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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>
Huadian Beijing Natural Gas based Power Generation Project
Version number of the document: 04
Date: 30/06/2009

A.2. Description of the project activity:

>>
Huadian Beijing Natural Gas based Power Generation Project (hereafter referred to as the Project) is sited within Zhengchangzhuang Village, Fengtai District, Beijing, P.R.China. The Project is a peak load balancing power plant including installation of two sets of 280 MW gas-steam combined cycle power generation units which use natural gas to generate electricity.

Annual consumption of natural gas by the Project is 429.01 million Nm^3. Being designed to operate 3500 hours per year with a power load factor of 0.40, it is estimated that the total power generation of the Project is 1,929,000 MWh and the net feed-in electricity to North China Grid from the Project is approximately 1,862,450 MWh per year via two 220 kV outlet circuits. In addition, the Project will supply waste steam for heating, only emissions reductions from electricity generated are claimed however.

In the gas-steam combined cycle system, natural gas is sent to the gas turbine for power generation. The flue gas is then sent to the heat recovery boiler to generate steam with a high temperature and pressure. This steam drives the steam turbine to generate more electric power.

The Project satisfies the national energy policy that requires adjusting and optimizing energy mix, enhancing energy security and achieving diversified energy supply. The Project will not only supply low-carbon electricity by means of utilization of natural gas, but also contribute to sustainable development of the local community, the host country and the world by means of:

- reducing GHG emissions compared to a business-as-usual scenario;
- compared with a coal fired power plant which installs desulphurizing equipment and has a commensurate scale to the Project, the Project can reduce emissions of SO_2, NO_X and smoke and dust[1];
- improving reliability and safety of power supply by the local grid as a peak load balancing power plant[2];
- promoting and intensifying transfer of gas-steam combined cycle power generation technology and knowledge;
- creating employment opportunities during construction of the Project and creating 208 positions for local people during operation of the Project[3].

A.3. Project participants:

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Project participants to the project activity are the following:

1 Lu Hua, Zhou Hao. *Environmental Cost Analysis of Power Plants*, Environmental Protection, 2004(4).
2 P16 of the Feasibility Study Report (hereafter referred to as the FSR)-A01-01.
3 FSR supplementary.

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
P.R.China (host)	Huadian Beijing Thermal Power Co., Ltd. (the project owner)	No
The United Kingdom of Great Britain and Northern Ireland	Global Carbon Capital Limited (the buyer)	No

More detailed contact information on the project participants is provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

>>
The Host Country is the People's Republic of China.

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

>>
Beijing

A.4.1.3. City/Town/Community etc:

>>
Zhengchangzhuang Village, Fengtai District

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

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The Project is sited within Zhengchangzhuang Village, Fengtai District, Beijing, P.R.China. The project site has geographical coordinates with east longitude of 116°15′ and north latitude of 39°50′. It lies in the northwest of Fengtai District between the West 3rd Ring Road and the West 4th Ring Road. Figure 1 is a map showing the location of Beijing. Figure 2 is a map showing the location of the Project.

Figure 1. Map showing the location of Beijing

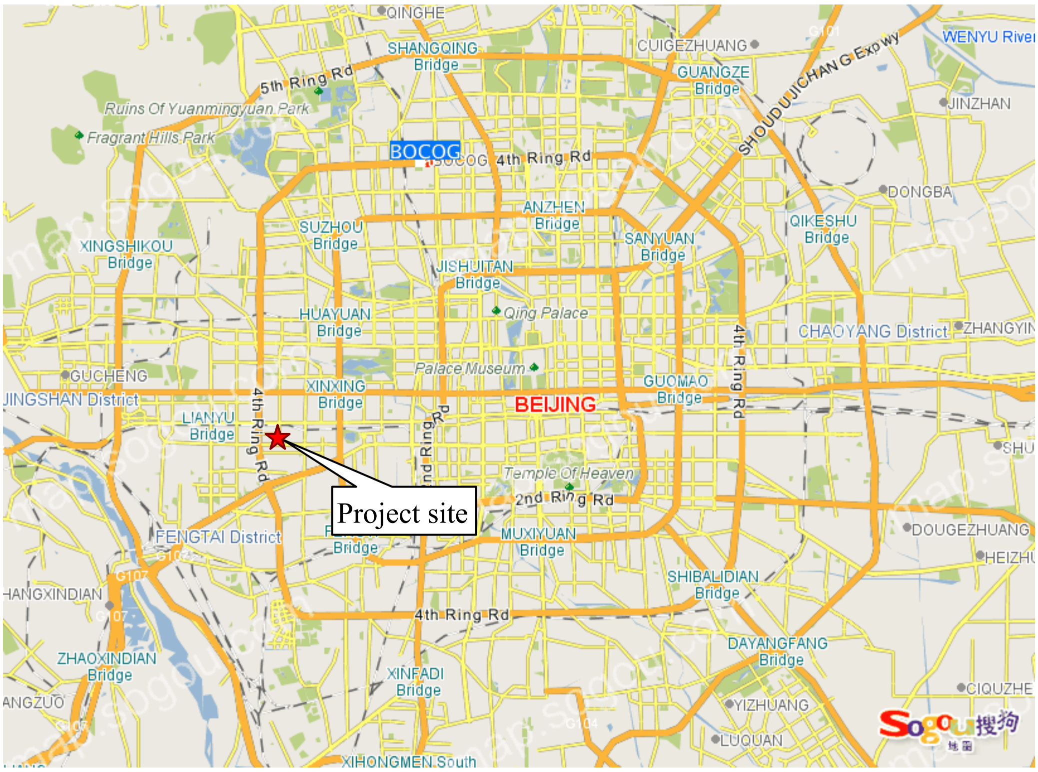

Figure 2. Map showing the location of the Project

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

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This category would fall within sectoral scope 1: energy industries (non-renewable energy).

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

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The Project includes installation of two sets of 280 MW high efficiency gas-steam combined cycle power generation units which use natural gas to generate electricity. It comprises the following activities:
• Installation of gas turbines;
• Installation of steam turbines;
• Installation of heat recovery boilers;
• Installation of a monitoring and control system;
• Installation of auxiliary systems to support the gas-steam combined cycle system.

In this system, natural gas is used as the startup fuel[4] and sent to the gas turbine for power generation. The flue gas is then sent to the heat recovery boiler to generate steam with a high temperature and pressure. This steam drives the steam turbine to generate more electric power. The Project is designed to be continuously operated in the heating season for about 3,096 hours and operated daily for a few hours in the non-heating season for about 404 hours to meet the demand. Annual consumption of natural gas by the Project is 429.01 million Nm^3. It is estimated that the feed-in electricity to North China Grid from the Project is approximately 1,862,450 MWh per year via two 220 kV outlet circuits.

Manufacture and key technical indicators of the key equipments used in the Project are illustrated in Table 1. Implementation of the Project will promote transfer of advanced gas-steam combined cycle power generation technology from abroad.

Table 1. Manufacture and key technical indicators of the key equipments of the Project

	Equipment	Type	Manufacture
1	Gas turbine	SGT5-2000E	Germany manufacturer of Siemens and Shanghai Turbine Co., Ltd.
2	power generator after gas turbine	QF-180-2	
3	Steam turbine	LZC81/57-7.78/0.65/0.15	
4	power generator after steam turbine	QF-100-2	
5	Heat recovery boiler	Q1976/543.8-242(52.9)-8(0.69)/521(213)	Wuhan Boiler Co., Ltd.

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

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Renewable crediting period (7yrs×3) is adopted by the Project. It is expected that the Project will generate emission reductions within North China Grid for about 726,820 tCO_2e per year over the first 7-year crediting period from 01/01/2010 to 31/12/2016.

4 P20 of FSR-A01-01.

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
2010	726,820
2011	726,820
2012	726,820
2013	726,820
2014	726,820
2015	726,820
2016	726,820
Total estimated reductions (tonnes of CO_2e)	**5,087,740**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**726,820**

A.4.5. Public funding of the project activity:

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There is no public funding from Annex I Parties for this Project.

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:

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AM0029 ver 03 - Approved baseline methodology AM0029 "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" and approved monitoring methodology AM0029 "Grid Connected Electricity Generation Plants using Non-Renewable and Less GHG Intensive Fuel".

Tool to calculate emission factor for an electricity system ver 01.1.

Tool for the Demonstration and Assessment of Additionality ver 05.2.

For more information regarding the methodology please refer to Hhttp://cdm.unfccc.int/methodologies/approved.html.

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

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Approved baseline methodology AM0029 "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" and approved monitoring methodology AM0029 "Grid Connected Electricity Generation Plants using Non-Renewable and Less GHG Intensive Fuel" are applicable to the Project for all conditions are satisfied by the Project. Further analysis is detailed as follows:

·*Condition: The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant*[5].
Analysis: The project activity is the construction and operation of a new natural gas fired grid connected electricity generation plant and no other fuels besides natural gas is used in the Project.

·*Condition: The geographical/physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating baseline emissions is publicly available.*
Analysis: Electricity generated by the Project will be supplied to North China Grid. With reference to *China's Regional Grid Baseline Emission Factors*[6], the geographical/physical boundaries of North China Grid can be clearly identified and information pertaining to the grid and used to estimate baseline emissions is publicly available.

·*Condition: Natural gas is sufficiently available in the region or country, e.g. future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of natural gas in the project activity*[7].
Analysis:

5 Natural gas should be the primary fuel. Small amounts of other startup or auxiliary fuels can be used, but can comprise no more than 1% of total fuel use, on energy basis.
6 Publicly available on the website of China's DNA on 15/12/2006.
7 In some situations, there could be price-inelastic supply constraints (e.g. limited resources without possibility of expansion during the crediting period) that could mean that a project activity displaces natural gas that would otherwise be used elsewhere in an economy, thus leading to possible leakage. Hence, it is important for the project proponent to document that supply limitations will not result in significant leakage as indicated here.

There is sufficient gas supply in the region for the Project. The natural gas for the Project will be supplied via the Shaanjing No. 1 line and Shaanjing No. 2 line which will bring gas from the Changqing gas field in western China to Beijing. Total natural gas reserves proved in this gas field amount to 4180 billion m^3. The present proved rate of the resource is only 8.2% meaning that the back-up resource is sufficient and the exploration potential is large[8].

The Shaanjing No. 1 line began operating in October 1997[9]. On 14th Dec., 2006, the Shaanjing No. 2 line began operating, supplying additional natural gas to Beijing from Changbei Natural Gas Station (which is part of the Changqing Oilfield Corporation)[10]. The combined total gas supply capacity to Beijing from Shaanjing No.1 line and Shaanjing No.2 line is estimated to be 15.3 billion m^3 of natural gas each year[11], of which 6.0 billion m^3 of gas supply capacity had been achieved by the end of 2005[12]. Moreover, 20 billion m^3 of gas supply capacity will be realized in 2015 for three cities including Beijing[13]. Demand for natural gas in Beijing is growing and is predicted to reach 5.8 billion m^3 in 2008, and 8.5 billion m^3 in 2014[14] Of it the Project will use approximately 429.01 million m^3. These figures indicate that sufficient natural gas will be available in Beijing for the Project and that natural gas supply in the region will not be constrained by the use of natural gas in the Project.

To summarize the analysis above, the Project fulfils all the applicable conditions of the methodology AM0029, therefore the methodology AM0029 is applied to the Project to determine the baseline scenario, estimate emission reductions and draft the monitoring plan.

According to the methodology AM0029, the emission factor of baseline grid electricity displaced by the net electricity supply of the Project is determined referring to *Tool to calculate emission factor for an electricity system* and the additionality of the Project is demonstrated and assessed referring to *Tool for the Demonstration and Assessment of Additionality*.

Data and information used in the PDD of the Project are mainly from the methodology AM0029, the FSR, *China's Regional Grid Baseline Emission Factors*, *China Energy Statistical Yearbook*, *China Electric Power Yearbook* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

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

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According to the methodology AM0029, the spatial extent of the project boundary includes the project site and all power plants connected physically to the baseline grid as defined in *Tool to calculate emission factor for an electricity system*.

Regarding the project site, the spatial extent of the project boundary covers gas turbines, gas turbine generators, steam turbines, steam turbine generators, heat recovery boilers, on-site gas transmission pipelines and auxiliary facilities.

Regarding all power plants connected physically to the baseline grid, the electricity generated by the

8 Http://www.china5e.com/dissertation/naturalgas/0009.htm.
9 P20 of FSR-A01-01.
10 Http://www.cnpc.com.cn/Paper/2006/12/19/Plate1/005.htm.
11 P20 of FSR-A01-01.
12 Http://www.china5e.com/news/oil/200506/200506130136.html.
13 LI Yangfu, LENG Feiyue. Feasibility Analysis for the Boiler Changing from Burning Oil to Gas. Industrial Boiler, No. 01, 2007.
14 Http://english.people.com.cn/200404/13/eng20040413_140287.shtml.

Project will be delivered to North China Grid, so according to the *China's Regional Grid Baseline Emission Factors*, North China Grid is defined as the electricity system boundary of the Project. It is composed of Beijing Power Grid, Tianjin Power Grid, Hebei Power Grid, Shanxi Power Grid, Inner Mongolia Power Grid and Shandong Power Grid.

The greenhouse gases included in or excluded from the project boundary are shown in Table 2.

Table 2. Overview of emissions sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	Power generation in North China Grid	CO_2	Yes	Main emission sources.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	On-site fuel combustion due to the project activity	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.

Figure 3 shows the boundary of the Project.

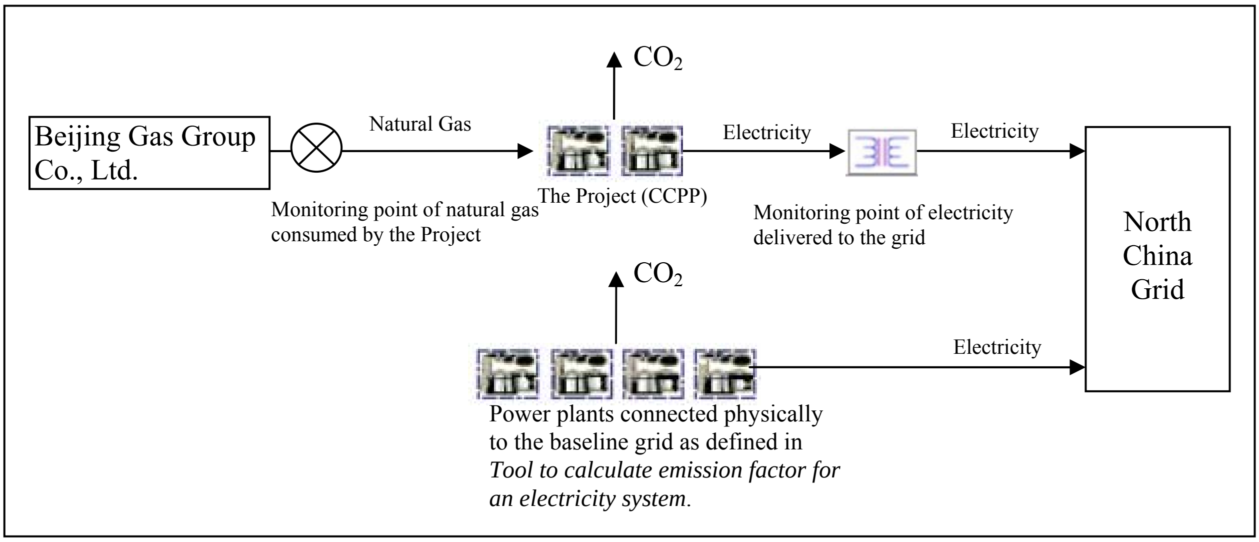

Figure 3. Project boundary

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

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According to the methodology AM0029, project participants shall use the following steps to define the baseline scenario:

1. Identify plausible baseline scenarios

The identification of alternative baseline scenarios should include all possible realistic and credible alternatives that provide outputs or services comparable with the proposed CDM project activity (including the proposed project activity without CDM benefits).

The Project is located in Beijing and construction started on 08/06/2006[15]. According to the *China Electric Power Yearbook*, relevant power plant technologies that have recently been constructed in Beijing prior to the implementation of the Project including thermal power generation technologies, hydro power generation technology and wind power generation technology (See Table A15~Table A18 for details). Wherein, thermal power plant technologies may include coal fired power plants and oil fired power plants. According to the FSR, only gas fired power plants are under construction or are being planned in Beijing from 2006 to 2010.

As per the methodology AM0029, based on the above summary and analysis, all relevant power plant technologies that have recently been constructed or are under construction or are being planned included as plausible alternatives are listed below.
Alternative a: The Project (combined cycle power generation using natural gas) not implemented as a CDM project;
Alternative b: Power generation using natural gas, but technologies other than that used by the Project, including single cycle gas turbine power plants and single cycle steam turbine power plants;
Alternative c: Power generation technologies using energy sources other than natural gas, including sub critical coal fired power plants, super critical coal fired power plants, oil fired power generation technology, hydro power generation technology, wind power generation technology, nuclear power generation technology, biomass power generation technology and solar PV power generation technology;
Alternative d: Import of electricity from North China Grid, including the possibility of new interconnections.

As per the methodology AM0029, these alternatives should deliver similar services (e.g. a peak load balancing power plant vs. a base load power plant). Therefore, analysis on the four alternatives is made from the perspective of resource, technology and delivery of similar services as follows:

For Alternative a, the Project (combined cycle power plant using natural gas) not implemented as a CDM project is plausible baseline scenario regarding resource, technology and mandatory laws and regulations.

For Alternative b, power generation using natural gas, but technologies other than that used by the Project, including single cycle gas turbine power plants and single cycle steam turbine power plants is not feasible for the following reasons:
·The temperature of exhaust gas is relatively high when single cycle gas turbine power generation technology is employed, so the waste heat in the exhaust gas is commonly recovered by installing a waste heat recovery boiler to produce steam for power generation or heat supply. Therefore, there is no large-scale single cycle natural gas turbine power generation project being operated or under construction in China[16] and it is not practical to employ the natural gas combusted single cycle power generation technology as the baseline.
·The thermal efficiency of single cycle natural gas steam turbine power generation technology is relatively low, which is only about 38%, as a consequence this technology is rarely used now[17]. Determining the single cycle natural gas steam turbine power generation technology as the baseline is not practical.

For Alternative c, power generation technologies using energy sources other than natural gas, including sub critical coal fired power plant, super critical coal fired power plant, oil fired power generation

15 *Permission of Construction Start* of the Project issued by the Consultant.
16 Http://www.ntet.net.cn/html/UploadFile/2005620164910134.doc.
17 Http://www.hdrqw.com/news/20060505-31.htm.

technology, hydro power generation technology, wind power generation technology, nuclear power generation technology, biomass power generation technology and solar PV power generation technology are partly feasible, further analysis is detailed as follows:
·According to the *Directive Catalog on Industry Structure Adjustment of Beijing* (2007 Edition), Degree No. JFG[2007]2039 (Nov. of 2007), "construction of conventional coal fired generators with a unit installed capacity equal to or less than 300 MW is restricted"[18]. Therefore, according to the installed capacity commonly used in China currently, sub critical coal fired power generation technology with the unit installed capacity of 600 MW and super critical coal fired power generation technology with the unit installed capacity of 600 MW are selected and considered as baseline alternatives. As per *Notice on Grid-connecting Operation and Management of Power Plants* issued by the State Electric Regulation Commission on 22/07/2003[19], coal fired power plants with installed capacity of more than 100 MW could provide peak load balancing services no less than 50% of the rated capacity.
·For oil fired power generation technology, since the Project is covered by North China Grid and the use of fuel oil in North China Grid declined by over 65% between 2002 and 2004, oil fired power generation technology can not be seen as part of current or future power generation technologies[20].
·For hydro power generation technology, since the Project is covered by North China Grid and the installed capacity of hydropower in North China Grid declined between 2002 and 2005 (See Annex 3 Table A18 for details), hydro power generation technology can not be seen as part of the possibly realistic and credible alternatives that provide outputs or services comparable with the Project.
·For wind power generation technology, since the Project is a power plant having peak load balancing function, while wind power generation technology can not undertake peak load balancing function, wind power generation technology can not be seen as part of the possibly realistic and credible alternatives that provide outputs or services comparable with the Project.
·For biomass power generation technology, since there are no economically exploitable biomass resources with a commensurate scale to the Project[21], it can not be seen as part of the possibly realistic and credible alternatives that provide outputs or services comparable with the Project.
·For nuclear power generation technology, since nuclear power plant can not undertake peak load balancing function as regulated by Safety Management Regulation on Grid-connected Nuclear Power Plants' Power Generation (Document No.GWYFG[1997])[22], it can not be seen as part of the possibly realistic and credible alternatives that provide outputs or services comparable with the Project.
·For solar PV power generation technology, since the installed capacity of the largest solar PV farm in China is only 8 MW[23], it can not be seen as part of the possibly realistic and credible alternatives that provide outputs or services comparable with the Project.

For Alternative d, North China Grid is composed of Beijing Power Grid, Tianjin Power Grid, Hebei Power Grid, Shanxi Power Grid, Inner Mongolia Power Grid and Shandong Power Grid. The Project is located in Beijing. According to the FSR, the installed power generation capacity can not meet the load demand of Beijing at least from 2005 to 2010. Since Beijing Power Grid is suffered from electricity shortage and this situation will continue, it is not feasible to import electricity from Beijing Power Grid. Beijing Power Grid is physically connected with South Hebei Power Grid, Shanxi Power Grid, West

18 Http://www.bjpc.gov.cn/tztg/200711/P020071128353167653156.doc.
19 Http://law.lawtime.cn/d645936651030.html.
20 According to *China Energy Statistical Yearbook*, 359,500 tonnes of fuel oil were used to generate electricity in North China Grid in 2002 and just 125,400 tonnes in 2005, a reduction of more than 65%.
21 Http://www.bjagri.gov.cn/detail?model=00000000000000005135&documentid=27345.
22 Provisions on Safety Management of Power Generation in On-grid Nuclear Power Plants (Http://www.powersafety.com.cn/default/Article/200402/432.html).
23 Http://market.ccidnet.com/pub/article/c1798_a135747_p1.html.

Inner Mongolia Power Grid and Northeast China Grid[24]. South Hebei Power Grid[25], Shanxi Power Grid[26], West Inner Mongolia Power Grid[27] and Northeast China Grid[28] are all suffer from lack of capacity of peak load regulation. Therefore, it is not feasible for Beijing Power Grid to import electricity from the other power grids or new interconnections to undertake the function of peak load regulation. Since the Project is a peak load balancing power plant, import of electricity from other power grids or new interconnections to undertake the function of peak load balancing is not feasible. Therefore, Alternative d (import of electricity from North China Grid, including the possibility of new interconnections) could not undertake the function of peak load balancing as the Project thus not feasible.

All power plant technologies that have recently been constructed or are under construction or are being planned in Beijing are analysed above. To summarize, the possible alternatives that provide outputs or services comparable with the Project include:
Alternative a: The Project (combined cycle power plant using natural gas) not implemented as a CDM project;
Alternative c(1): Sub-critical coal fired power plant with a unit capacity of 600 MW;
Alternative c(2): Super-critical coal fired power plant with a unit capacity of 600 MW.

2. Identify the most economically attractive baseline scenario alternative.

According to the methodology AM0029, the most economically attractive baseline scenario alternative is identified using investment analysis. Corresponding financial indicators for all alternatives remaining after step 1 should be calculated using the levelized cost of electricity generation in RMB/kWh as the financial indicator for investment analysis.

According to the *International Comparisons of Electricity Generation by Types & Costs*[29] written by Nathan Ilten, The formula applied to calculate the levelised electricity generation cost (EGC) is the following:

$$EGC = \frac{\sum_t \left[(I_t + M_t + F_t)((1+r)^{-t}) \right]}{\sum_t \left[E_t (1+r)^{-t} \right]} \qquad (1)$$

where,

EGC : Average lifetime levelised electricity generation cost in RMB/kWh.
I_t : Total project cost in the year t in RMB.
M_t : O&M expenses in the year t in RMB.
F_t : Fuel cost in the year t in RMB.
E_t : Electricity generation in the year t in kWh.
r : Discount rate.

24 Http://www.ncgc.com.cn/submodal_dwdd.htm.
25 Http://www.huanghua.gov.cn/html/200701/09/092348572.htm.
26 Http://blog.sina.com.cn/s/blog_4b4ad05b010008h5.html).
27 Http://www.nmgdlxw.cn/readNews.asp?id=4307.
28 Http://www.sxcoal.com/energy/2009/02/17/290640/article.html.
29 Http://people.cs.uchicago.edu/~nilten/docs/final.pdf#search='International%20Comparisons%20of%20Electricity%20 Generation%20by%20Types%20%26%20Costs'.

The relevant parameters and assumptions for Alternative a, Alternative c(1) and Alternative c(2) are listed in Table 3. And the results of the levelised electricity generation cost (EGC) are listed in Table 4.

Table 3. Parameters and assumptions for calculating the levelised EGC of each alternative[30]

Item	Unit	Alternative a	Alternative c(1)	Alternative c(2)
Total project cost	RMB/kW	3767	3938	4074
Construction period	Years	2	3	3
Technical lifetime	Years	20	20	20
O&M expenses				
Materials	RMB/MWh	12	5	5
Others (miscellaneous accounts)[31]	RMB/MWh	16	10	10
Water	RMB/MWh	2	1	1
Desulfuration	RMB/MWh	0	1.11	1.09
Employee	Person/MW	0 (suppose 0 for conservtive)	0.34	0.34
Salary	RMB/year	50000	50000	50000
Maintenance fee rate	%	2.5	2.5	2.5
Fuel consumption[32]	-	0.1750 m^3/kWh	305 gSCe/kWh	299 gSCe/kWh
NCV of fuel[33]	-	35.1597 MJ/Nm^3	29271.2 MJ/tSCe	29271.2 MJ/tSCe
Power generation efficiency[34]	-	58.51%	40.32%	41.13%
Fuel price	-	1.40 RMB/m^3 (including VAT)	400 RMB/tSCe	400 RMB/tSCe
Annual operation hours	h	3,500	5,000	5,000
Load factor	-	0.40	0.57	0.57

30 If not specifically indicated otherwise, data are from the Feasibility Study Report of the Project and P64, P165~167 of the Thermal Power Engineering Design Reference Cost Guide (2004 edition) published by China Institute of Power Planning and Design.

31 Including expenses relevant to daily office and business operation, such as administrative expense, travelling expense, traffic & commuting expense and business entertainment, not including maintenance, salary and social welfare.

32 Fuel consumption of the Project is obtained from P5 of the FSR-A03-02. Fuel consumption of the coal fired power plants are obtained from Circular of the National Development and Reform Commission on Requirements on Planning and Construction of Coal Fired Power Plants (Document No.NDRCEnergy[2004]864) and P165~167 of the Thermal Power Engineering Design Reference Cost Guide (2004 edition). The Guide was published by China Institute of Power Planning and Design as design guide of power plants for design institutes in China.

33 The NCV of natural gas is obtained from P31 of FSR-A02-01. The data of NCV of standard coal equivalent (SCe) are obtained from the *China Energy Statistical Yearbook*. The conversion factor is adopted as 1 kcal = 4.1816 kJ (http://www.hntj.gov.cn/tjabc/tjjz/200704030061.htm).

34 Data for the Project is obtained from P5 of the FSR-A03-02. Data for the coal fired power plants are calculated based on the data of NCV of fuel and the data of energy consumption for power generation.

Table 4. Results of the levelised EGC of each alternative

Item	Unit	Alternative a	Alternative c(1)	Alternative c(2)
EGC	RMB/kWh	0.4168	0.2425	0.2436

Taking the total project cost, the load factor, the fuel cost and the efficiency as uncertainty factors, sensitivity analysis is made, and the calculation results are listed in Table 5.

Table 5. Sensitivity analysis of the levelised EGC of each alternative (RMB/kWh)

Item	Variation	Alternative a	Alternative c(1)	Alternative c(2)
Total project cost	+20%	0.4451	0.2631	0.2650
Total project cost	-20%	0.3884	0.2218	0.2222
Load factor	+20%	0.3932	0.2252	0.2258
Load factor	-20%	0.4522	0.2683	0.2704
Fuel cost	+20%	0.4658	0.2669	0.2675
Fuel cost	-20%	0.3678	0.2181	0.2197
Efficiency	+20%	0.3759	0.2220	0.2235
Efficiency	-20%	0.4780	0.2732	0.2738

According to the methodology AM0029, the baseline alternative with the best financial indicator, i.e. the lowest levelised EGC, can be pre selected as the most plausible scenario. It can be drawn from Table 4 and Table 5 that Alternative c(1) (the sub-critical coal fired power plant with a unit capacity of 600 MW) is the most plausible scenario with the lowest levelised EGC. The sensitivity analysis provided above further confirms and supports that Alternative c(1) (the sub-critical coal fired power plant with a unit capacity of 600 MW) remains the lowest levelised EGC alternative even considering variations of key assumptions. Therefore, Alternative c(1) (the sub-critical coal fired power plant with a unit capacity of 600 MW) would be built to provide comparable services in the absence of the Project. Alternative c(1) (the sub-critical coal fired power plant with a unit capacity of 600 MW) is identified as the baseline scenario of the Project.

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):

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The additionality of the Project is demonstrated and assessed referring to *Tool for the Demonstration and Assessment of Additionality* approved by CDM EB.

The Project signed *Equipment Procurement Contract* on 28/02/2006 for turbines and generators, and 03/04/2006 for boilers. The Project signed *Civil Engineering Contract* on 25/04/2006. After this, the Project applied for *Permission of Construction Start* and started construction on 08/06/2006 when approved. According to the definition of the “the start date of a CDM project activity” provided in paragraph 67 of EB41 meeting report, the starting date of the Project is determined as 28/02/2006. The starting date of the Project is prior to both 02/08/2008 and the date of publication of the PDD for global stakeholder consultation. According to *Guidance on the Demonstration and Assessment of Prior Consideration of the CDM* (Annex 45 of EB41), the timeline is provided to demonstrate the prior consideration of CDM of the Project as below.

Date	Activity	Support documents
11/11/2005	EIA approval	EIA approval (Document No.JHS[2005]1065[35])
14/12/2005	FSR approval	FSR approval (Document No.JFG[2005]2604[36])
15/12/2005	CDM decision	Board Declaration issued by the project owner which pointed out that "CDM assistance was deemed as decisive factor in implementation of the Project. CDM consulting contract was seriously discussed and CDM application should be carried out immediately".
16/12/2005	CDM Consulting	*CDM Consulting Contract*
28/02/2006	Equipment	*Equipment Procurement Contract of turbines and generators*
03/04/2006	Equipment	*Equipment Procurement Contract of boilers*
25/04/2006	Engineering	*Civil Engineering Contract*
08/06/2006	Engineering	*Permission of Construction Start*
05/12/2006	CDM	*Term Sheet of Emission Reductions*
22/03/2007	CDM	LOA was issued by China's DNA
30/03/2007	CDM	Global stakeholder process (validation) started.
09/07/2008	CDM	One more time global stakeholder process in line with EB's requirement when a new version of the methodology AM0029 was issued.

The FSR of the Project is finalized by North China Power Engineering (Beijing) Co. Ltd. (hereafter referred to as the NCPE). NCPE, established in 1953, is a large scale enterprise majoring in survey, design, engineering, consulting and EPC and has Class A integrated qualification in engineering[37]. Therefore, the FSR compiled by NCPE is a reliable data source of input values.

During the process applying for government approvals necessary for implementation of the Project, the project owner kept communicating with consultants and the local government regarding the CDM development of the Project. With the detailed data of the Project provided in the FSR and the FSR supplementary by NCPE, as analyzed in Step 1 (Benchmark investment analysis) below, the project owner realized that the Project is not economically attractive without CERs sales revenues. The importance of applying CDM for the Project was further confirmed by the Board of Directors of the project owner on 15/12/2005 as
"Under the current electricity tariff standard of Beijing, the Project will take a loss once implemented. CDM revenues will be decisive to the smooth implementation and profits of the Project. Relevant departments should try their best to cooperate to start the application for CDM. CDM Consulting Service Agreement handed in by the department of production and technology has been discussed and finalized on the meeting.".

Then, the project owner signed *CDM Consulting Contract* on 16/12/2005. The project owner's practice regarding CERs sales revenues was also supported by the local government in the form of a supporting letter. All of these CDM related activities are prior to 28/02/2006, the actual action of the Project.

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35 Approval of Beijing Municipal Environmental Protection Bureau on the Environment Impact Assessment Report of the Project (Document No.JHS[2005]1065).
36 Approval of Beijing Municipal Commission of Development and Reform on the Project (Document No.JFG[2005]2604).
37 Http://www.ncpe.com.cn/ncpeInternet/NCPE/Gsjj/gsjs.aspx.

Although the project owner faced difficulties in finding a satisfied buyer in early 2006, they finally signed *Term Sheet of Emission Reductions* on 05/12/2006. Three months later, PDD of the Project was publicly available for global stakeholder process (validation) on 30/03/2007. At the same time, LOA was issued by China's DNA on 22/03/2007. On 09/07/2008, the PDD of the Project was updated for one more time global stakeholder process in line with EB's requirement when a new version of the methodology AM0029 was issued.

As described above, CDM was seriously considered in the decision to implement the Project. Detailed timeline of the Project is summarized below for clear understanding. Contracts, permission, meeting minutes and etc. listed in the timeline are provided to the DOE as evidences.

According to the methodology AM0029, the assessment of additionality comprises the following steps:

Step 1: Benchmark investment analysis
According to the methodology AM0029, this step will demonstrate that the proposed CDM project activity is unlikely to be financially attractive by applying sub-step 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators), and 2d (Sensitivity Analysis) of *Tool for the Demonstration and Assessment of Additionality* approved by the CDM EB.

According to *Interim Rules on Economic Assessment of Electric Power Retrofit Projects* published in March 2003, the benchmark IRR for the Project is 8%. On the basis of the above benchmark, calculation and comparison of financial indicators are carried out.

Sub-step 1a. Calculation and comparison of financial indicators

The FSR and its supplementary which provide detailed parameters and assumptions of the FSR were finalized by NCPE. NCPE, established in 1953, is a large scale enterprise majoring in survey, design, engineering, consulting and EPC and has Class A integrated qualification in engineering[38]. Therefore, the FSR compiled by NCPE is a reliable data source of input values. According to the FSR and its supplementary, basic parameters and assumptions for calculation of financial indicators of the Project are listed in Table 6:

38 Http://www.ncpe.com.cn/ncpeInternet/NCPE/Gsjj/gsjs.aspx

Table 6. Basic parameters and assumptions

Item	Value	Unit	Source
total project cost	210,940	10000RMB	FSR supplementary
working capital	5,930	10000RMB	P29 of FSR-A03-02
annual generated electricity	1,929,000	MWh	P4 of FSR-A03-02
annual heat generation	3,111,000	GJ	FSR supplementary
annual operating hour	3500	hours	P4 of FSR-A03-02
auxiliary electricity consumption rate	3.45%		FSR supplementary
efficiency of electricity and heat generation	66.66%		P5 of FSR-A03-02
bus-bar tariff (including VAT)	0.480	RMB/kWh	Document No.JFG[2005]883[39]
heat price (including VAT)	27	RMB/GJ	P28 of FSR-A03-02
Natural gas consumption	429,010,000	m^3	P5 of FSR-A02-01
Natural gas price (including VAT)	1.40	RMB/m^3	P5 of FSR-A03-02, the same as that in the letter issued by the natural gas company on 19/11/2004
VAT of electricity	17%		P6 of FSR-A03-02
VAT of heat	13%		P6 of FSR-A03-02
VAT of Natural gas	13%		P6 of FSR-A03-02
VAT of water	13%		P6 of FSR-A03-02
VAT of materials	13%		P6 of FSR-A03-02
income tax	33%		P6 of FSR-A03-02
urban maintenance and construction tax	7%		P6 of FSR-A03-02
surtax for education	3%		P6 of FSR-A03-02
technical lifetime	20	years	FSR-A03-02
depreciation	15	years	P34 of FSR-A03-02
residual value	5%		P5 of FSR-A03-02
social welfare	49.5%		P5 of FSR-A03-02
water	2	RMB/MWh	FSR supplementary
maintenance rate	2.50%		P5 of FSR-A03-02
employee	208	persons	FSR supplementary
salary	5	10000 RMB	P5 of FSR-A03-02
materials	12	RMB/MWh	P5 of FSR-A03-02
miscellaneous accounts	16	RMB/MWh	P5 of FSR-A03-02

In accordance with the benchmark analysis (Option III), if the project IRR of the Project is lower than the benchmark, the Project is not considered as financially attractive. The project IRR of the Project is 3.69% which is below the benchmark (8%). Thus the Project is not financially attractive.

Sub-step 1b. Sensitivity analysis

In the Project, the following financial parameters were taken as uncertainty factors for sensitivity analysis of financial attractiveness:

- Total project cost
- Annual O&M expenses

39 Circular on Transmitting Document of the National Development and Reform Commission on Issues Concerning Implementation of Coal and Electricity Prices' Linkage in North China Grid (Document No.JFG[2005]883).

- Annul operation hours
- Natural gas price
- Bus-bar tariff

Based on the sensitivity analysis, the project IRR of the Project could reach the benchmark if one of the following conditions can be achieved:

- Total project cost was decreased by at least 32%;
- Annul operation hours were increased by 42%;
- Annual O&M expenses were decreased by at least 82%;
- Natural gas price were decreased by at least 20%;
- Bus-bar tariff were increased by at least 14%.

However, none of these conditions can be achieved due to the following reasons:

·Price of major equipments keeps increasing
According to P10 of FSR-A03-02, the main part of the total project cost (more than 50%) is the equipment cost. The major equipments of gas-steam combined cycle power generation projects, especially the gas turbine, can only be supplied by very few advanced equipment manufacturers over the world. It is difficult to decrease the total project cost as much as 32%. In fact, as per *Thermal Power Engineering Design Reference Cost Guide* (2004 edition and 2007 edition)[40], the per kW project cost of gas-steam combined cycle power plant had been increased by 1.6%.

·Annual operation hours keeps stable for years
Load factor for gas fired power plants keeps stable for several years as per *Thermal Power Engineering Design Reference Cost Guide* (2004 edition and 2007 edition). The Guide is published by China Institute of Power Planning and Design as a design guide of power plants for design institutes in China. China has abundant coal resources. According to the research by State Power Economic Research Institute[41], China will mainly resort to coal for power generation until around 2050. According to *Interim Measures on Power Purchase Planning of Power Gird Operating Enterprises*, electricity generated by natural gas power plants is mainly used to meet the demand of peak load balancing and frequency modulation." Under such circumstances, the fact that natural gas power plant mainly functions for peak load balancing will be continued in foreseeable future[42]. Therefore, it is impossible to increase the annual operation hours as much as 42%.

·Annual O&M cost is determined by long term operation experience thus stable
Annual O&M cost comprises maintenance cost, salary, insurance cost and miscellaneous accounts. It is impossible to decrease the annual O&M cost as much as 82%.

·Natural gas price keeps increasing
Natural gas price keeps increasing for years. The natural gas price in 2004 was 1.40 RMB/m^3. Then, it was increased to 1.55 RMB/m^3 by the end of 2005[43], three months before the Project actually started. By

40 P171 of the Thermal Power Engineering Design Reference Cost Guide (2004 edition) and P292 of the Thermal Power Engineering Design Reference Cost Guide (2007 edition).
41 Http://www.cnmn.com.cn/Show_20344.aspx.
42 Http://info.westpower.com.cn/cgi-bin/Ginfo.dll?DispLaw&w=westpower&ac=&gr=505&pr=0&lid=15809.
43 Circular on Adjustment of the Sales Prices of Non-civil Natural Gas in Beijing (Document No.JFG[2006]1468).

the end of 2007, the natural gas price increased[44] again to 1.95 RMB/m^3. Since the natural gas price kept increasing prior to the implementation of the Project and kept the increasing trend, it is impossible to decrease the natural gas price as much as 20%.

·Bus-bar tariff adopted in the investment analysis is the highest at that time

A reform for electric power system in China, *Electric Power System Reform* was issued by China State Council on 10/02/2002, which breaks the state-monopoly of the electricity supply system, separates electric power generation and electric grid operation into two different sectors, and promotes market competition and other benefits[45]. On 09/07/2003, *Circular on the Electricity Tariff Reform Scheme* (Document No.GBF[2003]62) was issued by the General Office of the State Council, which further deepens the reform of the electricity tariff system and promotes market competition[46]. The Project was approved by the end of 2005. Therefore only bus-bar tariff issued from 2004 to 2005 reflect similar policy environment to the Project thus can be referred to make the construction decision of the Project. The highest bus-bar tariff of all the thermal power plants located in Beijing was 0.48 RMB/kWh from 2004 to 2005[47, 48], which is adopted in the investment analysis. Therefore, it is impossible to increase the bus-bar tariff of the Project by 14%. Actually, the approved bus-bar tariff of the Project is 0.452 RMB/kWh[49], which is 6% lower than the bus-bar tariff adopted in the investment analysis.

To summarize, the project IRR of the Project could not reach the benchmark according to the sensitivity analysis and the additionality of the Project would not be influenced.

Step 2: Common practice analysis.

According to the methodology AM0029, this step will demonstrate that the project activity is not a common practice in the relevant country and sector by applying Step 4 (common practice Analysis) of *Tool for the Demonstration and Assessment of Additionality* agreed by the CDM EB.

Sub-step 2a. Analyze other activities similar to the project activity:

As per "Tool for the demonstration and assessment of additionality" (V05.2), "projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc."

The Project is a newly built combined cycle power plant using natural gas as fuel. Beijing is provincial area in China. In China, key economic parameters (such as bus-bar tariff and fuel price) were controlled by government at provincial level[50]. Consider of comparable environment with respect to regulatory

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44 Circular of Beijing Municipal Commission of Development and Reform Transmitting Document of the National Development and Reform Commission on Issues Concerning Adjustment of Natural Gas Prices (Document No.JFG[2007]2154).

45 Http://www.ahdl.org.cn/display.asp?id=1081.

46 Http://law.chinalawinfo.com/newlaw2002/SLC/SLC.asp?Db=chl&Gid=57816.

47 Circular on Transmitting Circular of the National Development and Reform Commission on Issues Concerning Mediation of Conflict on the Electricity Tariff of North China Grid (Document No.JFG[2004]1061).

48 Circular on Transmitting Document of the National Development and Reform Commission on Issues Concerning Implementation of Coal and Electricity Prices' Linkage in North China Grid (Document No.JFG[2005]883).

49 Circular on Enhancing the Electricity Tariff of North China Gird by the National Development and Reform Commission (Document No.NDRCPrice[2008]1677).

50 For example in the *Notice on the Adjustment of Electricity Price of North China Grid issued by National Development and Reform Commission* on 28/06/2006, it was clearly pointed out that the bus-bar tariff for different provinces within North China Grid were different on provincial level.

framework and investment climate, Beijing, as the provincial level that covers the location of the Project, is selected as the region for common practice analysis.

According to Page 14 of the FSR and government statistics of Beijing[51], combined cycle power plants using natural gas constructed or under construction in Beijing that have a comparative scale with the Project are summarized in Table 8.

Table 8. Candidate activities that may be similar to the Project

No.	Project	Installed capacity	Under CDM development? (Y/N)
1	Beijing No.3 Thermal Power Plant Gas-Steam Combined Cycle Project Using Natural Gas	2×350 MW	Y[52]
2	Beijing Taiyanggong CCGT Trigeneration Project	2×350 MW	Y[53]
3	Beijing Caoqiao Thermal Power Plant Gas-Steam Combined Cycle Project Using Natural Gas	2×350 MW	Y[54]

Following the clarification made in the EB38 meeting report (paragraph 60), since the first two projects listed in Table 8 are project activities which have been registered as CDM projects (ref.1373 and ref.1320) on the UNFCCC CDM website, both of these projects are not identified as similar activities to the Project. Since the CDM development of the last project has been started simultaneously with the first project, it is not identified as a similar activity to the Project.

Sub-step 2b. Discuss any similar options that are occurring:
All of the three combined cycle power plants using natural gas are developing or developed as CDM projects. Therefore, the Project is not a common practice.

Step 3: Impact of CDM registration
According to the methodology AM0029, this step will describe the impact of the registration of the project activity.

If the Project can be successfully registered as a CDM project, the following impacts will result:
·Guarantee the loan payback, supplement the bus-bar tariff of the Project and improve the financial indicators of the Project to reach the benchmark;
·Be one of the sources to serve as the maintenance fund for the gas-steam combined cycle power generation units therefore to guarantee the successful implementation of the Project.

Considering the CERs sales revenues (calculated on the assumption that CERs price is 11 EURO/tCO_2e during 20 years of operation period)[55], the project IRR of the Project will be significantly improved to reach the benchmark, as shown in Table 9.

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51 *The Bus-bar Tariff of Power Plants in Beijing* (http://www.bjpc.gov.cn/syjg/syjg_ggspxxjg/200605/t119695.htm) issued by Beijing Development and Reform Commission.
52 Http://cdm.unfccc.int/Projects/DB/TUEV-SUED1191500853.33/view.
53 Http://cdm.unfccc.int/Projects/DB/SGS-UKL1188570070.22/view.
54 Page 45 of the report issued by the World Bank titled *CDM in China: Taking a Proactive and Sustainable Approach*.
55 Calculate based on an exchange rate of 1 EURO=10 RMB.

Table 9. Comparison of the project IRR of the Project with and without CERs sales revenues

	Without CERs sales revenues	With CERs sales revenues
The project IRR (%)	3.69	8.35

To summarize, without CERs sales revenues, the project IRR of the Project is below the benchmark; while with the CERs sales revenues, the project IRR of the Project will be significantly improved to reach the benchmark. Therefore, the Project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The methodology AM0029 is applied in the context of the Project in the following four steps:
·First, calculate the baseline GHG emissions;
·Second, calculate the project GHG emissions;
·Third, calculate the project leakage;
·Fourth, calculate the emission reductions.

I. Calculate the baseline GHG emissions

Baseline emissions are calculated by multiplying the electricity generation of power plant ($EG_{PJ,y}$) with a baseline CO_2 emission factor ($EF_{BL,CO2,y}$), as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{BL,CO2,y} \qquad (2)$$

In order to address this uncertainty in a conservative manner, project participants shall use for $EF_{BL,CO2,y}$ the lowest emission factor among the following three options:
Option 1. The build margin, calculated according to *Tool to calculate the emission factor for an electricity system*; and
Option 2. The combined margin, calculated according to *Tool to calculate the emission factor for an electricity system*, using a 50/50 OM/BM weight.
Option 3. The emission factor of the technology (and fuel) identified as the most likely baseline scenario under “Identification of the baseline scenario” above, and calculated as follows:

$$EF_{BL,CO2}(tCO_2/MWh) = \frac{COEF_{BL}}{\eta_{BL}} * 3.6GJ/MWh \qquad (3)$$

where,
$COEF_{BL}$: The fuel emission coefficient (tCO_2e/mass or volume unit), based on national average fuel data, if available, otherwise IPCC defaults can be used;
η_{BL} : The energy efficiency of the technology, as estimated in the baseline scenario analysis above.

Option 1. The build margin, calculated according to the Tool to calculate the emission factor for an electricity system

In accordance with *Tool to Calculate the Emission Factor for an Electricity System*, the project electricity

system of the Project is identified according to the delineation of the project electricity system and connected electricity systems published by China's DNA.

Electricity generated by the Project will be delivered to North China Grid. According to *China's Regional Grid Baseline Emission Factors* issued by China's DNA which provides the delineation of relevant electric power systems, North China Grid is the relevant electric power system of the Project. North China Grid is composed of Beijing Power Grid, Tianjin Power Grid, Hebei Power Grid, Shanxi Power Grid, Shandong Power Grid and Inner Mongolia Power Grid.

According to *Tool to calculate the emission factor for an electricity system*, the sample group of power units m used to calculate the build margin consists of either:
(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

It is suggested that project participants should use the set of power units that comprises the larger annual generation.

Considering data availability, CDM EB accepts the following deviation in application of methodology[56]:
1) Use of capacity additions during the last 1~3 years for estimating the build margin emission factor for grid electricity.
2) Use of weights estimated using installed capacity in place of annual electricity generation.

And it is suggested to use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

Therefore for the Project: First, calculate the share of different power generation technology in recent capacity additions. Second, calculate the weight for capacity additions of each power generation technology. And finally calculate the emission factor using the efficiency level of the best technology commercially available in China.

According to *Tool to calculate the emission factor for an electricity system*, project participants shall choose between one of the following two options to calculate the build margin emission factor ($EF_{grid,BM,y}$).
Option 1. For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.
Option 2. For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the Project Activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

56 Http://cdm.unfccc.int/Projects/Deviations.

Option 1 is adopted by the Project.

The build margin emission factor ($EF_{grid,BM,y}$) is calculated according to *Tool to calculate the emission factor for an electricity system* using equation (4):

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (4)$$

where:
$EF_{grid,BM,y}$ is the build margin CO_2 emission factor in year y (tCO_2/MWh);
$EG_{m,y}$ is the net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh);
$EF_{EL,m,y}$ is the CO_2 emission factor of power unit m in year y (tCO_2/MWh);

Since the data of installed capacity can not be separated into coal fired, oil fired and gas fired currently, the build margin emission factor is calculated by the following steps and formula:

Step a. Calculate the power generation emissions of solid fuel, liquid fuel and gas fuel and each share in the total emissions based on *Energy Balance Table* of the most recent year.

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}} \qquad (5)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}} \qquad (6)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}} \qquad (7)$$

where:
$FC_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by power plant j in year(s) y,
$NCV_{i,y}$ is the net calorific value (energy content) of fossil fuel type i in year y (GJ/ mass or volume unit);
$EF_{CO2,i,y}$ is the CO_2 emission factor of fuel i in year y (tCO_2/GJ).
COAL, OIL and GAS are footnote group for solid fuels, liquid fuels and gas fuels.

Step b. Calculate the emission factor for thermal power of the grid based on the result of Step a and the efficiency level of the best technology commercially available in China.

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \qquad (8)$$

Where $EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are emission factor proxies of efficiency level of the best coal fired, oil fired and gas fired power generation technology commercially available in China.

Step c. Calculate the build margin emission factor of the grid based on the result of Step b and the share of thermal power of recent 20% capacity additions.

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total.y}} \times EF_{Thermal,y} \quad (9)$$

Where $CAP_{Total,y}$ is the total capacity additions that most close to, but not exceed, 20% of existing capacity, while $CAP_{Thermal,y}$ is the capacity additions of thermal power.

The data on different fuel consumptions for power generation and the net calorific values of the fuels are obtained from *China Energy Statistical Yearbook* from 2002 to 2005. The emission factors of the fuels adopted are obtained from Table 1.3 and Table 1.4 on page 1.21-1.24 of volume 2 of 2006 *IPCC Guidelines for National Greenhouse Gas Inventories*.

With reference to *China's Regional Grid Baseline Emission Factors*, the build margin emission factor ($EF_{grid,BM,y}$) of North China Grid is 0.9253 tCO_2e/MWh.

Option 2. The combined margin, calculated according to the Tool to calculate the emission factor for an electricity system, using a 50/50 OM/BM weight

The combined margin (CM) is calculated based on the operating margin emission factor ($EF_{grid,OM,y}$) and the build margin emission factor ($EF_{grid,BM,y}$).

Four methods are provided in *Tool to calculate the emission factor for an electricity system* for calculation of the operating margin emission factor ($EF_{grid,OM,y}$), they are

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

As per *Tool to calculate the emission factor for an electricity system*, with reference to *China's Regional Grid Baseline Emission Factors*, method (a) simple OM is employed for calculation of the operating margin emission factor ($EF_{grid,OM,y}$) of the Project.

As per *Tool to calculate the emission factor for an electricity system*, the method (a) simple OM only can be used when low cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. Among the total electricity generation of North China Grid which the Project is connected to, the amount of low cost/must run resources accounts for about 1.13% in 2000, 0.85% in 2001, 0.89% in 2002, 0.86% in 2003 and 0.76% in 2004, all less than 50%. Thus, the method (a) simple OM can be used to calculate the baseline emission factor of operating margin ($EF_{grid,OM,y}$) of the Project.

The emission factors were determined ex ante (A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation).

Three options are provided in *Tool to Calculate the Emission Factor for an Electricity System* for determination of the simple OM emission factor ($EF_{grid,OMsimple,y}$). Since the data on the fuel consumption, net electricity generation, average efficiency and fuel type(s) used in each power unit in North China Grid are not available, Option C (based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the electricity system) is adopted to calculate the simple operating margin emission factor ($EF_{grid,OMsimple,y}$). The formula of $EF_{grid,OMsimple,y}$ calculation is

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \qquad (10)$$

where:
$EF_{grid,OMsimple,y}$ is the simple operating margin CO_2 emission factor in year y (tCO_2/MWh);
$FC_{i,y}$ is the amount of fuel i consumed in North China Grid in year y (mass or volume unit);
$NCV_{i,y}$ is the net calorific value (energy content) of fuel i in year y (GJ/ mass or volume unit);
$EF_{CO2,i,y}$ is the CO_2 emission factor of fuel i in year y (tCO_2/GJ);
EG_y is the net electricity generated and delivered to the grid by all power sources serving the North China Grid, not including low cost/must run power plants/units, in year y (MWh);
i are all fuel types combusted in power sources in North China Grid in year y;
y is the three most recent years for which data is available at the time of submission of the PDD to the DOE for validation.

Since there is net electricity import from Northeast China Grid and Central China Grid to North China Grid, weighted average of the operating margin emission factor sourced from electricity supplied by Northeast China Grid and Central China Grid will be used as the emission factor of net electricity import. With reference to *China's Regional Grid Baseline Emission Factors*, the simple OM emission factor ($EF_{grid,OM,y}$) of North China Grid is 1.0798 tCO_2e/MWh (see Annex 3 for details).

As described above, the build margin emission factor ($EF_{grid,BM,y}$) of North China Grid is calculated as 0.9253 tCO_2e/MWh. The combined margin (CM) is calculated based on the operating margin emission factor ($EF_{grid,OM,y}$) and the build margin emission factor ($EF_{grid,BM,y}$), using 50/50 OM/BM weight, as CM =0.5×1.0798+0.5×0.9253=1.00255 (tCO_2e/MWh).

Option 3. The emission factor of the technology (and fuel) identified as the most likely baseline scenario under "Identification of the baseline scenario" above

As described in Section B4, the 600 MW sub-critical coal-fired plant has been identified as the most likely baseline, then emission coefficients of coal can be calculated with formula (3) provided above as

$$EF_{BL,CO2}(tCO_2 / MWh) = \frac{COEF_{BL}}{\eta_{BL}} * 3.6GJ / MWh \qquad (3)$$

where,
$COEF_{BL}$: The fuel emission coefficient (tCO_2e/mass or volume unit), based on national average fuel data, if available, otherwise IPCC defaults can be used;

η_{BL} : The energy efficiency of the 600 MW sub-critical coal-fired plant.

According to Circular of the National Development and Reform Commission on Requirements on Planning and Construction of Coal Fired Power Plants (Document No.NDRCEnergy[2004]864), for a typical new sub-critical coal fired power plant, the coal consumption for 1 GWh is 305 tSCe. Calculated with the energy content of standard coal equivalent (SCe) of 7000 kcal/tSCe[57] and the conversion factor of 1 kcal = 4.1816 kJ[58], the energy content of standard coal equivalent (SCe) is 29.2712 GJ/tSCe. Therefore

η_{BL} = 3.6 GJ/MWh × 1000 MWh/GWh / (305 tSCe/GWh × 29.2712 GJ/tSCe) = 40.32% (11)

$EF_{BL,CO2}$ = 94600/1000/1000/40.32% × 3.6 = 0.8446 (tCO_2e/MWh) (12)

Summary
The value of the emission factor of the technology (and fuel) identified as the most likely baseline scenario under "Identification of the baseline scenario" is the lowest of the three options, therefore the baseline emission factor ($EF_{BL,CO2,y}$) of the Project is 0.8446 tCO_2e/MWh. According to the methodology AM0029, since neither option 1 (BM) nor option 2 (CM) is selected to determine the emission factor, this emission factor will be fixed for the first crediting period of the Project. The baseline emission factor will be updated at the start of the second and the third crediting period.

II. Calculate the project GHG emissions

According to the methodology AM0029, the project activity is on-site combustion of natural gas to generate electricity. Since there is no auxiliary fuel used in the Project besides natural gas, the project GHG emissions are those emissions from on-site combustion of natural gas. The CO_2 emissions from electricity generation (PE_y) are calculated as follows:

$$PE_y = FC_{NG,y} * COEF_{NG,y} \quad (13)$$

where:
$FC_{NG,y}$: is the total volume of natural gas combusted in the project plant in year(s) y (m^3);
$COEF_{NG,y}$: is the CO_2 emission coefficient in year(s) y (tCO_2/m^3) for natural gas and is obtained as:

$$COEF_{NG,y} = NCV_{NG,y} * EF_{CO2,NG,y} * OXID_{NG} \quad (13a)$$

where:
$NCV_{NG,y}$: is the net calorific value (energy content) per volume unit of natural gas in year y (GJ/m^3) as determined from the fuel supplier, wherever possible;
$EF_{CO2,NG,y}$: is the CO_2 emission factor per unit of energy of natural gas in year y (tCO_2/GJ);
$OXID_{NG}$: is the oxidation factor of natural gas.

For the Project, the net calorific value (energy content) per volume unit of natural gas in year y (GJ/m^3) is obtained from the natural gas supplier and other parameters are obtained from *2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

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57 P365 of *China Energy Statistical Yearbook* 2005 edition.
58 Http://www.hntj.gov.cn/tjabc/tjjz/200704030061.htm.

III. Calculate the project leakage

The natural gas used in the Project is not LNG. According to the methodology AM0029, leakage emission (LE_y) sources considered in the Project is equal to the fugitive CH_4 emissions ($LE_{CH4,y}$) associated with fuel extraction, processing, transportation and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity.

For the purpose of estimating fugitive CH_4 emissions, project participants should multiply the quantity of natural gas consumed by the Project in year y with an emission factor for fugitive CH_4 emissions ($EF_{NG,upstream,CH4}$) from natural gas consumption and subtract the emissions occurring from fossil fuels used in the absence of the project activity, as follows:

$$LE_{CH4,y} = \left[FC_y \cdot NCV_y \cdot EF_{NG,upstream,CH4} - EG_{PJ,y} \cdot EF_{BL,upstream,CH4}\right] \cdot GWP_{CH4} \qquad (14)$$

where:

$LE_{CH4,y}$ is the leakage emissions due to fugitive upstream CH_4 emissions in year y (tCO_2e);

FC_y is the quantity of natural gas combusted in the project plant in year y (m^3);

$NCV_{NG,y}$ is the average net calorific value of the natural gas combusted in year y (GJ/m^3);

$EF_{NG,upstream,CH4}$ is the emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, in t CH_4 per GJ fuel supplied to final consumers;

$EG_{PJ,y}$ is the electricity generation in the project plant in year (MWh);

$EF_{BL,upstream,CH4}$ is the emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in t CH_4 per MWh electricity generation in the project plant;

GWP_{CH4} is the global warming potential of methane valid for the relevant commitment period.

The emission factor of fugitive upstream emissions for natural gas ($EF_{NG,upstream,CH4}$) is obtained from Table 2 “other oil exporting countries/rest of world” provided in the methodology AM0029.

According to the methodology AM0029, the emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity ($EF_{NG,upstream,CH4}$) should be calculated consistent with the baseline emission factor ($EF_{BL,CO2,y}$) used above. Since Option 3 (the emission factor of the technology (and fuel) identified as the most likely baseline scenario under “Identification of the baseline scenario”) is selected for the calculation of the baseline emission factor, relevant emission factor for upstream fugitive CH_4 emissions ($EF_{BL,upstream,CH4}$) is calculated as follows:

$$EF_{BL,upstream,CH4} = \frac{EF_{k,upstream,CH4}}{\eta_{BL}} * 3.6GJ/MWh \qquad (15)$$

where:

$EF_{BL,upstream,CH4}$ is the emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in t CH_4 per MWh electricity generation in the project plant;

$EF_{k,upstream,CH4}$ is the emission factor for upstream fugitive methane emissions from production of coal in t CH_4 per MJ fuel produced;

η_{BL} is the energy efficiency of the most likely baseline technology.

The emission factor of fugitive upstream emissions for coal ($EF_{k,upstream,CH4}$) including fugitive emissions from underground coal production, is obtained from Table 2 provided in the methodology AM0029.

Since all natural gas used in the Project comes from domestic gas fields and no natural gas imported from other countries is used in the Project, upstream emissions occurring in Annex I countries that have ratified the Kyoto Protocol are not necessary to be excluded.

In case where the total net leakage effects are negative ($LE_y < 0$), $LE_y = 0$ is assumed for the Project (See Section B.3 for details.).

IV. Calculate the emission reductions
To calculate the emission reductions the following equation is applied:

$$ER_y = BE_y - PE_y - L_y \quad (16)$$

where:

ER_y is the emissions reductions in year y (tCO_2e),

BE_y is the emissions in the baseline scenario in year y (tCO_2e),

PE_y is the emissions in the project scenario in year y (tCO_2e),

L_y is the leakage in year y (tCO_2e).

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

Data/Parameter:	$CAP_{j,y}$
Data unit:	MW
Description:	Total installed capacity of province j of North China Grid in year y
Source of data used:	*China Electric Power Yearbook* from 2000 to 2005
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China Electric Power Yearbook* issued by authorized entity in China are reliable.
Any comment:	-

Data/Parameter:	$F_{i,j,y}$
Data unit:	t or m^3
Description:	Consumption of fuel i of province j of North China Grid in year y
Source of data used:	*China Energy Statistical Yearbook* from 2000 to 2005
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China Energy Statistical Yearbook* issued by authorized entity in China are reliable.
Any comment:	-

Data/Parameter:	$GEN_{j,y}$
Data unit:	MWh
Description:	Total power generation of province j of North China Grid in year y
Source of data used:	*China Electric Power Yearbook* from 2003 to 2005
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China Electric Power Yearbook* issued by authorized entity in China are reliable.
Any comment:	-

Data/Parameter:	$r_{j,y}$
Data unit:	-
Description:	Auxiliary electricity consumption rate of province j of North China Grid in year y
Source of data used:	*China Electric Power Yearbook* from 2003 to 2005
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China Electric Power Yearbook* issued by authorized entity in China are reliable.
Any comment:	For calculation of electricity output to the grid by province j in year y.

Data/Parameter:	NCV_i
Data unit:	TJ per mass or volume unit of fuel i
Description:	Net calorific value of fuel i in year y
Source of data used:	P365 of *China Energy Statistical Yearbook* 2005 edition
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China Energy Statistical Yearbook* issued by authorized entity in China are reliable.
Any comment:	-

Data/Parameter:	$EF_{CO2,i}$
Data unit:	tC/TJ
Description:	CO_2 emission factor per unit of energy of the fuel i in year y
Source of data used:	*2006 IPCC Guideline for National Greenhouse Gas Inventories*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *2006 IPCC Guideline for National Greenhouse Gas Inventories* are reliable.
Any comment:	-

Data/Parameter:	$FC_{adv,coal}$
Data unit:	gCe/kWh
Description:	weighted average fuel consumption for power generation of top 11 sets of 600 MW coal fired power generation units built in 2004 (taken as efficiency level of the best technology commercially available in China)
Source of data used:	*China's Regional Grid Baseline Emission Factors.*
Value applied:	336.66
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China's Regional Grid Baseline Emission Factors* made publicly available by China's DNA are reliable.
Any comment:	-

Data/Parameter:	$FC_{adv,oil/gas}$
Data unit:	gCe/kWh
Description:	weighted average fuel consumption for power generation of 200 MW oil/gas fired combined cycle power generation units (taken as efficiency level of the best technology commercially available in China)
Source of data used:	*China's Regional Grid Baseline Emission Factors*
Value applied:	268.13
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data obtained from *China's Regional Grid Baseline Emission Factors* are reliable.
Any comment:	-

Data/Parameter:	$EF_{NG,upstream,CH4}$.
Data unit:	tCH_4/PJ.
Description:	The emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, in t CH_4 per GJ fuel supplied to final consumers.
Source of data used:	"Other oil exporting countries/rest of world" provided in Table 2 of the methodology AM0029.
Value applied:	296.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Considering data availability, use the default value provided by the methodology AM0029.
Any comment:	-

Data/Parameter:	$EF_{coal,upstream,CH4}$.
Data unit:	tCH_4/kt.
Description:	The emission factor for fugitive upstream emissions of coal.
Source of data used:	"Underground coal production" provided in Table 2 of the methodology AM0029.
Value applied:	13.4.
Justification of the choice of data or description of measurement methods and procedures actually applied :	In China, coal supplied to generate electricity is dominated by underground mining[59]. Since the reliable and accurate national data on fugitive CH_4 emissions associated with the production of coal are not available, as per the guidance on P8 of the methodology AM0029 (version 03), "the default values provided in Table 2" of the methodology AM0029 version 03 was adopted.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

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

According to formula (2), the annual baseline emissions of the Project are 1,573,025 tCO_2e as calculated in the table below.

Item	$EG_{PJ,y}$ **(MWh)**	$EF_{BL,CO2,y}$ **(tCO_2e/MWh)**	BE_y **(tCO_2e)**
I.D.	A	B	C
Data	1,862,450	0.8446	1,573,025
Data source or calculation formula	P4 of FSR-A03-02	Calculated with formula 12	C=A×B

II. Estimated project activity emissions:

According to formula (13) and formula (13a), the annual emissions of the Project are 846,205 tCO_2e as calculated in the table below.

Item	$FC_{f,y}$ (NG) **(Nm^3)**	$NCV_{f,y}$ (NG) **(MJ/Nm^3)**	$COEF_{f,y}$ (NG) **($kgCO_2/TJ$)**	$OXID_f$	PE_y **(tCO_2e)**
I.D.	D	E	F	G	H
Data	429,010,000	35.1597	56,100	1	846,205
Data source or calculation formula	P5 of FSR-A02-01	P31 of FSR-A02-01	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*	H= $D \times E \times F \times G/10^9$

III. Estimated project leakage:

According to formula (15), the emission factor for fugitive upstream emissions of the Project is estimated as 0.004087 tCH_4/MWh as shown in the table below.

59 Http://www.chinasafety.gov.cn/wangluocankao/2005-02/21/content_75631.htm.

Item	$EF_{coal,upstream,CH4}$ (tCH$_4$/kt)	$NCV_{f,y}$ (SCe) (GJ/t)	η_{BL} (%)	$EF_{BL,upstream,CH4}$ (tCH$_4$/MWh)
I.D.	I	J	K	L
Data	13.4	29.2712	40.32	0.004087
Data source or calculation formula	AM0029	Calculated based on *China Energy Statistical Yearbook* and the conversion factor (1 kcal = 4.1816 kJ)	Document No.NDRCEnergy[2004]864 [60]	K=I/1000/J/K×3.6

According to formula (14), the total net leakage effects of the Project are estimated as -161,111 tCO$_2$e shown in the table below.

Item	$EF_{NG,upstream,CH4}$ (tCH$_4$/PJ)	Auxiliary electricity consumption of the Project (%)	GWP_{CH4} (tCO$_2$e/tCH$_4$)	$LE_{CH4,y}$ (tCO$_2$e)
I.D.	M	N	O	P
Data	296	3.45	21	-161,111
Data source or calculation formula	AM0029	FSR supplementary	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*	P=[D×E×M/10^9-A/(1-N)×L]×O

Since the total net leakage effects are negative ($LE_y < 0$), $LE_y = 0$ is assumed for the Project.

IV. Estimated emission reductions

According to formula (16), the annual emission reductions of the Project are estimated as 726,820 tCO$_2$e as shown in the table below.

Item	BE_y (tCO$_2$e)	PE_y (tCO$_2$e)	$LE_{CH4,y}$ (tCO$_2$e)	ER_y (tCO$_2$e)
I.D.	C	H	Q	R
Data	1,573,025	846,205	0	726,820
Data source or calculation formula	C=A×B	H= D×E×F×G/10^6	Q=Max(0,P)	R=C-H-Q

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

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60 Circular of the National Development and Reform Commission on Requirements on Planning and Construction of Coal Fired Power Plants (Document No.NDRCEnergy[2004]864).

Renewable crediting period (7yrs×3) is adopted by the Project. It is expected that the Project will generate emission reductions of about 726,820 tCO_2e per year over the first 7-year crediting period from 01/01/2010 to 31/12/2016.

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2010	846,205	1,573,025	0	726,820
2011	846,205	1,573,025	0	726,820
2012	846,205	1,573,025	0	726,820
2013	846,205	1,573,025	0	726,820
2014	846,205	1,573,025	0	726,820
2015	846,205	1,573,025	0	726,820
2016	846,205	1,573,025	0	726,820
Total (tCO_2e)	**5,923,435**	**11,011,175**	**0**	**5,087,740**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{PJ,y}$.
Data unit:	MWh.
Description:	Net electricity delivered to the grid by the Project.
Source of data to be used:	Data used in the PDD is obtained from the FSR and actual data will be obtained from direct measurement.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,862,450
Description of measurement methods and procedures to be applied:	Measured hourly by meter(s) installed at the GIS Building and recorded monthly by the project owner.
QA/QC procedures to be applied:	Transaction notes provided by the grid company are used for cross check.
Any comment:	Bi-director meter(s) with precision of 0.2s are employed by the Project.

Data / Parameter:	$FC_{NG,y}$.
Data unit:	Nm^3.
Description:	The total volume of natural gas combusted in the project plant in year(s) y.
Source of data used:	Data used in the PDD are obtained from the FSR and actual data will be obtained from direct measurement.
Value applied:	429,010,000.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Daily measured by ELSTER G4000 gas flow meter(s) installed at the gas pipeline and recorded monthly.
QA/QC procedures to be applied:	Transaction notes provided by the gas supplier are used for cross check.
Any comment:	Precision of ELSTER G4000 gas flow meter(s) used in the Project is ±1%.

Data / Parameter:	$NCV_{NG,y}$.
Data unit:	GJ/m^3.
Description:	The net calorific value per volume unit of natural gas in year y.
Source of data used:	Data used in the PDD are obtained from the FSR and actual data will be the supplier-provided data.
Value applied:	35.1597
Justification of the choice of data or description of measurement methods and procedures actually applied :	The supplier-provided data will be obtained from periodical measurement (per two weeks). In case when the supplier-provided data is not available, local data will be used. In case when the supplier-provided data and the local data are both not available, country-specific values will be used.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$COEF_y$
Data unit:	tCO_2/m^3
Description:	CO_2 emission coefficient of the Project in year y
Source of data used:	Calculated
Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	Annually calculated with $NCV_{f,y}$, $OXID_f$ and $EF_{CO2,f}$.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	PE_y
Data unit:	tCO_2
Description:	CO_2 emission of the Project in year y
Source of data used:	Calculated
Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	Annually calculated with $FC_{f,y}$ and $COEF_y$.
QA/QC procedures to be applied:	-
Any comment:	-

B.7.2 Description of the monitoring plan:

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The Project uses natural gas as startup fuel and employs fixed baseline emission factor during the first crediting period. Therefore, key contents of the monitoring plan for the Project include monitoring of the net electricity delivered to the grid, the natural gas consumption of the Project and the net calorific value of natural gas.

1. Management structure

Please refer to Figure 5 for details regarding the management structure of the monitoring plan.

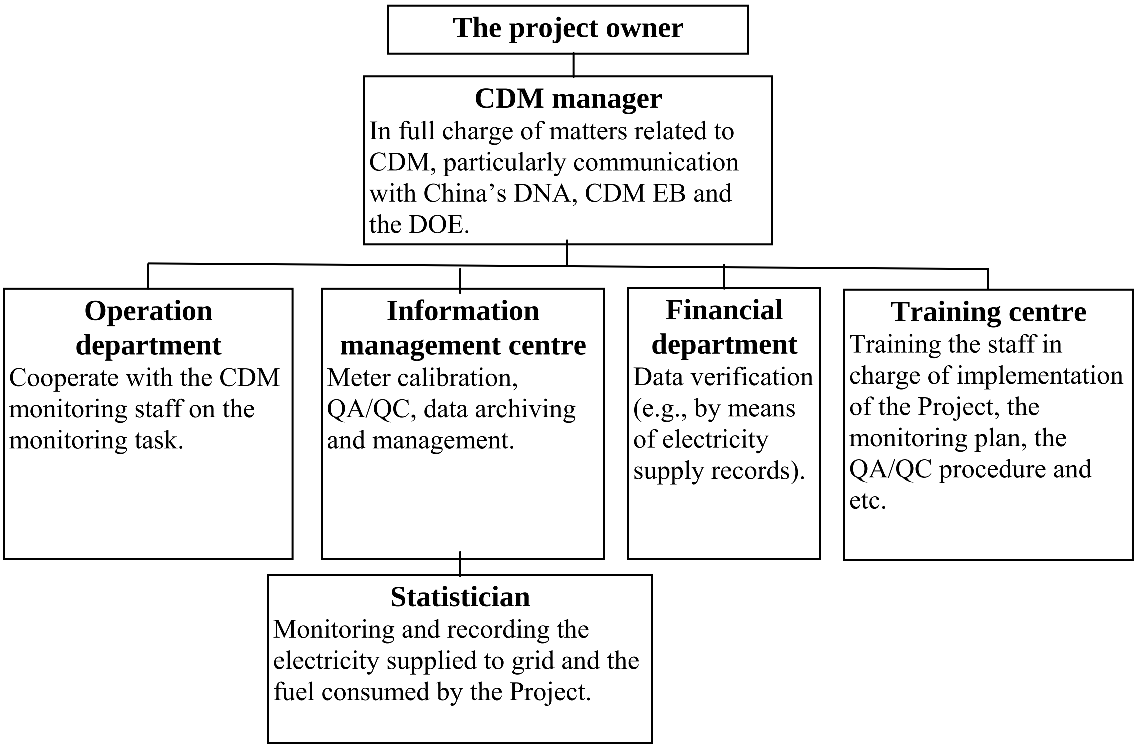

Figure 5. the management structure of the monitoring plan

2. Training plan

The staff of the Project has been trained by
·North China Electric Power University from May 2006 to July 2006 regarding control technologies of gas turbines;
·Shenzhen Nanshan Power Plant from August 2006 to October 2006 regarding operation and maintenance of gas-steam combined cycle power generation projects;
·the project owner from August 2007 regarding electrical technologies at the stage of production preparation and etc.

Further training regarding operation and maintenance of the Project is planned and will be carried out along with the implementation of the Project.

Prior to submission of request for registration, training the staff in charge of executing the monitoring plan will be carried out. The training contents include basic concepts and operation modality of CDM, approaches of data monitoring and archiving for CDM projects, quality control and quality assurance of monitoring and preparation and improvement of key documents for monitoring and verification. Contents and requirements of the training plan will be supplemented, modified and improved according to the DOE's requirements.

3. Methods of monitoring

<u>Net electricity delivered to the grid by the Project</u>: Net electricity delivered to the grid will be measured hourly by the bi-director meter(s) installed at the point connecting the Project to the grid system, recorded

monthly by the project owner and cross-checked by the transaction notes provided by the grid which the Project is connected to.

Consumption of natural gas by the Project: The consumption of natural gas will be daily monitored by natural gas flow meter(s) installed at the gas pipelines before the inlet of gas turbines, recorded monthly and cross-checked by the transaction notes provided by the gas supplier.

NCV of natural gas: The supplier of natural gas for the Project will provide the project owner with the analysis report of the calorific value of the natural gas at least once per two weeks. In case when the supplier-provided data is not available, local data will be used. In case when the supplier-provided data and the local data are both not available, country-specific values will be used.

The project owner will ensure that reading records of meter(s) are readily available for the DOE's verification.

4. Error disposal and reported data/results review

Error disposal procedures for the electricity delivered to the grid and the natural gas supply will be executed as per stipulations in the Power Purchase Agreement, the Parallel Operation Agreement and the Natural Gas Purchase Agreement.

Special team will be appointed by the project owner to undertake the responsibility of reviewing reported data/results.

5. Maintenance and calibration of meters & metering

The precision of ELSTER G4000 gas flow meters used in the Project is ±1%. The precision of meter(s) used in the Project is 0.2s. Calibration of meters & metering will be implemented according to the measuring rules issued by the project owner as per relevant national and local standards and rules. ELSTER G4000 gas flow meter(s) at the supplier end will be calibrated by qualified entities per two years. All the records will be documented and maintained by the project owner for the DOE's verification.

6. Quality assurance and quality control

The quality assurance and quality control procedures for recording, maintaining and archiving data will be improved as part of this CDM project activity according to CDM EB's rules and actual practice. This is an on-going process which will be ensured in terms of the need for verification of the emission reductions on an annual basis according to this PDD.

7. Emergency

There are no unintended GHG emissions when the power generation system stops working. When the power generation system stops working, no natural gas will be combusted for power generation. Moreover, the re-start of the power generation units will be supported by electricity imported from the grid, which will be monitored and deducted using the bi-director meter(s).

8. Data management system

·Special staff will be appointed by the project owner to take the overall responsibility of monitoring the

emission reductions and keeping all the data and information of the emission reductions for verification.
·Electronic data and documents, including readings from meter(s) connected into the computer central control system, will be regularly copied and archived via optical discs and storage tapes, and kept for at least two years after the end of the crediting period or the last issuance of CERs, whichever occurs later, for the project activity.
·Written data and documents, including transaction notes for cross-checking of data, will be copied and archived with an explanation of the department or company where the original copy is kept, and kept for at least two years after the end of the crediting period or the last issuance of CERs, whichever occurs later, for the project activity.

9. Procedures for corrective actions

To guarantee the accuracy and rationality of the reported results/data for verification, the project manager should undertake the responsibility of internal review. All reported results/data should pass the internal review prior to submission to the DOE.

Electronic and hard copy of data recorded will be submitted to the project manager per week for the internal review. The objective of the internal review includes reliability of project operation, continuity of monitoring and accuracy of monitored data. The result of the internal review can be checked by transaction notes between the project owner and the grid company/the gas supplier.

Data of electricity delivered to the grid and the natural gas consumed by the Project should be obtained from the transaction notes when, as pointed out by the project manager, the accuracy of monitored data fails to be guaranteed.

Moreover, all of the monitored data and results related to the internal review should be archived by the project owner and be transparent for verification.

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)

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The application of the baseline study and monitoring methodology of the Project was completed on 30/06/2009 by the below entities:

Entities	Project participate Yes/No
Additional Consulting and Engineering Contact: James Jiang Email: James.Jiang@Additional.cn Mobile: +86 13911049424	No
Global Carbon Capital Contact: Wenlin Xu Email: Wenlinxu@globalcarboncapital.co.uk	Yes

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:

>>
28/02/2006 (the starting date of construction)

The Project signed *Equipment Procurement Contract* on 28/02/2006 for turbines and generators, and 03/04/2006 for boilers. The Project signed *Civil Engineering Contract* on 25/04/2006. After this, the Project applied for *Permission of Construction Start* and started construction on 08/06/2006 when approved. According to the definition of the "the start date of a CDM project activity" provided in paragraph 67 of EB41 meeting report, the starting date of the Project is determined as 28/02/2006.

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

>>
20y-0m

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

C.2.1. Renewable crediting period

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

>>
01/01/2010[61]

C.2.1.2. Length of the first crediting period:

>>
7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Not applicable.

C.2.2.2. Length:

>>

61 The crediting period will start after registration of the Project. If the registration date is later than 01/01/2010, the starting date of the first crediting period will be revised to the registration date.

Not applicable.

SECTION D. Environmental impacts

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

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The Environmental Impact Assessment Report of the Project was completed by North China Power Engineering (Beijing) Co. Ltd. and approved by Beijing Environmental Protection Bureau on 11/11/2005 (Document No.JHS[2005]1065[62]).

Based on the Environmental Impact Assessment Report and the FSR, the environmental impacts arising from the Project are respectively analyzed in terms of the construction phase and the operation phase.

Construction Phase

Noise
Noise from mechanical equipments and transportation vehicles is expected the main noise pollution during the construction of the Project. Mitigation measures including using low-noise machinery and equipments, installing silencer and noise barriers, enhancing maintenance, strictly prohibiting constructing at night and others will be employed by the project owner to ensure the noise of the Project complies with relevant guidelines set out in *Noise Limits for Construction Site* (GB 12523-90).

Dust and waste gas
Air pollutants during the construction of the Project will be primarily dusts from vehicles and construction equipments. Mitigation measures including frequently watering of exposed area or worksite of excavation to maintain the surface wet, using closed and semi-closed vehicles to transport construction materials as well as restricting the speed of transportation vehicles (10~20 km/h) will be employed by the project owner to ensure the dust and waste gas emissions of the Project satisfy the requirements of *Discharge Limits of Atmospheric Pollutants* (DB44/27-2001).

Waste water
Wastewater discharged during the construction phase will be primarily domestic sewage and construction wastewater. Domestic sewage will be treated by using local sewage treatment facilities before discharged into the municipal network. Construction wastewater will be treated by temporary wastewater treatment facilities before discharged into the municipal network. Wastewater discharge during construction of the Project complies with the requirement of *Discharge Limits of Water Pollutants* (DB11/307-2005).

Solid waste
The main solid waste generated during the construction phase is the construction waste as well as the residential garbage at the project site. Most of the solid waste will be sent and treated by the environmental sanitation facilities; some construction waste will be collected for recycle. The overall impact of solid waste on the environment is considered to be insignificant.

Operation Phase

Noise
Noise during the operation phase is mostly from equipment operating. Mitigation measures including arranging plane reasonably, using low-noise machinery, installing noise silencers and barriers for

62 Approval of Beijing Municipal Environmental Protection Bureau on the Environment Impact Assessment Report of the Project .

equipments, enhancing maintenance, planting trees and others will be employed by the project owner to ensure the Project complies with relevant guidelines set out in Level I of *Standard of Noise at Boundary of Industrial Enterprises* (GB12348-90) and Level I of *Standard of Environmental Noise of Urban Area* (GB3096-93).

Waste gas and waste slag
Compared with a coal fired power plant which installs desulphurizing equipments and has a commensurate scale to the Project, the Project can reduce emissions of about 347 tons of SO_2, 1,137 tons of NO_X and 170 tons of smoke and dust per year[63]. Taking the lead in employing dry low-nitrogen burners in China, the Project will emit NO_X resulting in a concentration lower than 25 mg/Nm^3, far lower than the requirement of *Integrated Emission Standard of Boilers Pollutants* (DB11/139-2002) which is 150 mg/Nm^3. So, implementation of the Project will have significant environmental benefits.

Waste water
Wastewater during the operation phase is domestic sewage and industrial wastewater. After treated by primary neutralizing treatment, a small amount of acidic or alkali industrial wastewater and domestic wastewater will be treated by using local wastewater treatment facilities to ensure the wastewater emission complies with the requirement of *Discharge Limits of Water Pollutants* (DB11/307-2005).

Solid waste
Operation of the Project will produce residential garbage, which will be sent to and treated by the environmental sanitation facilities. The overall impact of solid waste on the environment is considered to be insignificant.

In conclusion, environmental impacts arising from the Project are considered insignificant.

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

>>
The Project uses clean and high efficiency natural gas fired combined cycle power generation technology to generate electricity whose environmental impacts comply with relevant national laws and regulations. Environmental impacts arising from the Project are considered insignificant.

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SECTION E. Stakeholders' comments

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

>>

In November 2006, the Villager's Committee of Zhengchangzhuang Village, Lugouqiao Town, Fengtai District, Beijing conducted a survey on local entities and local residents who might be impacted by the Project through distributing and collecting responses to a questionnaire.

Totally 30 returned out of 30 questionnaires with a 100% response rate. The survey on entities covers part of local companies and communities. The basic structure of the personal respondents is illustrated in Table 10.

Table 10. Structure of the personal respondents

Structure of Gender		
Gender	**Number**	**Percentage (%)**
Male	14	47
Female	16	53

Structure of educational level		
Educational level	**Number**	**Percentage (%)**
College	12	40
Senior middle school	8	27
Junior middle school and below	10	33

Structure of age		
Age	**Number**	**Percentage (%)**
20~29	10	33
30~39	7	23
40~49	4	13
Older than 50	9	30

It can be seen that respondents are adequately representative and their attitudes towards the impacts of the Project can be a comprehensive reflection of the public attitudes.

The questionnaires mainly focus on following issues:
·What's the extent of the stakeholders' knowledge about natural gas power plants?
·What's the attitude of the stakeholders on the construction of the Project?
·What positive impacts will be introduced by the implementation of the Project from the view of stakeholders?
·What negative impacts will be introduced by the implementation of the Project from the view of stakeholders?

E.2. Summary of the comments received:

>>

According to the 30 questionnaires received:
·23 respondents (77%) understand or have a very good understanding of the Project.
·29 respondents (97%) support the implementation of the Project, while 1 respondent (3%) presents no opinions.
·Respondents consider that positive impacts possibly caused by the construction of the Project mainly include pushing economy development (83%), increasing employment opportunities (27%), improving the living standard (63%) and increasing income (27%).
·Respondents consider that negative impacts possibly caused by the Project mainly include occupation of land (80%), noise (7%) and air pollution (7%).
·47 respondents (94%) consider the overall impact of the Project is positive, 1 respondent (2%) considers the Project has no impact on his life and 2 respondents (4%) present no opinions.
·27 respondents (90%) believe implementation of the Project has generally positive impacts on their life, while 3 respondents (10%) believe implementation of the Project basically has no impacts on their life.

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

>>

Based on the results of the questionnaires, stakeholders of the Project generally understand and support the construction of the Project. Therefore there has been no need to modify the Project due to the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex I Parties for the Project.

Annex 3

BASELINE INFORMATION

Determination of the emission factor of North China Grid

The latest data used to calculate the grid emission factor that was available at the commencement of validation (March 2007) is obtained from *China Electric Power Yearbook 2005* and *China Energy Statistical Yearbook 2005*. Methods recommended in *China's Regional Grid Baseline Emission Factors* issued by China's DNA for North China Grid on 15/12/2006 are adopted for the Project.

The following tables summarise the numerical results from the equations listed in *Tool to calculate the emission factor for an electricity system*. Information provided by the tables includes data, data sources and the underlying calculations. The analysis will be divided into two parts, the first part summarises the numerical results of the emission factor for Northeast China Grid and the second part summarises the numerical results of the emission factor for North China Grid.

Part I: Northeast China Grid

Table A1. Electricity generated in and delivered to Northeast China Grid in 2002

	Thermal power (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)	Hydropower (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)	Others (MWh)	Total (MWh)
Liaoning	70,450,000	7.42	65,222,610	1,551,000	2.52	1,511,915	0	
Jilin	26,034,000	7.81	24,000,745	4,900,000	2.19	4,792,690	0	
Heilongjiang	45,061,000	8.88	41,059,583	1,564,000	0.75	1,552,270	0	
Total			130,282,938			7,856,875	0	138,139,813

Data source: China Electric Power Yearbook 2003.

Table A2. Electricity generated in and delivered to Northeast China Grid in 2003

	Hydro power (10^5MWh)	Thermal power (10^5MWh)	Others (10^5MWh)	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Liaoning	23.83	797.51	2.02	82,336,000	7.17	76,432,509
Jilin	40.8	297.39	0.64	33,883,000	7.32	31,402,764
Heilongjiang	11.05	484.93	0	49,598,000	8.48	45,392,090

Total						153,227,363

Data source: China Electric Power Yearbook 2004.

Table A3. Electricity generated in and delivered to Northeast China Grid in 2004

	Thermal power (MWh)	**Auxiliary electricity consumption (%)**	**Electricity delivered to the grid (MWh)**	**Hydropower (MWh)**	**Auxiliary electricity consumption (%)**	**Electricity delivered to the grid (MWh)**	**Others (MWh)**	**Total (MWh)**
Liaoning	84,543,000	7.21	78,447,450	3,947,000	1.33	3,894,505	264,000	
Jilin	33,242,000	7.68	30,689,014	6,147,000	0.75	6,100,898	81,000	
Heilongjiang	53,482,000	7.84	49,289,011	1,338,000	1.27	1,321,007	46,000	
Total			158,425,475			11,316,410	391,000	170,132,885

Data source: China Electric Power Yearbook 2005.

Table A4. Basic statistics of thermal power plants of Northeast China Grid in 2002

Energy	**Unit**	**Liaoning A**	**Jilin B**	**Heilongjiang C**	**Total D=A+B+C**	**Emission factor (tC/TJ) E**	**NCV (MJ/t or 1000m^3) F**	**Emission[64] (tCO_2e) G**
Raw coal	10^4t	3258.52	1928.97	2422.27	7609.76	25.8	20908	150,513,200
Cleaned coal	10^4t	1.45	0.00	9.31	10.76	25.8	26344	268,155
Other washed coal	10^4t	347.55	13.65	140.4	501.6	25.8	8363	3,968,357
Coke oven gas	10^8m^3	1.89			1.89	13	16726	150,685
Other gas	10^8m^3	6.62			6.62	13	5227	164,940
Crude oil	10^4t	8.63			8.63	20	41816	264,640
Diesel	10^4t	0.6	1	0.11	1.71	20.2	42652	54,020
Fuel oil	10^4t	25.47	1.75	8.31	35.53	21.1	41816	1,149,454
LPG	10^4t	0.04			0.04	17.2	50179	1,266
Refinery gas	10^4t	6.99		0.38	7.37	18.2	46055	226,510
Natural gas	10^8m^3		0.02	2.56	2.58	15.3	38931	563,480
Other energy	10^4tCe	12.14			12.14	0	0	0
Total emissions of Northeast China Grid (tCO_2e)					157,324,705			
Electricity generation in and delivered to Northeast China Grid (MWh)					138,139,813			

64 If the unit of the fuel is 10^4 t, then $G=D\times E\times F\times 44/12/10^2$; if the unit of the fuel is 10^8 m^3, then $G=D\times E\times F\times 44/12/10$. The same with the calculation of G in Table A5 and Table A6.

Emission factor of Northeast China Grid (tCO_2e/MWh)	1.1357

Data source: China Energy Statistical Yearbook 2000~2002.

Table A5. Basic statistics of thermal power plants of Northeast China Grid in 2003

Energy	**Unit**	**Liaoning** A	**Jilin** B	**Heilongjiang** C	**Total** D=A+B+C	**Emission factor (tC/TJ)** E	**NCV (MJ/t or 1000m^3)** F	**Emission[65] (tCO_2e)** G
Raw coal	10^4t	3556.51	2006.66	2763.62	8326.79	25.8	20908	164,695,313
Cleaned coal	10^4t	70.83	0.00	3	73.83	25.8	26344	1,839,949
Other washed coal	10^4t	617.04	15.9	53.41	686.35	25.8	8363	5,429,988
Coke oven gas	10^8m^3	1.66	0.00	0.00	1.66	12.1	16726	123,185
Other gas	10^8m^3	5.31	0.00	0.00	5.31	12.1	5227	123,141
Crude oil	10^4t	3.39	0.00	0.00	3.39	20	41816	103,955
Diesel	10^4t	0.32	0.34	0.00	0.66	20.2	42652	20,850
Fuel oil	10^4t	14.87	0.7	4.32	19.89	21.1	41816	643,474
LPG	10^4t	1.55	0.00	0.00	1.55	17.2	50179	49,052
Refinery gas	10^4t	4.03	0.00	0.46	4.49	15.7	46055	119,040
Natural gas	10^8m^3	0.00	0.04	4.47	4.51	15.3	38931	984,997
Other energy	10^4tCe	29.38	0.00	0.00	29.38	0	0	0
Total emissions of Northeast China Grid (tCO_2e)					174,132,943			
Electricity generation in and delivered to Northeast China Grid (MWh)					153,227,363			
Emission factor of Northeast China Grid (tCO_2e/MWh)					1.1364			

Data source: China Energy Statistical Yearbook 2004.

65 If the unit of the fuel is 10^4 t, then G=D×E×F×44/12/10^2; if the unit of the fuel is 10^8 m^3, then G=D×E×F×44/12/10. The same with the calculation of G in Table A5 and Table A6.

Table A6. Basic statistics of thermal power plants of Northeast China Grid in 2004

Energy	Unit	Liaoning A	Jilin B	Heilongjiang C	Total D=A+B+C	Emission factor (tC/TJ) E	NCV (MJ/t or $1000m^3$) F	Emission (tCO_2e) G
Raw coal	10^4t	4144.2	2310.9	3084.8	9539.9	25.8	20908	188,689,377
Cleaned coal	10^4t	84.75	1.09	4.88	90.72	25.8	26344	2,260,872
Other washed coal	10^4t	577.67	14.26	61	652.93	25.8	8363	5,165,589
Coke oven gas	10^8m^3	4.83	2.91	0.00	7.74	12.1	16726	574,367
Other gas	10^8m^3	57.33	4.19	0.00	61.52	12.1	5227	1,426,677
Diesel	10^4t	2.04	1.16	0.24	3.44	20.2	42652	108,673
Fuel oil	10^4t	12.81	1.78	2.86	17.45	21.1	41816	564,536
LPG	10^4t	2.19	0.00	0.00	2.19	17.2	50179	69,305
Refinery gas	10^4t	9.79	0.00	1.14	10.93	15.7	46055	289,779
Natural gas	10^8m^3	0.00	0.03	2.53	2.56	15.3	38931	559,111
Other energy	10^4tCe	26.97	5.07	0.00	32.04	0	0	0
Total emissions of the Northeast China Grid (tCO_2)					199,708,288			
Electricity generation in and delivered to Northeast China Grid (MWh)					170,132,885			
Emission factor of Northeast China Grid (tCO_2e/MWh)					1.1738			

Data sources: China Energy Statistical Yearbook 2005

Part II: North China Grid

Table A7. Thermal power generation of North China Grid in 2002

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	17,886,000	7.95	16,464,063
Tianjin	27,263,000	7.08	25,332,780
Hebei	100,970,000	6.72	94,184,816
Shanxi	82,256,000	7.98	75,691,971
Inner Mongolia	51,382,000	7.93	47,307,407
Shandong	124,162,000	6.79	115,731,400
Total			374,712,437

Data source: China Electric Power Yearbook 2003.

Table A8. Thermal power generation of North China Grid in 2003

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	18,608,000	7.52	17,208,678
Tianjin	32,191,000	6.79	30,005,231
Hebei	108,261,000	6.5	101,224,035
Shanxi	93,962,000	7.69	86,736,322
Inner Mongolia	65,106,000	7.66	60,118,880
Shandong	139,547,000	6.79	130,071,759
Total			425,364,906

Data source: China Electric Power Yearbook 2004.

Table A9. Thermal power generation of North China Grid in 2004

	Electricity generation (MWh)	**Auxiliary electricity consumption (%)**	**Electricity delivered to the grid (MWh)**
Beijing	18,579,000	7.94	17,103,827
Tianjin	33,952,000	6.35	31,796,048
Hebei	124,970,000	6.5	116,846,950
Shanxi	104,926,000	7.7	96,846,698
Inner Mongolia	80,427,000	7.17	74,660,384
Shandong	163,918,000	7.32	151,919,202
Total			489,173,110

Data source: China Electric Power Yearbook 2005.

Table A10. Basic statistics of thermal power plants of North China Grid in 2002

Energy	Unit	Beijing A	Tianjin B	Hebei C	Shanxi D	Inner Mongolia E	Shandong F	Total G=A+B+…+F	Emission factor (tC/TJ) H	NCV (MJ/t or $1000m^3$) I	Emission[66] (tCO_2e) J
Raw coal	10^4t	691.84	1052.74	4988.01	4037.39	3218.00	5162.86	19150.84	25.8	20908	378,783,852
Cleaned coal	10^4t	0.00	0.00	0.00	0.00	0.00	80.71	80.71	25.8	26344	2,011,408
Other washed coal	10^4t	3.43	0.00	65.20	135.56	0.00	106.32	310.51	25.8	8363	2,456,568
Coke oven gas	10^8m^3	0.17	1.71		0.75	0.16	0.04	2.83	13	16726	225,628
Other gas	10^8m^3	15.82		7.34		10.35		33.51	13	5227	834,914
Crude oil	10^4t	0.00	0.00	0.00	0.00	0.00	14.98	14.98	20	41816	459,363
Gasoline	10^4t	0.00	0.00	0.00	0.00	0.00	0.65	0.65	18.9	43070	19,401
Diesel	10^4t	0.26	2.35	4.12		1.60	10.02	18.35	20.2	42652	579,693
Fuel oil	10^4t	13.94	0.04	1.22		0.42	20.33	35.95	21.1	41816	1,163,042
Refinery gas	10^4t			0.27				0.27	18.2	46055	8,298
Natural gas	10^8m^3		0.55			0.02		0.57	15.3	38931	124,490
Other energy	10^4tCe					1.10	15.92	17.02	0	0	0
Net electricity imported from Northeast China Grid to North China Grid (MWh)								2,905,200			
Emission factor of the net electricity imported from Northeast China Grid (tCO_2/MWh)								1.1357			
Total emissions of North China Grid (tCO_2)								389,965,993			

Data sources: China Energy Statistical Yearbook 2000~2002

66 If the unit of the fuel is 10^4 t, then J=G×H×I×44/12/10^2; if the unit of the fuel is 10^8 m^3, then J=G×H×I×44/12/10. The same with the calculation of J in Table A11, Table A12 and Table A13.

Table A11. Basic statistics of thermal power plants of North China Grid in 2003

Energy	Unit	Beijing A	Tianjin B	Hebei C	Shanxi D	Inner Mongolia E	Shandong F	Total G=A+B+…+F	Emission factor (tC/TJ) H	NCV (MJ/t or 1000m^3) I	Emission[67] (tCO_2e) J
Raw coal	10^4t	714.73	1052.74	5482.64	4528.5	3949.32	6808	22535.93	25.8	20908	445,737,438
Cleaned coal	10^4t	0.00	0.00	0.00	0.00	0.00	9.41	9.41	25.8	26344	234,511
Other washed coal	10^4t	6.31	0.00	67.28	208.21	0.00	450.9	732.7	25.8	8363	5,796,681
Coke	10^4t	0.00	0.00	0.00	0.00	2.8	0.00	2.8	29.2	28435	85,244
Coke oven gas	10^8m^3	0.24	1.71	0.00	0.9	0.21	0.02	3.08	12.1	16726	228,560
Other gas	10^8m^3	16.92	0.00	10.63	0.00	10.32	1.56	39.43	12.1	5227	914,400
Crude oil	10^4t	0.00	0.00	0.00	0.00	0.00	29.68	29.68	20	41816	910,139
Gasoline	10^4t	0.00	0.00	0.00	0.00	0.00	0.01	0.01	18.9	43070	298
Diesel	10^4t	0.29	1.35	4	0.00	2.91	5.4	13.95	20.2	42652	440,693
Fuel oil	10^4t	13.95	0.02	1.11	0.00	0.65	10.07	25.8	21.1	41816	834,672
Refinery gas	10^4t	0.00	0.00	0.27	0.00	0.00	0.83	1.1	15.7	46055	29,164
Natural gas	10^8m^3	0.00	0.5	0.00	0.00	0.00	1.08	1.58	15.3	38931	345,077
Other energy	10^4tCe	9.83	0.00	0.00	0.00	0.00	39.21	49.04	0	0	0
Net electricity imported from Northeast China Grid to North China Grid (MWh)								4,244,380			
Emission factor of the net electricity imported from Northeast China Grid (tCO_2/MWh)								1.1364			
Total emissions of North China Grid (tCO_2)								460,380,340			

Data sources: China Energy Statistical Yearbook 2004

67 If the unit of the fuel is 10^4 t, then J=G×H×I×44/12/10^2; if the unit of the fuel is 10^8 m^3, then J=G×H×I×44/12/10. The same with the calculation of J in Table A11, Table A12 and Table A13.

Table A12. Basic statistics of thermal power plants of North China Grid in 2004

Energy	Unit	Beijing A	Tianjin B	Hebei C	Shanxi D	Inner Mongolia E	Shandong F	Total G=A+B+…+F	Emission factor (tC/TJ) H	NCV (MJ/t or 1000m^3) I	Emission (tCO_2e) J
Raw coal	10^4t	823.09	1410	6299.8	5213.2	4932.2	8550	27228.29	25.8	20908	538,547,477
Cleaned coal	10^4t	0.00	0.00	0.00	0.00	0.00	40	40	25.8	26344	996,857
Other washed coal	10^4t	6.48	0.00	101.04	354.17	0.00	284.22	745.91	25.8	8363	5,901,191
Coke	10^4t	0.00	0.00	0.00	0.00	0.22	0.00	0.22	29.2	28435	6,698
Coke oven gas	10^8m^3	0.55	0.00	0.54	5.32	0.4	8.73	15.54	12.1	16726	1,153,187
Other gas	10^8m^3	17.74	0.00	24.25	8.2	16.47	1.41	68.07	12.1	5227	1,578,574
Diesel	10^4t	0.39	0.84	4.66	0.00	0.00	0.00	5.89	20.2	42652	186,070
Fuel oil	10^4t	14.66	0.00	0.16	0.00	0.00	0.00	14.82	21.1	41816	479,451
Refinery gas	10^4t	0.00	0.55	1.42	0.00	0.00	0.00	1.97	15.7	46055	52,229
Natural gas	10^8m^3	0.00	0.37	0.00	0.19	0.00	0.00	0.56	15.3	38931	122,306
Other energy	10^4tCe	9.41	0.00	34.64	109.73	4.48	0.00	158.26	0	0	0
Net electricity imported from Northeast China Grid to North China Grid (MWh)								4,514,550			
Emission factor of the net electricity imported from Northeast China Grid (tCO_2/MWh)								1.1738			
Total emissions of North China Grid (tCO_2)								554,323,387			

Data sources: China Energy Statistical Yearbook 2005

With the data provided in Table A7~A12, the value of Simple OM emission factor ($EF_{OM,y}$) is calculated as

(554,323,387+460,380,340+389,965,993) / (4,514,550+4,244,380+2,905,200+489,173,110+425,364,906+374,712,437) = 1.0798 tCO_2e/MWh.

Table A13. Data and results of Step a.

Energy	Unit	Beijing A	Tianjin B	Hebei C	Shanxi D	Inner Mongolia E	Shandong F	Total G=A+B+…+F	Emission factor (tC/TJ) H	NCV (MJ/t or 1000m^3) I	Emission (tCO_2e) J
Raw coal	10^4t	823.09	1410.00	6299.80	5213.20	4932.20	8550.00	27228.29	25.8	20908	538,547,477
Cleaned coal	10^4t	0.00	0.00	0.00	0.00	0.00	40.00	40.00	25.8	26344	996,857
Other washed coal	10^4t	6.48	0.00	101.04	354.17	0.00	284.22	745.91	25.8	8363	5,901,191
Coke	10^4t	0.00	0.00	0.00	0.00	0.22	0.00	0.22	29.2	28435	6,698
Sub-total											**545,452,222**
Diesel	10^4t	0.39	0.84	4.66	0.00	0.00	0.00	5.89	20.2	42652	186,070
Fuel oil	10^4t	14.66	0.00	0.16	0.00	0.00	0.00	14.82	21.1	41816	479,451
Sub-total											**665,522**
Natural gas	10^8m^3	0.00	0.37	0.00	0.19	0.00	0.00	0.56	15.3	38931	122,306
Coke oven gas	10^8m^3	0.55	0.00	0.54	5.32	0.40	8.73	15.54	12.1	16726	1,153,187
Other gas	10^8m^3	17.74	0.00	24.25	8.20	16.47	1.41	68.07	12.1	5227	1,578,574
Refinery gas	10^4t	0.00	0.55	1.42	0.00	0.00	0.00	1.97	15.7	46055	52,229
Sub-total											**2,906,297**
Total											**549,024,041**

Data source: China Energy Statistical Yearbook 2005.

Table A14. Emission factor of the best technology

	Variable	Electricity supply efficiency	Emission factor of fuel (tC/TJ)	Oxidation Rate	Emission factor (tCO_2/MWh)
		A	B	C	D=3.6/A/1000×B×C×44/12
Coal fired power plants	$EF_{Coal,Adv}$	36.53%	25.8	1	0.9323
Gas fired power plants	$EF_{Gas,Adv}$	45.87%	15.3	1	0.4403
Oil fired power plants	$EF_{Oil,Adv}$	45.87%	21.1	1	0.6072

Calculated with the data provided in Table A13 and formula (5)~(8), the value of λ_{Coal} is 99.35%, the value of λ_{Oil} is 0.12% and the value of λ_{Gas} is 0.53%. Therefore, $EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y}$ =0.9293 tCO_2e/MWh.

Table A15. Installed capacity of North China Grid in 2004

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

Data source: China Electric Power Yearbook 2005.

Table A16. Installed capacity of North China Grid in 2002

	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power (MW)	3407.5	6245.5	16745.7	14327.8	9778.7	25102.4	75607.6
Hydro power (MW)	1038.5	5.0	775.9	795.3	592.1	50.8	3257.6
Wind power and Others (MW)	0	0	13.5	0	76.6	0	90.1
Total (MW)	4446.0	6250.5	17535.1	15123.1	10447.4	25153.2	78955.3

Data source: China Electric Power Yearbook 2003.

Table A17. Installed capacity of North China Grid in 2001

	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power (MW)	3412.5	5632	16474.9	13415.8	8898.3	20957.7	68791.3
Hydro power (MW)	1058.1	5	742.6	795.9	566.2	56.2	3224.0
Wind power and Others (MW)	0	0	9.9	0	46.7	0	56.6
Total (MW)	4470.6	5637	17227.4	14211.8	9511.2	21013.9	72071.9

Data source: China Electric Power Yearbook 2002.

Table A18. Calculation of the build margin emission factor of North China Grid

	Installed capacity in 2001 (MW) A	Installed capacity in 2002 (MW) B	Installed capacity in 2004 (MW) C	Capacity additions from 2001 to 2004 (MW) D=C-A	Share in total capacity additions
Thermal power	68791.2	75607.6	93594.9	24803.7	99.57%
Hydro power	3224.0	3257.6	3250.7	26.7	0.11%
Wind power and Others	56.6	90.1	137.5	80.9	0.32%
Total	72071.8	78955.3	96983.1	24911.3	100.00%
Share in the total installed capacity of 2006	74.31%	81.41%	100.00%		

Therefore, $EF_{grid,BM,y}$ =0.9293×99.57%=0.9253 tCO_2e/MWh.

Table A19. Share of low cost/must run resources in North China Grid

	2000	2001	2002	2003	2004
Thermal power (GWh)	327327	358066	403919	457675	526772
Hydropower (GWh)	3633	2927	3455	3798	3758
Wind power and others (GWh)	115	126	171	181	56
Total (GWh)	331075	361119	407545	461653	530804
Share of the low-cost/must run resources (%)	1.13%	0.85%	0.89%	0.86%	0.76%

Data source: China Electric Power Yearbook 2001 ~2005.

Annex 4

MONITORING INFORMATION

The calibration of meters & metering, the QA/QC procedures and others of the monitoring plan will be carried out with reference to the Power Purchase Agreement, the Parallel Operation Agreement, the Natural Gas Purchase Agreement, the report on the analysis data of the component of natural gas, the checking and testing standards and the specifications of the monitoring equipments, and no other additional information.

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