (after tax)	4.16 M-Yuan/Year
Investment recovery period	8.6 Years
IRR	10.2 %

Currently, the lower limit of CER price for CDM projects approved by the Chinese Government is considered around 9 Euros. Taking this into account, the project generates a profit of 13.41 million Yuan/year (before tax: assuming 1 Euro = 128 Yen, 1 Yuan = 14 Yen), which can be obtained over the 8.6-year project period.

In this case, profitability of the project improves, as shown below, making conditions more preferable for investment decision-making.

Table 13 Comparison of project profitability (with/without credit)

	Without profit from credit	With profit from credit
Investment recovery period	8.6 Years	2.9 Years
IRR	10.2 %	33.5 %

Sub-step 2d: Sensitivity analysis (only applicable to Options II and III):

Credit price can be changed in the future reflecting political or market situations. Therefore, sensitivity analysis was conducted.

As shown below, it is not likely that credit price would give effects on investment decision-making, even in the case of plunging credit prices.

Table 14 Changes in IRR depending on credit prices (with credit)

Credit price	5	7	9	11	13

IRR	22.8%	28.2%	33.5%	38.8%	44.1%

Moreover, considering pellet purchase cost accounts for a large share of production cost, sensitivity analysis was conducted, with variations of current pellet price (1,720 Yuan/t).

As result, when price increases only 1%, profitability is decreased to as low as benchmark level, indicating that profitability largely depends on pellet price. However, such price-change risk can be lowered considerably by making long-term purchase contract for pellet as major raw material before the project commences.

Table 15 Changes in IRR depending on pellet price (with credit)

Pellet price (Yuan/t)	1,703 （-1% from current price）	1,720	1,737 (+1% from current price)
IRR	44.8%	33.5%	20.8%

Step 4: Common practice analysis

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

In the past or on-going cases, there have been no other activities similar to the proposing project activity.

As described in Sub-step 3a, baseline scenario is consisted with BF-C steelmaking using coke and COG use as energy, which is the common practice.

In addition, barriers exist with sponge-iron production technology to be used in this project, including:

(1) technological barrier to use it in a wider range
(2) barrier in cost of initial investment and operation

Therefore, this project is enough worth conducting as CDM.

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

No similar project has been conducted.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>
This project employs the new methodology NMxxxx.

<u>Step.1 Baseline emissions</u>

(1) Emissions from coke oven

$$COKEM_{CO2}^{BSL} = COK_{COG\_CO2}^{BSL} + COK_{BFG\_CO2}^{BSL} + COK_{ELE\_CO2}^{BSL} \quad (1)$$

Where:

$COKEM_{CO2}^{BSL}$	kg-CO2/t-coke	CO2 from the coke oven process for producing 1 ton of coke
$COK_{COG\_CO2}^{BSL}$	kg-CO2/t-coke	CO2 from COG combustion for producing 1 ton of coke
$COK_{BFG\_CO2}^{BSL}$	kg-CO2/t-coke	CO2 from BFG combustion for producing 1 ton of coke
$COK_{ELE\_CO2}^{BSL}$	kg-CO2/t-coke	CO2 from electricity consumption for producing 1 ton of coke

CO2 emissions from COG combustion

$$COK_{COG\_CO2}^{BSL} = prm_{COG\_C}^{BSL} / 100 \times COK_{COG}^{BSL} \times 44 / 22.4 \quad (2)$$

Where:

$COK_{COG\_CO2}^{BSL}$	kg-CO2/t-coke	CO2 from COG combustion for producing 1 ton of coke
$prm_{COG\_C}^{BSL}$	%	Carbon content of COG
COK_{COG}^{BSL}	m3-COG/t-coke	COG necessary for producing 1 ton of coke

$$COK_{COG}^{BSL} = prm_{coal\_COG}^{BSL} \times COK_{coal}^{BSL} \quad (3)$$

Where:

COK_{COG}^{BSL}	m3-COG/t-coke	COG necessary for producing 1 ton of coke
$prm_{coal\_COG}^{BSL}$	m3-COG/t-coal	Carbon content of coal
COK_{coal}^{BSL}	t-coal/t-coke	Coal necessary for producing 1 ton of coke

CO2 emissions from BFG combustion

$$COK_{BFG\_CO2}^{BSL} = prm_{BFG\_C}^{BSL} / 100 \times COK_{BFG}^{BSL} \times 44 / 22.4 \quad (4)$$

Where:

$COK_{BFG\_CO2}^{BSL}$	kg-BFG/t-coke	CO2 from BFG combustion for producing 1 ton of coke
$prm_{BFG\_C}^{BSL}$	%	Carbon content of BFG
COK_{BFG}^{BSL}	m3-BFG/t-coke	BFG necessary for producing 1 ton of coke

CO2 emissions from electricity consumption

$$COK_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times COK_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times COK_{ELE\_SG}^{BSL} \quad (5)$$

Where:

$COK^{BSL}_{ELE\_CO2}$	kg-CO2/t-coke	CO2 from electricity consumed for producing 1 ton of coke
EF^{BSL}_{grid}	kg-CO2/kWh	CO2 emission coefficient for power grid
$COK^{BSL}_{ELE\_grid}$	kWh/t-coke	Electricity consumed from power grid for producing 1 ton of coke
EF^{BSL}_{SG}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$COK^{BSL}_{ELE\_SG}$	kWh/t-coke	Electricity consumed from on-site power generation for producing 1 ton of coke

(2) Emissions from sintering furnace

$$SINEM^{BSL}_{CO2} = SIN^{BSL}_{coal\_CO2} + SIN^{BSL}_{BFG\_CO2} + SIN^{BSL}_{ELE\_CO2} \qquad (6)$$

Where:

$SINEM^{BSL}_{CO2}$	kg-CO2/t-sinter ore	CO2 from the sintering furnace process for producing 1 ton of sintered ore
$SIN^{BSL}_{coal\_CO2}$	kg-CO2/t-sinter ore	CO2 from coal combustion for producing 1 ton of sintered ore
$SIN^{BSL}_{BFG\_CO2}$	kg-CO2/t-sinter ore	CO2 from BFG combustion for producing 1 ton of sintered ore
$SIN^{BSL}_{ELE\_CO2}$	kg-CO2/t-sinter ore	CO2 from electricity consumed for producing 1 ton of sintered ore

CO2 emissions from coal combustion

$$SIN^{BSL}_{coal\_CO2} = prm^{BSL}_{SINcoal\_C} / 100 \times SIN^{BSL}_{coal} \times 1000 \times 44/12 \qquad (7)$$

Where:

$SIN^{BSL}_{coal\_CO2}$	kg-CO2/t-sinter ore	CO2 from coal combustion for producing 1 ton of sintered ore
$prm^{BSL}_{SINcoal\_C}$	%	Carbon content of coal
SIN^{BSL}_{coal}	t-coal/t-sinter ore	Coal necessary for producing 1 ton of sintered ore

CO2 emissions from combustion of blast furnace gas (BFG)

$$SIN^{BSL}_{BFG\_CO2} = prm^{BSL}_{BFG\_C} / 100 \times SIN^{BSL}_{BFG} \times 44/22.4 \qquad (8)$$

Where:

$SIN^{BSL}_{BFG\_CO2}$	kg-CO2/t-sinter ore	CO2 from BFG combustion for producing 1 ton of sintered ore
$prm^{BSL}_{BFG\_C}$	%	Carbon content of BFG
SIN^{BSL}_{BFG}	m3-BFG/t-sinter ore	BFG necessary for producing 1 ton of sintered ore

CO2 emissions from electricity consumption

$$SIN_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times SIN_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times SIN_{ELE\_SG}^{BSL} \quad (9)$$

Where:

$SIN_{ELE\_CO2}^{BSL}$	kg-CO2/t-sinter ore	CO2 from electricity consumed for producing 1 ton of sintered ore
EF_{grid}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for power grid
$SIN_{ELE\_grid}^{BSL}$	kWh/t-sinter ore	Electricity consumed by power grid for producing 1 ton of sintered ore
EF_{SG}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$SIN_{ELE\_SG}^{BSL}$	kWh/t-sinter ore	Electricity consumed for on-site power generation for producing 1 ton of sintered ore

(3) Emissions from pellet production process

$$PELEM_{CO2}^{BSL} = PEL_{BFG\_CO2}^{BSL} + PEL_{ELE\_CO2}^{BSL} \quad (10)$$

Where:

$PELEM_{CO2}^{BSL}$	kg-CO2/t-pellet	CO2 from the process of production for producing 1 ton of pellet
$PEL_{BFG\_CO2}^{BSL}$	kg-CO2/t-pellet	CO2 from BFG combustion for producing 1 ton of pellet
$PEL_{ELE\_CO2}^{BSL}$	kg-CO2/t-pellet	CO2 from electricity consumed for producing 1 ton of pellet

CO2 emissions from combustion of blast furnace gas (BFG)

$$PEL_{BFG\_CO2}^{BSL} = prm_{BFG\_C}^{BSL} / 100 \times PEL_{BFG}^{BSL} \times 44 / 22.4 \quad (11)$$

Where:

$PEL_{BFG\_CO2}^{BSL}$	kg-CO2/t-pellet	CO2 from BFG combustion for producing 1 ton of pellet
$prm_{BFG\_C}^{BSL}$	%	Carbon content of BFG
PEL_{BFG}^{BSL}	m3-BFG/t-pellet	BFG necessary for producing 1 ton of pellet

CO2 emissions from electricity consumption

$$PEL_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times PEL_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times PEL_{ELE\_SG}^{BSL} \quad (12)$$

Where:

$PEL_{ELE\_CO2}^{BSL}$	kg-CO2/t-pellet	CO2 from electricity consumed for producing 1 ton of pellet
EF_{grid}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for power grid

$PEL_{ELE\_grid}^{BSL}$	kWh/t-pellet	Electricity consumed from power grid for producing 1 ton of pellet
EF_{SG}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$PEL_{ELE\_SG}^{BSL}$	kWh/t-pellet	Electricity consumed from on-site power generation for producing 1 ton of pellet

(4) Emissions from blast furnace

$$BLFEM_{CO2}^{BSL} = BLF_{BFG\_CO2}^{BSL} + BLFBLF_{ELE\_CO2}^{BSL} \quad (13)$$

Where:

$BLFEM_{CO2}^{BSL}$	kg-CO2/t-pig iron	CO2 from blast furnace process for producing 1 ton of pig iron
$BLF_{BFG\_CO2}^{BSL}$	kg-CO2/t-pig iron	CO2 from BFG combustion for producing 1 ton of pig iron
$BLF_{ELE\_CO2}^{BSL}$	kg-CO2/t-pig iron	CO2 from electricity consumed for producing 1 ton of pig iron

CO2 emissions from combustion of blast furnace gas (BFG)

$$BLF_{BFG\_CO2}^{BSL} = prm_{BFG\_C}^{BSL} / 100 \times BLF_{BFG}^{BSL} \times 44 / 22.4 \quad (14)$$

Where:

$BLF_{BFG\_CO2}^{BSL}$	kg-CO2/t-pig iron	CO2 from BFG combustion for producing 1 ton of pig iron
$prm_{BFG\_C}^{BSL}$	%	Carbon content of coke
BLF_{BFG}^{BSL}	t-coke/t-pig iron	BFG necessary for producing 1 ton of pig iron

CO2 emissions from electricity consumption

$$BLF_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times BLF_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times BLF_{ELE\_SG}^{BSL} \quad (15)$$

Where:

$BLF_{ELE\_CO2}^{BSL}$	kg-CO2/t-pig iron	CO2 from electricity consumed for producing 1 ton of pig iron
EF_{grid}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for power grid
$BLF_{ELE\_grid}^{BSL}$	kWh/t-pig iron	Electricity consumed by power grid for producing 1 ton of pig iron
EF_{SG}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$BLF_{ELE\_SG}^{BSL}$	kWh/t-pig iron	Electricity consumed from on-site power generation for producing 1 ton of pig iron

(5) Emission from converter

$$CVTEM_{CO2}^{BSL} = CVT_{COG\_CO2}^{BSL} + CVT_{ELE\_CO2}^{BSL} \quad (16)$$

Where:

$CVTEM_{CO2}^{BSL}$	kg-CO2/t-crude steel	CO2 from converter process for producing 1 ton of crude steel
$CVT_{COG\_CO2}^{BSL}$	kg-CO2/t-crude steel	CO2 from COG combustion for producing 1 ton of crude steel
$CVT_{ELE\_CO2}^{BSL}$	kg-CO2/t-crude steel	CO2 from electricity consumed for producing 1 ton of crude steel

CO2 emissions from COG combustion

$$CVT_{COG\_CO2}^{BSL} = prm_{COG\_C}^{BSL} / 100 \times CVT_{COG}^{BSL} \times 44 / 22.4 \quad (17)$$

Where:

$CVT_{COG\_CO2}^{BSL}$	kg-CO2/t-crude steel	CO2 from COG for producing 1 ton of crude steel
$prm_{COG\_C}^{BSL}$	%	Carbon content of COG
CVT_{COG}^{BSL}	m3-COG/t-crude steel	COG necessary for producing 1 ton of crude steel

CO2 emissions from electricity consumption

$$CVT_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times CVT_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times CVT_{ELE\_SG}^{BSL} \quad (18)$$

Where:

$CVT_{ELE\_CO2}^{BSL}$	kg-CO2/t-crude steel	CO2 from electricity consumed for producing 1 ton of crude steel
EF_{grid}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for power grid
$CVT_{ELE\_grid}^{BSL}$	kWh/t-crude steel	Electricity consumed by power grid for producing 1 ton of crude steel
EF_{SG}^{BSL}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$CVT_{ELE\_SG}^{BSL}$	kWh/t-crude steel	Electricity consumed from on-site power generation for producing 1 ton of crude steel

(6) CO2 emissions on baseline

$$\begin{aligned} EM_{CO2}^{BSL} &= COKEM_{CO2}^{BSL} \times CSTL_{coke}^{BSL} + SINEM_{CO2}^{BSL} \times CSTL_{siore}^{BSL} \\ &+ PELEM_{CO2}^{BSL} \times CSTL_{pellet}^{BSL} + BFL_{CO2}^{BSL} \times CSTL_{pigiron}^{BSL} + CVTEM_{CO2}^{BSL} \end{aligned} \quad (19)$$

Where:

EM_{CO2}^{BSL}	kg-CO2/t-crude steel	CO2 from all process for producing 1 ton of crude steel on baseline
$CSTL_{coke}^{BSL}$	t-coke/t-crude steel	Coke necessary for producing 1 ton of crude steel

$CSTL_{siore}^{BSL}$	t-sintered ore/t-crude steel	Sintered ore necessary for producing 1 ton of crude steel
$CSTL_{pellet}^{BSL}$	t-pellet/t-crude steel	Pellet necessary for producing 1 ton of crude steel
$CSTL_{pigiron}^{BSL}$	t-pig iron/t-crude steel	Pig iron necessary for producing 1 ton of crude steel

Step.2 Project emission

(1) Emissions from pellet production process

$$PELEM_{CO2}^{PRJ} = PEL_{BFG\_CO2}^{PRJ} + PEL_{ELE\_CO2}^{PRJ} \quad (20)$$

Where:

$PELEM_{CO2}^{PRJ}$	kg-CO2/t-pellet	CO2 from pellet production process for producing 1 ton of pellet
$PEL_{BFG\_CO2}^{PRJ}$	kg-CO2/t-pellet	CO2 from BFG combustion for producing 1 ton of pellet
$PEL_{ELE\_CO2}^{PRJ}$	kg-CO2/t-pellet	CO2 from electricity consumed for producing 1 ton of pellet

CO2 emissions from combustion of blast furnace gas(BFG)

$$PEL_{BFG\_CO2}^{PRJ} = prm_{BFG\_C}^{PRJ} / 100 \times PEL_{BFG}^{PRJ} \times 44 / 22.4 \quad (21)$$

Where:

$PEL_{BFG\_CO2}^{PRJ}$	kg-CO2/t-pellet	CO2 from BFG combustion for producing 1 ton of pellet
$prm_{BFG\_C}^{PRJ}$	%	Carbon content of BFG
PEL_{BFG}^{PRJ}	m3-BFG/t-pellet	BFG necessary for producing 1 ton of pellet

CO2 emissions from electricity consumption

$$PEL_{ELE\_CO2}^{PRJ} = EF_{grid}^{PRJ} \times PEL_{ELE\_grid}^{PRJ} + EF_{SG}^{PRJ} \times PEL_{ELE\_SG}^{PRJ} \quad (22)$$

Where:

$PEL_{ELE\_CO2}^{PRJ}$	kg-CO2/t-pellet	CO2 from electricity consumed for producing 1 ton of pellet
EF_{grid}^{PRJ}	kg-CO2/kWh	CO2 emission coefficient for power grid
$PEL_{ELE\_grid}^{PRJ}$	kWh/t-pellet	Electricity consumed by power grid for producing 1 ton of pellet
EF_{SG}^{PRJ}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$PEL_{ELE\_SG}^{PRJ}$	kWh/t-pellet	On-site generated power consumption for producing 1 ton of pellet

(2) Emissions from direct reduction furnace

$$DRFEM_{CO2}^{PRJ} = DRF_{COG\_CO2}^{PRJ} + DRF_{ELE\_CO2}^{PRJ} \quad (23)$$

Where:

$DRFEM_{CO2}^{PRJ}$	kg-CO2/t-sponge iron	CO2 from converter process for producing 1 ton of sponge iron
$DRF_{COG\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	CO2 from COG combustion for producing 1 ton of sponge iron
$DRF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	CO2 from electricity consumption for producing 1 ton of sponge iron

CO2 emissions from COG combustion

$$DRF_{COG\_CO2}^{PRJ} = prm_{COG\_C}^{PRJ} / 100 \times DRF_{COG}^{PRJ} \times 44 / 22.4 \quad (24)$$

Where:

$DRF_{COG\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	CO2 from COG combustion for producing 1 ton of sponge iron
$prm_{COG\_C}^{PRJ}$	%	Carbon content of COG
DRF_{COG}^{PRJ}	m3-COG/t-sponge iron	COG necessary to produce 1 ton of sponge iron

CO2 emissions from electricity consumption

$$DRF_{ELE\_CO2}^{PRJ} = EF_{grid}^{PRJ} \times DRF_{ELE\_grid}^{PRJ} + EF_{SG}^{PRJ} \times DRF_{ELE\_SG}^{PRJ} \quad (25)$$

Where:

$DRF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	CO2 from electricity consumed for producing 1 ton of sponge iron
EF_{grid}^{PRJ}	kg-CO2/kWh	CO2 emission coefficient for power grid
$DRF_{ELE\_grid}^{PRJ}$	kWh/t-sponge iron	Electricity consumed by power grid for producing 1 ton of sponge iron
EF_{SG}^{PRJ}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$DRF_{ELE\_SG}^{PRJ}$	kWh/t-sponge iron	Electricity consumed from on-site power generation for producing 1 ton of sponge iron

(3) CO2 emissions in electric arc furnace

$$ELFEM_{CO2}^{PRJ} = ELF_{ELE\_CO2}^{PRJ} \quad (26)$$

Where:

$ELFEM_{CO2}^{PRJ}$	kg-CO2/t-crude steel	CO2 from electric furnace process for producing 1 ton of crude

		steel
$ELF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-crude steel	CO2 from electricity consumed for producing 1 ton of crude steel

CO2 emissions from electricity consumption

$$ELF_{ELE\_CO2}^{PRJ} = EF_{grid}^{PRJ} \times ELF_{ELE\_grid}^{PRJ} + EF_{SG}^{BSL} \times ELF_{ELE\_SG}^{PRJ} \quad (27)$$

Where:

$ELF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-crude steel	CO2 from electricity consumed for producing 1 ton of crude steel
EF_{grid}^{PRJ}	kg-CO2/kWh	CO2 emission coefficient for power grid
$ELF_{ELE\_grid}^{PRJ}$	kWh/t-crdue steel	Electricity consumed by power grid for producing 1 ton of crude steel
EF_{SG}^{PRJ}	kg-CO2/kWh	CO2 emission coefficient for on-site power generation
$ELF_{ELE\_SG}^{PRJ}$	kWh/t-crude steel	Electricity consumed from on-site power generation for producing 1 ton of crude steel

(4) CO2 emissions on the project activity

Regarding CO2 emissions from each process as described in (1) – (3), each value is converted into CO2 emissions per 1 ton crude steel production to obtain CO2 emissions per 1 ton crude steel production on the project activity.

$$EM_{CO2}^{PRJ} = PELEM_{CO2}^{PRJ} \times CSTL_{pellet}^{PRJ} + DRFEM_{CO2}^{PRJ} \times CSTL_{spongeiron}^{PRJ} + ELFEM_{CO2}^{PRJ} \quad (28)$$

Where:

EM_{CO2}^{PRJ}	kg-CO2/t-crude steel	CO2 from all processes for producing 1 ton of crude steel in the project case
$CSTL_{pellet}^{PRJ}$	t-pellet/t-crude steel	Pellet necessary for producing 1 ton of crude steel
$CSTL_{spongeiron}^{PRJ}$	t-sponge iron/t-crude steel	Sponge iron necessary for producing 1 ton of crude steel

<u>**Step.3 Electricity emission factor**</u>

The calculation of the GHG emission reductions by the proposed project is followed by the "Tool to calculate the emission factor for an electricity system". Also the Government of China provides calculated OM, BM and CM in the "*Notification on Determining Baseline Emission Factor of China's Grid*"[4] according to the "Tool to calculate the emission factor for an electricity system".

[4] Based on the official data released by the Chinese DNA (http://cdm.ccchina.gov.cn)

The baseline emission factor (EF_y) is calculated ex-ante as the simple average of the operating margin emission factor ($EF_{OM,y}$) and the build margin emission factor ($EF_{BM,y}$).

Step 3-1. Identify the relevant electric power system

According to the "Tool to calculate the emission factor for an electricity system", the data published on August 9th of 2007 by the DNA of China is employed in this PDD. The North China Power Grid is identified as the electric system, from which would provide electricity in baseline scenario. The North China Power Grid covers Beijing city, Tianjin city, Hebei province, Shanxi province, Shandong province and Inner Mongolia.

Step 3-2. Select an operating margin (OM) method

The Operating Margin Emission Factor ($EF_{OM,y}$) based on one of the following four methods:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.
According to "*Notification on Determining Baseline Emission Factor of China's Grid*", the DNA of China employs the simple OM method (option a). For the simple OM the emission factor can be selected between "Ex-ante" or "Ex-post" calculation. In this PDD Ex-ante option is selected.

Step 3-3. Calculate the Operating Margin emission factor ($EF_{grid,OM,y}$)

In accordance with the "Tool to calculate the emission factor for an electricity system", the simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation of all generating power plants serving the system, not including low-cost/must-run power plants/units.
Though the DNA of China has already calculated the Operating Margin emission factor for each grid system, in this PDD these figures are recalculated with Chinese national statistical data[5] and IPCC default values at the lower limit of the uncertainty at a 95% confidence interval[6].
The calculation results are as follows:

Table 16 The simple Operating Margin emission factor for the North China Power Grid.

Year	The simple OM factor for the North China Power Grid (t-CO_2/MWh)
2003	1.013700
2004	1.061729
2005	1.092098
Average	1.059810

Step3-4. Identify the cohort of power units to be included in the build margin

The sample group of power units *m* used to calculate the build margin consists of either:

5 p.287, China Energy Statistical Yearbook, 2006

6 Table 1.4 of Chapter 1 of Vol. 2 (Energy), 2006 IPCC Guidelines for National Greenhouse Gas Inventories

(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Because it is difficult to obtain the information of the five power plants built most recently in China, the sample group of power units *m* used to calculate the build margin is chosen (b).
In terms of vintage of data, Option 1 is chosen.

Step 3-5. Calculate the build margin emission factor

In accordance with the "Tool to calculate the emission factor for an electricity system", the BM emission factor is calculated as the generation-weighted average emission factor (tCO2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available.
Though the DNA of China has already calculated the BM emission factor for each grid system, in this PDD these figures are recalculated Chinese national statistical data[7] and with IPCC default values at the lower limit of the uncertainty at a 95% confidence interval[8].
The calculation results are the followings:

Table 17 The Build Margin emission factor for the North China Power Grid.

Year (most recent)	The BM factor for the North China Power Grid (t-CO_2/MWh)
2005	0.889498

Step3-6. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM} \quad (3)$$

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM} :

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent
- All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

In this PDD, the default values, w_{OM} = 0.5 and w_{BM} = 0.5, are used.

[7] p.287, China Energy Statistical Yearbook, 2006

[8] Table 1.4 of Chapter 1 of Vol. 2 (Energy), 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Step.4 Leakage emissions

There are no leakage emissions in this project.

Step.5 Emission reductions

$$ER_y = (EM_{CO2}^{BSL} - EM_{CO2,y}^{PRJ}) \times PRD_{crd\_stl}^{PRJ} / 1000 - LE_y \quad (29)$$

Where:

ER_y	=	Emission reductions in year *y* (tCO2/yr)
EM_{CO2}^{BSL}	=	CO2 from all process for producing 1 ton of crude steel in the baseline case (tCO2/t-crude steel)
$EM_{CO2,y}^{PRJ}$	=	CO2 from all process for producing 1 ton of crude steel in the project case (tCO2/t-crude steel)
$PRD_{crd\_stl}^{PRJ}$	=	Crude steel production in the project case (t-crude steel/yr)
LE_y	=	Leakage emissions in year *y* (tCO2/yr)

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

Data / Parameter:	$prm_{COG\_C}^{BSL}$
Data unit:	%
Description:	Carbon content of COG
Source of data used:	Data from statistics
Value applied:	35
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$prm_{Coal\_COG}^{BSL}$
Data unit:	m3-COG/t-coal
Description:	COG emitted from 1 ton of coal in coke oven
Source of data used:	Data from statistics
Value applied:	320
Justification of the choice of data or description of measurement methods and procedures actually	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.

applied :	
Any comment:	

Data / Parameter:	COK_{coal}^{BSL}
Data unit:	t-coal/t-coke
Description:	Coal necessary for producing 1 ton of coke
Source of data used:	Data from statistics
Value applied:	1.32
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	COK_{BFG}^{BSL}
Data unit:	m3-BFG/t-coke
Description:	BFG necessary for producing 1 ton of coke
Source of data used:	Data from statistics
Value applied:	793
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	EF_{grid}^{BSL}
Data unit:	kg-CO2/kWh
Description:	CO2 emission coefficient for power grid
Source of data used:	Chinese government and IPCC
Value applied:	0.9747
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according to “Tool to calculate the emission factor for an electricity system”. Electricity data is provided by DNA of China dated 9 August, 2007. National averaged default values are used for net calorific value of fossil fuel (NCV) because values are reliable and documented in national energy statistics[9]. IPCC default values are used for CO2 emission factor of fossil fuels according to the description, “IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories”, in the Tool.

[9] P.287, China Energy Statistical Yearbook, 2006

	OM: 1.05981 kgCO2/kWh BM: 0.88949 kgCO2/kWh CM: 0.97465 kgCO2/kWh
Any comment:	In detail, see Annex 3.

Data / Parameter:	$COK_{ELE\_grid}^{BSL}$
Data unit:	kWh/t-coke
Description:	Electricity consumed from power grid for producing 1 ton of coke
Source of data used:	Data from statistics
Value applied:	36.79
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is base on Steel Industry Association in China.
Any comment:	

Data / Parameter:	EF_{SG}^{BSL}
Data unit:	kg-CO2/kWh
Description:	CO2 emission coefficient for on-site power generation
Source of data used:	Data from statistics
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	On-site power generation is not utilised in this project site.
Any comment:	

Data / Parameter:	$COK_{ELE\_SG}^{BSL}$
Data unit:	kWh/t-coke
Description:	Electricity consumed from on-site power generation for producing 1 ton of coke
Source of data used:	Data from statistics
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	On-site power generation is not be utilised in this project site.
Any comment:	

Data / Parameter:	$prm_{SINcoal\_C}^{BSL}$

Data unit:	%
Description:	Carbon content of coal
Source of data used:	Data from statistics
Value applied:	75
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	SIN_{coal}^{BSL}
Data unit:	t-coal/t-sinter
Description:	Coal necessary for producing 1 ton of sinter ore
Source of data used:	Data from statistics
Value applied:	0.07
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$prm_{BFG\_C}^{BSL}$
Data unit:	%
Description:	Carbon content of BFG
Source of data used:	Data from statistics
Value applied:	42
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	SIN_{BFG}^{BSL}
Data unit:	m3-BFG/t-sinter
Description:	BFG necessary for producing 1 ton of sinter ore
Source of data used:	Data from statistics
Value applied:	60
Justification of the choice of data or	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$SIN_{ELE\_grid}^{BSL}$
Data unit:	kWh/t-sinter ore
Description:	Electricity consumed from power grid for producing 1 ton of sinter ore
Source of data used:	Data from statistics
Value applied:	37.89
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is base on Steel Industry Association in China.
Any comment:	

Data / Parameter:	$SIN_{ELE\_SG}^{BSL}$
Data unit:	kWh/t-sinter ore
Description:	Electricity consumed from on-site power generation for producing 1 ton of sinter ore
Source of data used:	Data from statistics
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	On-site power generation is not be utilised in this project site.
Any comment:	

Data / Parameter:	PEL_{BFG}^{BSL}
Data unit:	m3-BFG/t-pellet
Description:	BFG necessary for producing 1 ton of pellet
Source of data used:	Data from statistics
Value applied:	250
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$PEL_{ELE\_grid}^{BSL}$
Data unit:	kWh/t-pellet
Description:	Electricity consumed from power grid for producing 1 ton of pellet
Source of data used:	Data from statistics
Value applied:	34.85
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is base on Steel Industry Association in China.
Any comment:	

Data / Parameter:	$PEL_{ELE\_SG}^{BSL}$
Data unit:	kWh/t-pellet
Description:	Electricity consumed from on-site power generation for producing 1 ton of pellet
Source of data used:	Data from statistics
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	On-site power generation is not be utilised in this project site.
Any comment:	

Data / Parameter:	$prm_{coke\_C}^{BSL}$
Data unit:	%
Description:	Carbon content of coke
Source of data used:	Data from statistics
Value applied:	85
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	BLF_{BFG}^{BSL}
Data unit:	m3-BFG/t-pig iron
Description:	BFG necessary for producing 1 ton of pig iron
Source of data used:	Data from statistics

Value applied:	810
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$BLF_{ELE\_grid}^{BSL}$
Data unit:	kWh/t-pig iron
Description:	Electricity consumed from power grid for producing 1 ton of pig iron
Source of data used:	Data from statistics
Value applied:	167.69
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is base on Steel Industry Association in China.
Any comment:	

Data / Parameter:	$BLF_{ELE\_SG}^{BSL}$
Data unit:	kWh/t-pig iron
Description:	Electricity consumed from on-site power generation for producing 1 ton of pig iron
Source of data used:	Data from statistics
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	On-site power generation is not be utilised in this project site.
Any comment:	

Data / Parameter:	CVT_{COG}^{BSL}
Data unit:	m3-COG/t-crude steel
Description:	COG necessary for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	10
Justification of the choice of data or description of measurement methods	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.

and procedures actually applied :	
Any comment:	

Data / Parameter:	$CVT^{BSL}_{ELE\_grid}$
Data unit:	kWh/t-crude steel
Description:	Electricity consumed from power grid for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	43.46
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is base on Steel Industry Association in China.
Any comment:	

Data / Parameter:	$CVT^{BSL}_{ELE\_SG}$
Data unit:	kWh/t-crude steel
Description:	Electricity consumed from on-site power generation for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	On-site power generation is not be utilised in this project site.
Any comment:	

Data / Parameter:	$CSTL^{BSL}_{coke}$
Data unit:	t-coke/t-crude steel
Description:	Coke necessary for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	0.42
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$CSTL^{BSL}_{siore}$

Data unit:	t-sintered ore/t-crude steel
Description:	Sinter ore necessary for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	1.26
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$CSTL_{pellet}^{BSL}$
Data unit:	t-pellet/t-crude steel
Description:	Pellet necessary for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	0.525
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	$CSTL_{pigiron}^{BSL}$
Data unit:	t-pig iron/t-crude steel
Description:	Pig iron necessary for producing 1 ton of crude steel
Source of data used:	Data from statistics
Value applied:	1.05
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of data is calculated based on the laboratory findings by Beris Engineering and Research Corporation.
Any comment:	

Data / Parameter:	EF_{grid}^{PRJ}
Data unit:	kg-CO2/kWh
Description:	CO2 emission coefficient for power grid
Source of data used:	Chinese government and IPCC
Value applied:	0.9747
Justification of the choice of data or	Same as EF_{grid}^{BSL} .

description of measurement methods and procedures actually applied :	
Any comment:	In detail, see Annex 3.

Data / Parameter:	EF_{SG}^{PRJ}
Data unit:	kg-CO2/kWh
Description:	CO2 emission coefficient for on-site power generation
Source of data used:	Chinese government and IPCC
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Same as EF_{SG}^{BSL} .
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

>>

Baseline emissions

(1) Emissions from coke oven

$$COKEM_{CO2}^{BSL} = COK_{COG\_CO2}^{BSL} + COK_{BFG\_CO2}^{BSL} + COK_{ELE\_CO2}^{BSL} \quad (30)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$COKEM_{CO2}^{BSL}$	kg-CO2/t-coke	980	980	980	980	980	980	980	980	980	980
$COK_{COG\_CO2}^{BSL}$	kg-CO2/t-coke	290	290	290	290	290	290	290	290	290	290
$COK_{BFG\_CO2}^{BSL}$	kg-CO2/t-coke	654	654	654	654	654	654	654	654	654	654
$COK_{ELE\_CO2}^{BSL}$	kg-CO2/t-coke	36	36	36	36	36	36	36	36	36	36

$$COK_{COG\_CO2}^{BSL} = prm_{COG\_C}^{BSL} / 100 \times COK_{COG}^{BSL} \times 44 / 22.4 \quad (31)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$COK_{COG\_CO2}^{BSL}$	kg-CO2/t-coke	290	290	290	290	290	290	290	290	290	290
$prm_{COG\_C}^{BSL}$	%	35	35	35	35	35	35	35	35	35	35
COK_{COG}^{BSL}	m3-COG/t-coke	422	422	422	422	422	422	422	422	422	422

$$COK_{COG}^{BSL} = prm_{coal\_COG}^{BSL} \times COK_{coal}^{BSL} \quad (32)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
COK_{COG}^{BSL}	m3-COG/t-coke	422	422	422	422	422	422	422	422	422	422
$prm_{coal\_COG}^{BSL}$	m3-COG/t-coal	320	320	320	320	320	320	320	320	320	320
COK_{coal}^{BSL}	t-coal/t-coke	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

$$COK^{BSL}_{BFG\_CO2} = prm^{BSL}_{BFG\_C} / 100 \times COK^{BSL}_{BFG} \times 44 / 22.4 \qquad (33)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$COK_{BFG\_CO2}^{BSL}$	kg-CO2/t-coke	654	654	654	654	654	654	654	654	654	654
$prm_{BFG\_C}^{BSL}$	%	42	42	42	42	42	42	42	42	42	42
COK_{BFG}^{BSL}	m3-BFG/t-coke	793	793	793	793	793	793	793	793	793	793

$$COK^{BSL}_{ELE\_CO2} = EF^{BSL}_{grid} \times COK^{BSL}_{ELE\_grid} + EF^{BSL}_{SG} \times COK^{BSL}_{ELE\_SG} \qquad (34)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$COK_{ELE\_CO2}^{BSL}$	kg-CO2/t-coke	36	36	36	36	36	36	36	36	36	36
EF_{grid}^{BSL}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$COK_{ELE\_grid}^{BSL}$	kWh/t-coke	37	37	37	37	37	37	37	37	37	37
EF_{SG}^{BSL}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$COK_{ELE\_SG}^{BSL}$	kWh/t-coke	0	0	0	0	0	0	0	0	0	0

(2) Emissions from sintering furnace

$$SINEM^{BSL}_{CO2} = SIN^{BSL}_{coal\_CO2} + SIN^{BSL}_{BFG\_CO2} + SIN^{BSL}_{ELE\_CO2} \qquad (35)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$SIMEM_{CO2}^{BSL}$	kg-CO2/t-sinter ore	279	279	279	279	279	279	279	279	279	279
$SIM_{coal\_CO2}^{BSL}$	kg-CO2/t-sinter ore	193	193	193	193	193	193	193	193	193	193
$SIM_{BFG\_CO2}^{BSL}$	kg-CO2/t-sinter ore	50	50	50	50	50	50	50	50	50	50
$SIM_{ELE\_CO2}^{BSL}$	kg-CO2/t-sinter ore	37	37	37	37	37	37	37	37	37	37

$$SIN^{BSL}_{coal\_CO2} = prm^{BSL}_{SINcoal\_C} / 100 \times SIN^{BSL}_{coal} \times 1000 \times 44 / 12 \qquad (36)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$SIM_{coal\_CO2}^{BSL}$	kg-CO2/t-sinter ore	193	193	193	193	193	193	193	193	193	193
$prm_{SINcoal\_C}^{BSL}$	%	75	75	75	75	75	75	75	75	75	75
SIM_{coal}^{BSL}	t-coal/t-sinter ore	0	0	0	0	0	0	0	0	0	0

$$SIN^{BSL}_{BFG\_CO2} = prm^{BSL}_{BFG\_C} / 100 \times SIN^{BSL}_{BFG} \times 44 / 22.4 \qquad (37)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$SIM_{BFG\_CO2}^{BSL}$	kg-CO2/t-sinter ore	50	50	50	50	50	50	50	50	50	50
$prm_{BFG\_C}^{BSL}$	%	42	42	42	42	42	42	42	42	42	42
SIM_{BFG}^{BSL}	m3-BFG/t-sinter ore	60	60	60	60	60	60	60	60	60	60

$$SIN^{BSL}_{ELE\_CO2} = EF^{BSL}_{grid} \times SIN^{BSL}_{ELE\_grid} + EF^{BSL}_{SG} \times SIN^{BSL}_{ELE\_SG} \qquad (38)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$SIM_{ELE\_CO2}^{BSL}$	kg-CO2/t-sinter ore	37	37	37	37	37	37	37	37	37	37
EF_{grid}^{BSL}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$SIN_{ELE\_grid}^{BSL}$	kWh/t-sinter ore	38	38	38	38	38	38	38	38	38	38
EF_{SG}^{BSL}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$SIN_{ELE\_SG}^{BSL}$	kWh/t-sinter ore	0	0	0	0	0	0	0	0	0	0

(3) Emissions from pellet production process

$$PELEM_{CO2}^{BSL} = PEL_{BFG\_CO2}^{BSL} + PEL_{ELE\_CO2}^{BSL} \quad (39)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$PELEM_{CO2}^{BSL}$	kg-CO2/t-pellet	240	240	240	240	240	240	240	240	240	240
$PEL_{BFG\_CO2}^{BSL}$	kg-CO2/t-pellet	206	206	206	206	206	206	206	206	206	206
$PEL_{ELE\_CO2}^{BSL}$	kg-CO2/t-pellet	34	34	34	34	34	34	34	34	34	34

$$PEL_{BFG\_CO2}^{BSL} = prm_{BFG\_C}^{BSL} / 100 \times PEL_{BFG}^{BSL} \times 44/22.4 \quad (40)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$PEL_{BFG\_CO2}^{BSL}$	kg-CO2/t-pellet	206	206	206	206	206	206	206	206	206	206
$prm_{BFG\_C}^{BSL}$	%	42	42	42	42	42	42	42	42	42	42
PEL_{BFG}^{BSL}	m3-BFG/t-pellet	250	250	250	250	250	250	250	250	250	250

$$PEL_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times PEL_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times PEL_{ELE\_SG}^{BSL} \quad (41)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$PEL_{ELE\_CO2}^{BSL}$	kg-CO2/t-pellet	34	34	34	34	34	34	34	34	34	34
EF_{grid}^{BSL}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$PEL_{ELE\_grid}^{BSL}$	kWh/t-pellet	35	35	35	35	35	35	35	35	35	35
EF_{SG}^{BSL}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$PEL_{ELE\_SG}^{BSL}$	kWh/t-pellet	0	0	0	0	0	0	0	0	0	0

(4) Emissions from blast furnace

$$BLFEM_{CO2}^{BSL} = BLF_{BFG\_CO2}^{BSL} + BLFBLF_{ELE\_CO2}^{BSL} \quad (42)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$BLFEM_{CO2}^{BSL}$	kg-CO2/t-pig iron	832	832	832	832	832	832	832	832	832	832
$BLF_{BFG\_CO2}^{BSL}$	kg-CO2/t-pig iron	668	668	668	668	668	668	668	668	668	668
$BLF_{ELE\_CO2}^{BSL}$	kg-CO2/t-pig iron	163	163	163	163	163	163	163	163	163	163

$$BLF_{BFG\_CO2}^{BSL} = prm_{BFG\_C}^{BSL} / 100 \times BLF_{BFG}^{BSL} \times 44/22.4 \quad (43)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$BLF_{BFG\_CO2}^{BSL}$	kg-CO2/t-pig iron	668	668	668	668	668	668	668	668	668	668
$prm_{BFG\_C}^{BSL}$	%	42	42	42	42	42	42	42	42	42	42
BLF_{BFG}^{BSL}	m3-BFG/t-pig iron	810	810	810	810	810	810	810	810	810	810

$$BLF_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times BLF_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times BLF_{ELE\_SG}^{BSL} \quad (44)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$BLF_{ELE\_CO2}^{BSL}$	kg-CO2/t-pig iron	163	163	163	163	163	163	163	163	163	163
EF_{grid}^{BSL}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$BLF_{ELE\_grid}^{BSL}$	kWh/t-pig iron	168	168	168	168	168	168	168	168	168	168
EF_{SG}^{BSL}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$BLF_{ELE\_SG}^{BSL}$	kWh/t-pig iron	0	0	0	0	0	0	0	0	0	0

(5) Emissions from converter

$$CVTEM_{CO2}^{BSL} = CVT_{COG\_CO2}^{BSL} + CVT_{ELE\_CO2}^{BSL} \quad (45)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$CVTEM_{CO2}^{BSL}$	kg-CO2/t-crude stl	55	55	55	55	55	55	55	55	55	55
$CVT_{COG\_CO2}^{BSL}$	kg-CO2/t-crude stl	13	13	13	13	13	13	13	13	13	13
$CVT_{ELE\_CO2}^{BSL}$	kg-CO2/t-crude stl	42	42	42	42	42	42	42	42	42	42

$$CVT_{COG\_CO2}^{BSL} = prm_{COG\_C}^{BSL} / 100 \times CVT_{COG}^{BSL} \times 44 / 22.4 \quad (46)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$CVT_{COG\_CO2}^{BSL}$	kg-CO2/t-crude stl	13	13	13	13	13	13	13	13	13	13
$prm_{COG\_C}^{BSL}$	%	35	35	35	35	35	35	35	35	35	35
CVT_{COG}^{BSL}	m3-COG/t-crude stl	10	10	10	10	10	10	10	10	10	10

$$CVT_{ELE\_CO2}^{BSL} = EF_{grid}^{BSL} \times CVT_{ELE\_grid}^{BSL} + EF_{SG}^{BSL} \times CVT_{ELE\_SG}^{BSL} \quad (47)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$CVT_{ELE\_CO2}^{BSL}$	kg-CO2/t-crude stl	42	42	42	42	42	42	42	42	42	42
EF_{grid}^{BSL}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$CVT_{ELE\_grid}^{BSL}$	kWh/t-crude stl	43	43	43	43	43	43	43	43	43	43
EF_{SG}^{BSL}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$CVT_{ELE\_SG}^{BSL}$	kWh/t-crude stl	0	0	0	0	0	0	0	0	0	0

Project activity emissions

(1) Emissions from pellet production process

$$PELEM_{CO2}^{PRJ} = PEL_{BFG\_CO2}^{PRJ} + PEL_{ELE\_CO2}^{PRJ} \quad (48)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$PELEM_{CO2}^{PRJ}$	kg-CO2/t-pellet	240	240	240	240	240	240	240	240	240	240
$PEL_{BFG\_CO2}^{PRJ}$	kg-CO2/t-pellet	206	206	206	206	206	206	206	206	206	206
$PEL_{ELE\_CO2}^{PRJ}$	kg-CO2/t-pellet	34	34	34	34	34	34	34	34	34	34

$$PEL_{BFG\_CO2}^{PRJ} = prm_{BFG\_C}^{PRJ} / 100 \times PEL_{BFG}^{PRJ} \times 44 / 22.4 \quad (49)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$PEL_{BFG\_CO2}^{PRJ}$	kg-CO2/t-pellet	206	206	206	206	206	206	206	206	206	206
$prm_{BFG\_C}^{PRJ}$	%	42	42	42	42	42	42	42	42	42	42
PEL_{BFG}^{PRJ}	m3-BFG/t-pellet	250	250	250	250	250	250	250	250	250	250

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
PEL_{BFG}^{PRJ}	m3-BFG/t-pellet	250	250	250	250	250	250	250	250	250	250
$PEL_{BFG\_annual}^{PRJ}$	m3-BFG	59,500,000	59,500,000	59,500,000	59,500,000	59,500,000	59,500,000	59,500,000	59,500,000	59,500,000	59,500,000
$PEL_{PEL\_annual}^{PRJ}$	t-pellet	238,000	238,000	238,000	238,000	238,000	238,000	238,000	238,000	238,000	238,000

$$PEL_{ELE\_CO2}^{PRJ} = EF_{grid}^{PRJ} \times PEL_{ELE\_grid}^{PRJ} + EF_{SG}^{PRJ} \times PEL_{ELE\_SG}^{PRJ} \quad (50)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$PEL_{ELE\_CO2}^{PRJ}$	kg-CO2/t-pellet	34	34	34	34	34	34	34	34	34	34
EF_{grid}^{PRJ}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$PEL_{ELE\_grid}^{PRJ}$	kWh/t-pellet	35	35	35	35	35	35	35	35	35	35
EF_{SG}^{PRJ}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$PEL_{ELE\_SG}^{PRJ}$	kWh/t-pellet	0	0	0	0	0	0	0	0	0	0

(2) Emissions from direct reduction furnace

$$DRFEM_{CO2}^{PRJ} = DRF_{COG\_CO2}^{PRJ} + DRF_{ELE\_CO2}^{PRJ} \quad (51)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$DRFEM_{CO2}^{PRJ}$	kg-CO2/t-sponge iron	326	326	326	326	326	326	326	326	326	326
$DRF_{COG\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	297	297	297	297	297	297	297	297	297	297
$DRF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	29	29	29	29	29	29	29	29	29	29

$$DRF_{COG\_CO2}^{PRJ} = prm_{COG\_C}^{PRJ} / 100 \times DRF_{COG}^{PRJ} \times 44 / 22.4 \quad (52)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$DRF_{COG\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	297	297	297	297	297	297	297	297	297	297
$prm_{COG\_C}^{PRJ}$	%	42	42	42	42	42	42	42	42	42	42
DRF_{COG}^{PRJ}	m3-COG/t-sponge iro	364	364	364	364	364	364	364	364	364	364

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
DRF_{COG}^{PRJ}	m3-COG/t-sponge iro	364	364	364	364	364	364	364	364	364	364
$DRF_{COG\_annual}^{PRJ}$	m3-COG	61,880,000	61,880,000	61,880,000	61,880,000	61,880,000	61,880,000	61,880,000	61,880,000	61,880,000	61,880,000
$DRF_{spgiron\_annual}^{PRJ}$	t-sponge iron	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000

$$DRF_{ELE\_CO2}^{PRJ} = EF_{grid}^{PRJ} \times DRF_{ELE\_grid}^{PRJ} + EF_{SG}^{PRJ} \times DRF_{ELE\_SG}^{PRJ} \quad (53)$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$DRF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-sponge iron	29	29	29	29	29	29	29	29	29	29
EF_{grid}^{PRJ}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$DRF_{ELE\_grid}^{PRJ}$	kWh/t-sponge iron	30	30	30	30	30	30	30	30	30	30
EF_{SG}^{PRJ}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$DRF_{ELE\_SG}^{PRJ}$	kWh/t-sponge iron	0	0	0	0	0	0	0	0	0	0

(4) Emissions from electric arc furnace

$$ELFEM_{CO2}^{PRJ} = ELF_{ELE\_CO2}^{PRJ} \tag{54}$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$ELFEM_{CO2}^{PRJ}$	kg-CO2/t-crude stl	370	370	370	370	370	370	370	370	370	370
$ELF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-crude stl	370	370	370	370	370	370	370	370	370	370

$$ELF_{ELE\_CO2}^{PRJ} = EF_{grid}^{PRJ} \times ELF_{ELE\_grid}^{PRJ} + EF_{SG}^{BSL} \times ELF_{ELE\_SG}^{PRJ} \tag{55}$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$ELF_{ELE\_CO2}^{PRJ}$	kg-CO2/t-crude stl	273	273	273	273	273	273	273	273	273	273
EF_{grid}^{PRJ}	kg-CO2/kWh	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747	0.9747
$ELF_{ELE\_grid}^{PRJ}$	kWh/t-crude stl	280	280	280	280	280	280	280	280	280	280
EF_{SG}^{PRJ}	kg-CO2/kWh	0	0	0	0	0	0	0	0	0	0
$ELF_{ELE\_SG}^{PRJ}$	kWh/t-crude stl	0	0	0	0	0	0	0	0	0	0

Leakage

No leakage.

Emission reductions

$$ER_y = (EM_{CO2}^{BSL} - EM_{CO2,y}^{PRJ}) \times PRD_{crd\_stl}^{PRJ} - LE_y \tag{56}$$

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EM_{CO2}^{PRJ}	kg-CO2/t-crude stl	1,099	1,099	1,099	1,099	1,099	1,099	1,099	1,099	1,099	1,099
$PELEM_{CO2}^{PRJ}$	kg-CO2/t-pellet	240	240	240	240	240	240	240	240	240	240
$CSTL_{pellet}^{PRJ}$	t-pellet/t-crude stl	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54
$DRFEM_{CO2}^{PRJ}$	kg-CO2/t-sponge iron	326	326	326	326	326	326	326	326	326	326
$CSTL_{spongeiron}^{PRJ}$	t-sponge iron/t-crude s	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
$ELFEM_{CO2}^{PRJ}$	kg-CO2/t-crude stl	370	370	370	370	370	370	370	370	370	370

In addition, as the crediting period will be from 01/01/2010 or after the date of registration (whichever is later) to 31/21/2019.

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

>>

Year	Estimation of project activity	Estimation of baseline emissions	Estimation of leakage	Estimation of overall emission

	emissions (tonnes of CO2e)	**(tonnes of CO2e)**	**(tonnes of CO2e)**	**reductions (tonnes of CO2e)**
2010	169,824	280,938	0	111,114
2011	169,824	280,938	0	111,114
2012	169,824	280,938	0	111,114
2013	169,824	280,938	0	111,114
2014	169,824	280,938	0	111,114
2015	169,824	280,938	0	111,114
2016	169,824	280,938	0	111,114
2017	169,824	280,938	0	111,114
2018	169,824	280,938	0	111,114
2019	169,824	280,938	0	111,114
Total (tonnes of CO2e)	1,698,243	2,809,379	0	111,1136

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

In addition, as the crediting period will be from 01/01/2010 or after the date of registration (whichever is later) to 31/21/2019.

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)	
Data / Parameter:	$prm_{BFG\_C}^{PRJ}$
Data unit:	%
Description:	Carbon content of BFG
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	42
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	PEL_{BFG}^{PRJ}

Data unit:	m3-BFG/t-pellet
Description:	BFG necessary for producing 1 ton of pellet
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	250
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$PEL_{ELE\_grid}^{PRJ}$
Data unit:	kWh/t-pellet
Description:	Electricity consumed from power grid for producing 1 ton of pellet
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	35
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$PEL_{ELE\_SG}^{PRJ}$
Data unit:	kWh/t-pellet
Description:	Electricity consumed from on-site power generation for producing 1 ton of pellet
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of	The data is based on actual performance of plant operation.

measurement methods and procedures to be applied:	Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$prm_{COG\_C}^{PRJ}$
Data unit:	%
Description:	Carbon content of COG
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	42
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	DRF_{COG}^{PRJ}
Data unit:	m3-COG/t-sponge iron
Description:	COG necessary for producing 1 ton of sponge iron
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	364
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$DRF_{ELE\_grid}^{PRJ}$
Data unit:	kWh/t-sponge iron

Description:	Electricity consumed from power grid for producing 1 ton of sponge iron
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	30
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$DRF_{ELE\_SG}^{PRJ}$
Data unit:	kWh/t-sponge iron
Description:	Electricity consumed from on-site power generation for producing 1 ton of sponge iron
Source of data to be used:	Actual measurement
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 data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$ELF_{ELE\_grid}^{PRJ}$
Data unit:	kWh/t-crdue steel
Description:	Electricity consumed from power grid for producing 1 ton of crude steel
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	380
Description of	The data is based on actual performance of plant operation.

measurement methods and procedures to be applied:	Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$ELF_{ELE\_SG}^{PRJ}$
Data unit:	kWh/t-crdue steel
Description:	Electricity consumed from on-site power generation for producing 1 ton of crude steel
Source of data to be used:	Actual measurement
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 data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$CSTL_{pellet}^{PRJ}$
Data unit:	t-pellet/t-crude steel
Description:	Pellet necessary for producing 1 ton of crude steel
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.54
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$CSTL_{spongeiron}^{PRJ}$

Data unit:	t-sponge iron/t-crude steel
Description:	Sponge iron necessary for producing 1 ton of crude steel
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.10
Description of measurement methods and procedures to be applied:	The data is based on actual performance of plant operation. Monitoring equipment is calibrated and checked by the company itself. In addition, some important parts of this equipment are replaced frequently.
QA/QC procedures to be applied:	The accuracy is checked by some useful evidences.
Any comment:	

Data / Parameter:	$PRD_{crd\_stl}^{PRJ}$
Data unit:	t-crude steel/y
Description:	Crude steel produced in project case
Source of data to be used:	Actual measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Monitoring is to be conducted through usual recording method for production, adopted in the factory. Estimate based on planned production volume of sponge iron and sponge iron necessary to produce 1 ton of crude steel. Planned production volume of sponge iron: 170,000t Sponge iron necessary to produce 1 ton of crude steel: 1.10t
Description of measurement methods and procedures to be applied:	Daily product volume is recorded and compiled annually.
QA/QC procedures to be applied:	The accuracy is checked by evidences such as shipping tickets and receipts.
Any comment:	

B.7.2. Description of the monitoring plan:

>>
The monitoring plan is established according to the requirement of NM xxxx.

In order to achieve the real, credible CERs of the project design document has calculated, it needs the managers of project participants to ensure the safe operation of the project, to satisfy the information need of the DOE for verifying project as part of verification and certification process, to establish and maintain the appropriate monitoring system.
The environmental manager will be requested to be responsible for all interrelated CDM activity.

The quality assurance and quality control for recording, maintaining and archiving data shall be approved as the part of this CDM project activity. This is on going process that ensured by the CDM mechanism in terms of need for verification emission on the annual basis.
The company will have ISO9002 and ISO14001 certificate, therefore, they will develop both quality control system and quality assurance system as well as environmental management system for daily usual operation. In this CDM project, these management systems will be utilized effectively.

Monitoring system
The project owner will establish its CDM project implementation team within the company to implement the project in accordance with the official rules by the United Nations and to conduct monitoring. Liaison section will take care of communication with Kyushu Electric Co., a project participant. Application section is in charge of confirmation of the latest information on UNFCCC, Kyoto Protocol and CDM.
The steel production line of the company is divided into some parts. Each part has a responsible person who will monitor and check the data required. Each personnel will transcribe data on a specific sheet. The items that are subject to monitoring in this CDM project are consistent with the items needed for its quality management in regular operations for clinker and cement manufacturing. The project operator will acquire ISO 9001 and ISO 14001 certificates and conduct measurement and management for each monitoring item according to the rules in their regular operation. So it will be effective to employ this measurement/management system as it is into this CDM project.
Besides each monitoring item, relevant purchasing slips etc. are also calculated in order to ensure preciseness by crosschecking.

Education on CDM
As mentioned above, items for monitoring are consistent with that conducted in the regular operation. It is important, from CDM perspective, to catch up with the latest information to make clear the purpose and the scope of responsibility of the project as well as to be able to correspond to any changes in CDM rules. Therefore, in the CDM project implementation team, members share the latest information regarding CDM, while holding company-wide training to deepen employees' understanding and knowledge on CDM. As a part of such education, some staffs will participate in a seminar on CDM which is organized by NDRC, a China's DNA.

Monitoring equipment and calibration
Monitoring equipment will be used in usual operation and located in production lines. The equipment must be calibrated for normal operation of steel making. The calibration will be done by the qualified inspector.

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):

>>
Date of completion of the application of the baseline study and monitoring methodology: xx/xx/2009.

Contact information of the person responsible:

Table 18 Contact information of the person responsible

Entity	Contact details	Project participants
Beris Engineering and Research Corporation	Mr. Zhao Zong Bo Phone: +86-0335-8387878	No

	Fax: 86-0338-8051397 E-mail: zbzh@shou.com	
Mizuho Information & Research Institute Co., Inc. Tokyo, Japan	Mr. Takuya Nakamura Phone: +81-3-5281-5410 Fax: +81-3-5281-5466 E-mail: takuya.nakamura@mizuho-ir.co.jp	No

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:

>>

The starting date of the project activity is 01/01/2010.

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

>>

Operational lifetime is estimated to be 21 years and 0 months. It was assumed in consideration of the general lifetime of the steel production line.

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

Fixed crediting period has chosen.

C.2.1. Renewable crediting period:

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

>>

Not applicable (NA)

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/01/2010 or after the date of registration (whichever is later)

C.2.2.2. Length:

>>

10 years and 0 months

SECTION D. Environmental impacts

>>

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

>>

For implementation of the project activity in China, following the procedures specified by the Environmental Impact Assessment (EIA) Law, operators are required to conduct EIA and meet its environmental standards which are mainly set for air, water, noise and solid waste.

Regarding air quality, outlet concentration is assessed based on emission standards. For emission standards (for SO2 and dusts), China's national standard of "GB9078-1996" (Emission Standard for Air Pollutants from Industrial Kiln and Furnace) is applied. For environmental impacts as result of emissions, China's national standard of "GB3095-1996" (Ambient Air Quality Standard) is applied for assessment of atmospheric concentration (SO2, NO2, TSP) within a certain distance from flues.

Regarding water quality, what to be assessed is impact of domestic waste water to ground water, since there is no industrial wastewater, which means that outlet concentration is not subject to assessment. For coverage of assessment on environmental impact as result of discharge, "ground water within industrial premise" is applied. Ground water quality applied is in accordance with China's national standard of "GB/T14848-93" (groundwater quality standard).

Regarding noise, both facility operators and builders are required to satisfy standards for noise environment. Standard values in China's national standard "GB12348-90" (Standard of Noise at Boundary of Industrial Enterprises) are applied for facility operation, while China's national standard "GB12532-90" (Noise Standard for Construction Work Site) for construction period. Moreover, for environmental impact of these types of noise on neighbouring area, China's national standard "GB3096-1993" (Standard of Environmental Noise of Urban Area) is applied.

Regarding solid waste, national standard "GB 18599-2001" (Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes) is applied.

As above, to satisfy environmental laws and regulations is indispensable for implementation of this new project, therefore analyses results should fall within the boundaries of relevant laws and regulations.

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:

>>

It is assumed that environmental impact of this project would be at a negligible level as long as it meets the aforementioned laws and regulations. Moreover, for implementation of the project, maximum attention is to be paid not to generate further environmental impacts. If any problems occur with regard to levels of environmental impacts, the project will be promptly halted for recovery from environmental impacts.

SECTION E. Stakeholders' comments

>>

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

>>

A stakeholders' comments have been obtained through two routes.

The first one is for the players related to steel industry in China, which was held on 1st of December, 2008 in Beijing City with having 4 participants. Kyushu Electric Power Co. delivered an explanation on the CDM project.

The second one is for the players related to the local governments, which was held on 15th of January, 2009 in Shijiazhuang City with having 6 participants. Mizuho Information & Research Institute delivered an explanation on the CDM project.

- Stakeholder's meeting with China Steel Industry Association
  - Schedule: 1st of December 2008
  - Location: China Steel Industry Association office at Beijing City
  - Participants: Staffs of China Steel Industry Association and Kyushu Electric Power Co, Inc. The persons have been invited by official invitation.
  - Methods: Kyushu Electric Power Co., Inc. has demonstrated the summary of Kyoto mechanism and this iron-making CDM project in Hebei Province and then received some comments from the stakeholders.

- Stakeholder's meeting with Hebei Province Environmental Protection and Hebei Province Cokes Industry Association
  - Schedule: 15th of January 2009
  - Location: Hebei Province Environmental Protection office at Shijiazhuang City
  - Participants: Governmental staffs of Hebei Province Environmental Protection, Hebei Province Cokes Industrial Association, Kyushu Electric Power Co, Inc., and Mizuho Information & Research Institute. The persons have been invited by official invitation.
  - Methods: Mizuho Information & Research Institute has demonstrated the summary of Kyoto mechanism and this iron-making CDM project in Hebei Province and then received some comments from the stakeholders.

E.2. Summary of the comments received:

>>

Stakeholders' comments we received are summarized as follows.

- Stakeholder's meeting with China Steel Industry Association

This project will promote energy conservation and CO2 emission reduction in Hebei Province. A staff of China Steel Industry Association gave a positive comment regarding this project that it will actively promote the implementation of this Project.

For reference, there have been approx. 30 CDM projects for iron & steel sector, some of which have already registered by the CDM Executive Board.

- Stakeholder's meeting with Hebei Province Environmental Protection and Hebei Province Environmental Protection

COG can be used for energy purpose, as actually used for such as methyl alcohol (for gasoline additives, coatings, etc.), city gas, power generation and heating. In this project, COG is utilized as reducing agent in direct reduction steelmaking process, before being used in the aforementioned ways: calorific value of the COG remains intact before/after the process, which allows using the COG as an energy source. This means that surplus COG is utilized two times. In this regard, Hebei Province Environmental Protection Department and Hebei Coke Industry Association gave positive comment that this project is reasonable in terms of utilizing surplus COG two times, as reducing agent and energy source, which they consider is worth supporting.

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

>>

No additional action was required because any issues were not raised.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	BERIS Engineering and Research Corporation
Street/P.O.Box:	47 West Hebei Dajie, P.O.Box 119
Building:	
City:	Qinhuangdao
State/Region:	Hebei Province
Postcode/ZIP:	066004
Country:	P.R. China
Telephone:	86-0335-8387878
FAX:	86-0338-8051397
E-Mail:	zbzh@shou.com
URL:	http://www.beris.com.cn
Represented by:	Zhao Zong Bo
Title:	Director & Deputy General Manager
Salutation:	Mr.
Last name:	Zhao
Middle name:	Zong
First name:	Bo
Department:	-
Mobile:	86-13633338333
Direct FAX:	86-0338-8051397
Direct tel:	86-0335-8387878
Personal e-mail:	zbzh@shou.com

Organization:	Tangshan City Zhengnan Burut Limited Company
Street/P.O.Box:	Houyujiadiancun, Yuehezhen, Kaiping
Building:	
City:	Tangshan City
State/Region:	Hebei Province
Postcode/ZIP:	063002
Country:	P.R. China
Telephone:	86-0315-2972858
FAX:	86-0315-2972898
E-Mail:	
URL:	
Represented by:	Liu Chong Qing
Title:	General Manager & Senior Engineer
Salutation:	Mr.
Last name:	Liu
Middle name:	Chong
First name:	Qing
Department:	-
Mobile:	86-13831502676

Direct FAX:	86-0315-2972898
Direct tel:	86-0315-2972858
Personal e-mail:	

Organization:	Mizuho Information & Research Institute, Inc.
Street/P.O.Box:	3-1 Kanda-Nishikicho
Building:	-
City:	Chiyoda-ku
State/Region:	Tokyo
Postcode/ZIP:	101-0054
Country:	Japan
Telephone:	+81-3-5281-5410
FAX:	+81-3-5281-5466
E-Mail:	takuya.nakamura@mizuho-ir.co.jp
URL:	http://www.mizuho-ir.co.jp/
Represented by:	Takuya Nakamura
Title:	Consultant
Salutation:	Mr.
Last name:	Nakamura
Middle name:	-
First name:	Takuya
Department:	Environment, Natural Resources and Energy Division
Mobile:	-
Direct FAX:	+81-3-5281-5466
Direct tel:	+81-3-5281-5410
Personal e-mail:	takuya.nakamura@mizuho-ir.co.jp

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding or official development assistant (ODA) has been used on this project activity

Annex 3

BASELINE INFORMATION

Baseline emission factor for electricity

Step 1. Calculation of the Operating Margin Emission Factor

Table A 1 Calculation of CO_2 emissions of North China Power Grid in 2003.

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Carbon emission factor	Oxidation rate	Low caloric value	CO2 emission
									(kgCO2/TJ)	(%)	（MJ/t,km3）	(t-CO2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J/1000
Raw coal	10000 ton	714.73	1052.74	5482.64	4528.51	3949.32	6808.00	22535.94	89500	100	20908	**421,707,383.00**
Cleaned coal	10000 ton						9.41	9.41	89500	100	26344	**221,867.85**
Other washed coal	10000 ton	6.31		67.28	208.21		450.90	732.70	89500	100	8363	**5,484,175.24**
Coke	10000 ton					2.80		2.80	87300	100	28435	**69,506.51**
Coke oven gas	108 m3	0.24	1.71		0.90	0.21	0.02	3.08	37300	100	16726	**192,154.98**
Other coal gas	108 m3	16.92		10.63		10.32	1.56	39.43	37300	100	5227	**768,755.28**
Crude oil	10000 ton						29.68	29.68	71100	100	41816	**882,421.30**
Gasoline	10000 ton						0.01	0.01	67500	100	43070	**290.72**
Diesel	10000 ton	0.29	1.35	4.00		2.91	5.40	13.95	72600	100	42652	**431,966.66**
Fuel oil	10000 ton	13.95	0.02	1.11		0.65	10.07	25.80	75500	100	41816	**814,533.86**
LPG	10000 ton							0.00	61600	100	50179	**0.00**
Refinery gas	10000 ton			0.27			0.83	1.10	48200	100	46055	**24,418.36**
Natural gas	108 m3		0.50				1.08	1.58	54300	100	38931	**334,004.62**
Other petloreum product	10000 ton							0.00	69300	100	38369	**0.00**
Other energy	10000 ton	9.83					39.21	49.04	0	100	0	**0.00**
											Total	**430,931,478.39**

Source: China Energy Statistical Year Book (2004) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table A 2 Calculation of CO2 emissions of Northeast Power Grid in 2003.

Fuel Type	Unit	Liaoning	Jilin	Heilong jiang	Total	Carbon emission factor	Oxidation rate	Low caloric value	CO2 emission
						(kgCO2/TJ)	(%)	（MJ/t,km3）	(t-CO2e)
		A	B	C	G=A+B+C	H	I	J	K=G*H*I*J/1000
Raw coal	10000 ton	3556.51	2006.66	2763.62	8326.79	89500	100	20908	155,816,390.16
Cleaned coal	10000 ton	70.83		3.00	73.83	89500	100	26344	1,740,754.88
Other washed coal	10000 ton	617.04	15.90	53.41	686.35	89500	100	8363	5,137,250.82
Coke	10000 ton				0.00	87300	100	28435	0.00
Coke oven gas	10^8 m^3	1.66			1.66	37300	100	16726	103,564.05
Other coal gas	10^8 m^3	5.31			5.31	37300	100	5227	103,527.53
Crude oil	10000 ton	3.39			3.39	71100	100	41816	100,788.69
Gasoline	10000 ton					67500	100	43070	0.00
Diesel	10000 ton	0.32	0.34		0.66	72600	100	42652	20,437.13
Fuel oil	10000 ton	14.87	0.70	4.32	19.89	75500	100	41816	627,948.78
LPG	10000 ton	1.55			1.55	61600	100	50179	47,910.91
Refinery gas	10000 ton	4.03		0.46	4.49	48200	100	46055	99,671.31
Natural gas	10^8 m^3		0.04	4.47	4.51	54300	100	38931	953,392.94
Other petloreum product	10000 ton				0.00	69300	100	38369	0.00
Other energy	10000 ton	29.38			29.38	0	100	0	0.00
								Total	164,751,637.20

Source: China Energy Statistical Year Book (2004) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table A 3 Power generation of Northeast Power Grid in 2003.

Region	Generation (MWh)	Self usage rate （%）	Supply (MWh)
Liaoning	79751000	7.17	**74032853.3**
Jilin	29739000	7.32	**27562105.2**
Heilong jiang	48493000	8.48	**44380793.6**
Total			**145975752.1**

Source: China Electric Power Year Book (2004)

Table A 4 Power generation of North China Power Grid in 2003.

Region	Generation (MWh)	Self usage rate (%)	Supply (MWh)
Beijing	18608000	7.52	**17208678.4**
Tianjin	32191000	6.79	**30005231.1**
Hebei	108261000	6.50	**101224035.0**
Shanxi	93962000	7.69	**86736322.2**
Inner Mongolia	65106000	7.66	**60118880.4**
Shandong	139547000	6.79	**130071758.7**
Total			**425364905.8**

Source: China Electric Power Year Book (2004)

The CO2 emission of North China Power Grid in 2003: 430,931,478.39 t-CO2
The power supply of thermal plants in North China Power Grid in 2003: 425,364,905.8 MWh
The import electricity from Northeast Power Grid to North China Power Grid in 2003: 4,244,380 MWh
The CO2 emission of Northeast Power Grid in 2003: 164,751,637.20 t-CO2
Therefore, the emission factor of Operating Margin of North China Power Grid in 2003 is 1.013700 t-CO2/MWh.

Table A 5 Calculation of CO_2 emissions of North China Power Grid in 2004.

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Carbon emission factor	Oxidation rate	Low caloric value	CO2 emission
									(kgCO2/TJ)	（%）	（MJ/t,km3）	(t-CO2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J/1000
Raw coal	10000 ton	823.09	1410.00	6299.80	5213.20	4932.20	8550.00	27228.29	89500	100	20908	**509,513,733.15**
Cleaned coal	10000 ton						40.00	40.00	89500	100	26344	**943,115.20**
Other washed coal	10000 ton	6.48		101.04	354.17		284.22	745.91	89500	100	8363	**5,583,050.57**
Coke	10000 ton					0.22		0.22	87300	100	28435	**5,461.23**
Coke oven gas	10^8 m^3	0.55		0.54	5.32	0.40	8.73	15.54	37300	100	16726	**969,509.21**
Other coal gas	10^8 m^3	17.74		24.25	8.20	16.47	1.41	68.07	37300	100	5227	**1,327,141.05**
Crude oil	10000 ton							0.00	71100	100	41816	**0.00**
Gasoline	10000 ton								67500	100	43070	**0.00**
Diesel	10000 ton	0.39	0.84	4.66				5.89	72600	100	42652	**182,385.92**
Fuel oil	10000 ton	14.66		0.16				14.82	75500	100	41816	**467,883.41**
LPG	10000 ton							0.00	61600	100	50179	**0.00**
Refinery gas	10000 ton		0.55	1.42				1.97	48200	100	46055	**43,731.06**
Natural gas	10^8 m^3		0.37		0.19			0.56	54300	100	38931	**118,381.38**
Other petloreum product	10000 ton							0.00	69300	100	38369	**0.00**
Other energy	10000 ton	9.41		34.64	109.73	4.48		158.26	0	100	0	**0.00**
											Total	**519,154,392.19**

Source: China Energy Statistical Year Book (2005) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table A 6 Calculation of CO2 emissions of Northeast Power Grid in 2004.

Fuel Type	Unit	Liaoning	Jilin	Heilong jiang	Total	Carbon emission factor	Oxidation rate	Low caloric value	CO2 emission
						(kgCO2/TJ)	(%)	（MJ/t,km3）	(t-CO2e)
		A	B	C	G=A+B+C	H	I	J	K=G*H*I*J*44/12/1000
Raw coal	10000 ton	4144.20	2310.90	3084.80	9539.90	89500	100	20908	178,516,905.13
Cleaned coal	10000 ton	84.75	1.09	4.88	90.72	89500	100	26344	2,138,985.27
Other washed coal	10000 ton	577.67	14.26	61.00	652.93	89500	100	8363	4,887,105.96
Coke	10000 ton				0.00	87300	100	28435	0.00
Coke oven gas	10^8 m^3	4.83	2.91		7.74	37300	100	16726	482,882.97
Other coal gas	10^8 m^3	57.33	4.19		61.52	37300	100	5227	1,199,437.60
Crude oil	10000 ton				0.00	71100	100	41816	0.00
Gasoline	10000 ton					67500	100	43070	0.00
Diesel	10000 ton	2.04	1.16	0.24	3.44	72600	100	42652	106,520.81
Fuel oil	10000 ton	12.81	1.78	2.86	17.45	75500	100	41816	550,915.35
LPG	10000 ton	2.19			2.19	61600	100	50179	67,693.48
Refinery gas	10000 ton	9.79		1.14	10.93	48200	100	46055	242,629.71
Natural gas	10^8 m^3		0.03	2.53	2.56	54300	100	38931	541,172.04
Other petloreum product	10000 ton				0.00	69300	100	38369	0.00
Other energy	10000 ton	26.97	5.07		32.04	0.0	100	0	0.00
								Total	188,734,248.33

Source: China Energy Statistical Year Book (2005) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table A 7 Power generation of Northeast Power Grid in 2004.

Region	Generation (MWh)	Self usage rate （%）	Supply (MWh)
Liaoning	84543000	7.21	**78447449.7**
Jilin	33242000	7.68	**30689014.4**
Heilong jiang	53482000	7.84	**49289011.2**
Total			**158425475.3**

Source: China Electric Power Year Book (2005)

Table A 8 Power generation of North China Power Grid in 2004.

Region	Generation (MWh)	Self usage rate （%）	Supply (MWh)
Beijing	18579000	7.94	17103827.4
Tianjin	33952000	6.35	31796048.0
Hebei	124970000	6.50	116846950.0
Shanxi	104926000	7.70	96846698.0
Inner Mongolia	80427000	7.17	74660384.1
Shandong	163918000	7.32	151919202.4
Total			489173109.9

Source: China Electric Power Year Book (2005)

The CO2 emission of North China Power Grid in 2004: 519,154,392.19 t-CO2
The power supply of thermal plants in North China Power Grid in 2004: 489,173,109.9 MWh
The import electricity from Northeast Power Grid to North China Power Grid in 2004: 4,514,550 MWh
The CO2 emission of Northeast Power Grid in 2004: 188,734,248.33 t-CO2
Therefore, the emission factor of Operating Margin of North China Power Grid in 2004 is 1.061729 t-CO2/MWh.

Table A 9 Calculation of CO2 emissions of North China Power Grid in 2005.

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Carbon emission factor	Oxidation rate	Low caloric value	CO2 emission
									（tc/TJ）	（%）	（MJ/t,km3）	(t-CO2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J/1000
Raw coal	10000 ton	897.75	1675.20	6726.50	6176.45	6277.23	10405.40	32158.53	89500	100	20908	**601,771,637.99**
Cleaned coal	10000 ton						42.18	42.18	89500	100	26344	**994,514.98**
Other washed coal	10000 ton	6.57		167.45	373.65		108.69	656.36	89500	100	8363	**4,912,779.12**
Coke	10000 ton					0.21	0.11	0.32	87300	100	28435	**7,943.60**
Coke oven gas	10^8 m^3	0.64	0.75	0.62	21.08	0.39		23.48	37300	100	16726	**1,464,869.77**
Other coal gas	10^8 m^3	16.09	7.86	38.83	9.88	18.37		91.03	37300	100	5227	**1,774,785.51**
Crude oil	10000 ton					0.73		0.73	71100	100	41816	**21,703.76**
Gasoline	10000 ton			0.01				0.01	67500	100	43070	**290.72**
Diesel	10000 ton	0.48		3.54		0.12		4.14	72600	100	42652	**128,196.56**
Fuel oil	10000 ton	12.25		0.23		0.06		12.54	75500	100	41816	**395,901.34**
LPG	10000 ton							0.00	61600	100	50179	**0.00**
Refinery gas	10000 ton			9.02				9.02	48200	100	46055	**200,230.56**
Natural gas	10^8 m^3	0.28	0.08		2.76			3.12	54300	100	38931	**659,553.43**
Other petloreum product	10000 ton							0.00	69300	100	38369	**0.00**
Other energy	10000 ton	8.58		32.35	69.31	7.27	118.90	236.41	89500	100	0	**0.00**
											Total	**612,332,407.34**

Source: China Energy Statistical Year Book (2006) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table A 10 Calculation of CO2 emissions of Northeast Power Grid in 2005.

Fuel Type	Unit	Liaoning	Jilin	Heilong jiang	Total	Carbon emission factor	Oxidation rate	Low caloric value	CO2 emission
						(kgCO2/TJ)	(%)	（MJ/t,km3）	(t-CO2e)
		A	B	C	G=A+B+C	H	I	J	K=G*H*I*J*44/12/1000
Raw coal	10000 ton	4305.41	2446.13	3383.21	10134.75	89500	100	20908	189,648,130.94
Cleaned coal	10000 ton				0.00	89500	100	26344	0.00
Other washed coal	10000 ton	524.74	19.26	24.16	568.16	89500	100	8363	4,252,612.26
Coke	10000 ton				0.00	87300	100	28435	0.00
Coke oven gas	10^8 m^3	1.03	3.57	0.68	5.28	37300	100	16726	329,408.53
Other coal gas	10^8 m^3	12.62	8.37		20.99	37300	100	5227	409,235.94
Crude oil	10000 ton	1.16			1.16	71100	100	41816	34,488.16
Gasoline	10000 ton				0.00	67500	100	43070	0.00
Diesel	10000 ton	1.18	1.48	0.57	3.23	72600	100	42652	100,018.09
Fuel oil	10000 ton	9.32	2.46	1.55	13.33	75500	100	41816	420,842.50
LPG	10000 ton	0.12			0.12	61600	100	50179	3,709.23
Refinery gas	10000 ton	5.48		1.32	6.80	48200	100	46055	150,949.87
Natural gas	10^8 m^3		0.84	2.24	3.08	54300	100	38931	651,097.62
Other petloreum product	10000 ton				0.00	69300	100	38369	0.00
Other energy	10000 ton	16.18			16.18	0	100	0	0.00
								Total	196,000,493.14

Source: China Energy Statistical Year Book (2006) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Table A 11 Power generation of Northeast Power Grid in 2005.

Region	Generation (MWh)	Self usage rate （%）	Supply (MWh)
Liaoning	83697000	7.03	**77813100.9**
Jilin	35294000	6.59	**32968125.4**
Heilong jiang	58000000	7.96	**53383200.0**
Total			**164164426.3**

Source: China Electric Power Year Book (2006)

Table A 12 Power generation of North China Power Grid in 2005.

Region	Generation (MWh)	Self usage rate （%）	Supply (MWh)
Beijing	20880000	7.73	19,265,976
Tianjin	36993000	6.63	34,540,364
Hebei	134348000	6.57	125,521,336
Shanxi	128785000	7.42	119,229,153
Inner Mongolia	92345000	7.01	85,871,616
Shandong	189880000	7.14	176,322,568
Total			560,751,013

Source: China Electric Power Year Book (2006)

The CO2 emission of North China Power Grid in 2005: 612,332,407.34 t-CO2
The power supply of thermal plants in North China Power Grid in 2005: 560,751,013 MWh
The import electricity from Northeast Power Grid to North China Power Grid in 2005: 23,423,000 MWh
The CO2 emission of Northeast Power Grid in 2005: 196,000,493.14 t-CO2
Therefore, the emission factor of Operating Margin of North China Power Grid in 2005 is 1.092098 t-CO2/MWh.

As a result, Operating Margin Emission Factor of North China Power Grid is calculated in Table A 13.
Therefore, EF_{OM} = 1.05981 t-CO2/MWh.

Table A 13 Operating Margin Emission Factor of North China Power Grid.

Year	Total Emission (t-CO2)	Total Supplied Power (MWh)	Emission Factor (t-CO2/MWh)	EF_{OM} (t-CO2/MWh)
2003	435,495,079	429,609,286	1.013700	
2004	524,162,537	493,687,660	1.061729	
2005	637,975,480	584,174,013	1.092098	
Total	1,597,633,097	1,507,470,959		1.059810199

Step 2. Calculation of the Build Margin Emission Factor

Sub step 1. Calculation of percentage of each fuel
The CO2 emission percentage of coal, oil and gas fired in the total emissions of North China Power Grid is calculated.

Table A 14 Calculation of CO2 emissions of North China Power Grid in 2005.

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Shandong	Inner Mongolia	Total	Low Caloric Value	Carbon emission factor	Oxidation rate	CO2 emission
										(kgCO2/TJ)	（%）	(t-CO2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J/10000/1000
Raw coal	10000 ton	897.75	1675.20	6726.50	6176.45	10405.40	6277.23	32158.53	20908	89500	100	601,771,638
Cleaned coal	10000 ton	0.00	0.00	0.00	0.00	42.18	0.00	42.18	26344	89500	100	994,515
Other washed coal	10000 ton	6.57	0.00	167.45	373.65	108.69	0.00	656.36	8363	89500	100	4,912,779
Coke	10000 ton	0.00	0.00	0.00	0.00	0.11	0.21	0.32	28435	87300	100	7,944
Sub Total												**607,686,876**
Crude oil	10000 ton	0.00	0.00	0.00	0.00	0.00	0.73	0.73	41816	71100	100	21,704
Gasoline	10000 ton	0.00	0.00	0.01	0.00	0.00	0.00	0.01	43070	67500	100	291
Coal Tar	10000 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43070	71100	100	0
Diesel	10000 ton	0.48	0.00	3.54	0.00	0.00	0.12	4.14	42652	72600	100	128,197
Fuel oil	10000 ton	12.25	0.00	0.23	0.00	0.00	0.06	12.54	41816	75500	100	395,901
Other petloreum product	10000 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38369	69300	100	0
Sub Total												**546,092**
Natural gas	10^7 m^3	2.80	0.80	0.00	27.60	0.00	0.00	31.20	38931	54300	100	659,553
Coke oven gas	10^7 m^3	6.40	7.50	6.20	210.80	0.00	3.90	234.80	16726	37300	100	1,464,870
Other coal gas	10^7 m^3	160.90	78.60	388.30	98.80	0.00	183.70	910.30	5227	37300	100	1,774,786
LPG	10000 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50179	61600	100	0
Refinery gas	10000 ton	0.00	0.00	9.02	0.00	0.00	0.00	9.02	46055	48200	100	200,231
Sub Total												**4,099,439**
											Total	**612,332,407**

Source: China Energy Statistical Year Book (2006) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

According to Table A 14, each percentage of fuel is as follows:
The percentage for coal: 99.24%
The percentage for oil: 0.09%
The percentage for gas: 0.67%

Sub step 2. Calculation of the average emission factor of thermal power plants

Table A 15 Emission factor of thermal power plants.

Plant Type	Item	Efficiency	Carbon Emission Factor (kg-CO2/TJ)		Emission Factor (t-CO2/MWh)
		A	B	C	D=3.6/A/1000*B*C
Coal Fired	$EF_{Coal,Adv}$	35.82%	89500	1	0.8995
Gas Fired	$EF_{Gas,Adv}$	47.67%	54300	1	0.4101
Oil Fired	$EF_{Oil,Adv}$	47.67%	75500	1	0.5702

Source: China Electric Power Year Book (2006)

The average emission factor of thermal power plants is:
99.24*0.8995/100 + 0.67*0.4101/100 + 0.09*0.5702/100 = 0.895927164 t-CO2/MWh.

Sub step 3. Calculation of Build Margin Emission Factor

Table A 16 Installed capacity of North China Power Grid in 2003.

Plant type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal	MW	3347.5	6008.5	17698.7	15035.8	11421.7	30494.4	84006.6
Hydro	MW	1058.1	5.0	764.3	795.7	592.1	50.8	3266.0
Nuclear	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind and Others	MW	0.0	0.0	13.5	0.0	76.6	0.0	90.1
Toral	MW	4405.6	6013.5	18476.5	15831.5	12090.4	30545.2	87362.7

Table A 17 Installed capacity of North China Power Grid in 2004.

Plant type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal	MW	3458.5	6008.5	19932.7	17693.3	13641.5	32860.4	93594.9
Hydro	MW	1055.9	5.0	783.8	787.3	567.9	50.8	3250.7
Nuclear	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind and Others	MW	0.0	0.0	13.5	0.0	111.7	12.3	137.5
Toral	MW	4514.4	6013.5	20730.0	18480.6	14321.1	32923.5	96983.1

Table A 18 Installed capacity of North China Power Grid in 2005.

Plant type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal	MW	3833.5	6149.9	22333.3	22246.8	19173.3	37332.0	111068.8
Hydro	MW	1025.0	5.0	784.5	783.0	567.9	50.8	3216.2
Nuclear	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind and Others	MW	24.0	24.0	48.0	0.0	208.9	30.6	335.5
Toral	MW	4882.5	6178.9	23165.8	23029.8	19950.1	37413.4	114620.5

Table A 19 Capacity change of North China Power Grid.

	2003	2004	2005		
	A	B	C	D=C-A	
Thermal Power	84006.6	93594.9	111068.7	27062.1	99.282%
Hydro Power	3266.0	3250.7	3216.2	-49.8	-0.183%
Nuclear	0.0	0.0	0.0	0.0	0.000%
Wind and Others	90.1	137.5	335.5	245.4	0.900%
Total	87362.7	96983.1	114620.4	27257.7	100%

Therefore, EF_{BM} =0.895927164*99.282% = 0.88949 t-CO2/MWh.

Step 3. Calculation of the Combined Margin Emission Factor

The emission factor of combined margin for North China Power grid is calculated as follows:

EM_{CM} = 0.5*1.05981 + 0.5*0.88949 = 0.97465 t-CO2/MWh.

Table A 20 "Lower" effective CO2 emission factor

Energy type in China	Lower Value (kg-CO2/TJ)	Remarks
Raw coal	89500	Other Bituminous Coal
Cleaned coal	89500	Other Bituminous Coal
Other washed coal	89500	Other Bituminous Coal
Coke	87300	Coking Coal
Coke oven gas	37300	Coke Oven Gas
Other coal gas	37300	Gas Works Gas
Crude oil	71100	Crude Oil
Gasoline	67500	Motor Gasoline
Diesel	72600	Diesel Oil
Fuel oil	75500	Residual Fuel Oil
LPG	61600	Liquefied Petroleum Gas
Refinery gas	48200	Refinery Gas
Natural gas	54300	Natural Gas
Other petloreum produ	69300	Naptha
Other energy product	89500	Other Bituminous Coal
Other energy	0	-

Source: Table1.4, Chapter 1, 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Annex 4

MONITORING INFORMATION

- - - - -