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

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SECTION A. General description of project activity

A.1 Title of the project activity:

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Shaqu 14 MW CMM Power Generation Project in Shanxi Province (Phase I)

Version number of the document: 07

Date: 24/09/2010

Version Number	Date	Description and reason of revision
01	29 April 2009	The PDD for GSP
02	27 July 2009	The first revised PDD based on the CARs and CLs after on-site validation
03	14 September 2009	The second revised PDD based on the CARs and CLs issued by TUV SUD
04	21 October 2009	The third revised PDD based on the CARs and CLs issued by TUV SUD
05	20 November 2009	The fourth revised PDD based on the CARs and CLs issued by TUV SUD
06	9 April 2010	Further revisions as result of ‘completeness check’ questions
07	24 September 2010	Further revisions following ‘request for review’

A.2. Description of the project activity:

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The Shaqu 14 MW CMM Power Generation Project in Shanxi Province (Phase I) (hereafter referred as the Project) developed by Huajin Coking Coal Co., Ltd is located within Shaqu Coalmine in Liulin County, Luliang City, Shanxi Province, People’s Republic of China.

The purpose of the project activity:

Shaqu Coalmine is a high-gas coalmine; therefore, in 2004 when Shaqu Coalmine started to produce coal i.e. prior to the implementation of the project, the gas extraction system and mine ventilation was installed in the coalmine to keep the working environment safe. There are two existing gas extraction stations, one is for the north wing of the mine and the other is for the south wing. Of the methane drained prior to the start of the project activity, some gas extracted from the south wing was supplied to Liulin Towngas Company but the majority was released into the atmosphere directly which caused waste of resources and air pollution. All ventilation air methane (VAM) is vented to the atmosphere. Buildings at the coal mine site are heated using coal fired boilers. The electricity used by Shaqu Coalmine was purchased from the coal-dominated North China Power Grid (NCPG).

The Project aims to partially recover the CMM currently emitted to the air and to utilize it as fuel for power generation. All CMM used in the project will be above the minimum concentration required by

Chinese safety regulations. The Project doesn't involve any utilization or destruction of ventilation air methane (VAM) which will still be vented in Shaqu Coalmine. The project has been designed as a captive power generation project with a total capacity of 14 MW, consisting of twenty units of 700kW generators. The net power supplied is 60.515GWh per year, which will be totally used to meet the on-site power demand of Shaqu Coalmine, therefore reducing the electricity purchased from the predominantly coal powered North China Power Grid (NCPG) by Shaqu Coalmine. In addition, four waste heat recovery boilers will be installed to utilize the waste heat energy from power generators. The boilers will supply heat to the residential area in Shaqu Coalmine and replace the heat previously generated by coal-fired boilers. The project participants have decided not to claim CERs from the recovered heat.

The baseline scenario of the Project is the same as the scenario existing prior to the start of implementation of the project, i.e. some gas was supplied to Liulin Towngas Company and the rest was released into the atmosphere without any use. The electricity used by Shaqu Coalmine was purchased from the coal-dominated North China Power Grid.

<u>How the Project reduces GHG emissions:</u>

By operation of the Project, the annual CH_4 consumption could be up to 21.704 million m^3, the net power supplied by the project will be 60.515GWh per year. Therefore, the Project will achieve GHG emission reductions by destroying CH_4 that would be emitted directly and avoiding CO_2 emissions from replacing electricity generated by those fossil fuel-fired power plants connected into NCPG. The estimated annual emission reductions will be 324,133 tCO_2e.

<u>Contributions of the project to sustainable development:</u>

As a clean energy project, the Project will produce positive environmental and socio-economic benefits and contribute to the local sustainable development through following aspects:

- ✧ Guaranteeing coal mine production safety;
- ✧ Taking full advantage of clean energy that would have been wasted;
- ✧ Contributing to local economy development by providing electricity and heat to meet local energy demands;
- ✧ Reducing GHG emissions compared with a business-as-usual scenario;
- ✧ Mitigating the emissions of other pollutants caused from local coal-fired power plants and coal-fired boilers compared with a business-as-usual scenario, and
- ✧ Creating numerous short-term employment opportunities during the project construction period and some permanent jobs during the operation time for the local people.

A.3. Project participants:

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Name of Party Involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party Involved wishes to be Considered as project Participant (Yes/No)
P.R.China (host)	Huajin Coking Coal Co., Ltd.	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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People's Republic of China

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

>>
Shanxi Province

A.4.1.3. City/Town/Community etc:

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Liulin County, Luliang City

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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Shaqu Coalmine in which the proposed project activity will take place is located in Liulin County, Luliang City, Shanxi Province, P.R.China. The project has geographical coordinates with east longitude of 110°51′43″ and north latitude of 37°24′44″.

Figure A1 and Figure A2 show the detailed geographical location of the Project site.

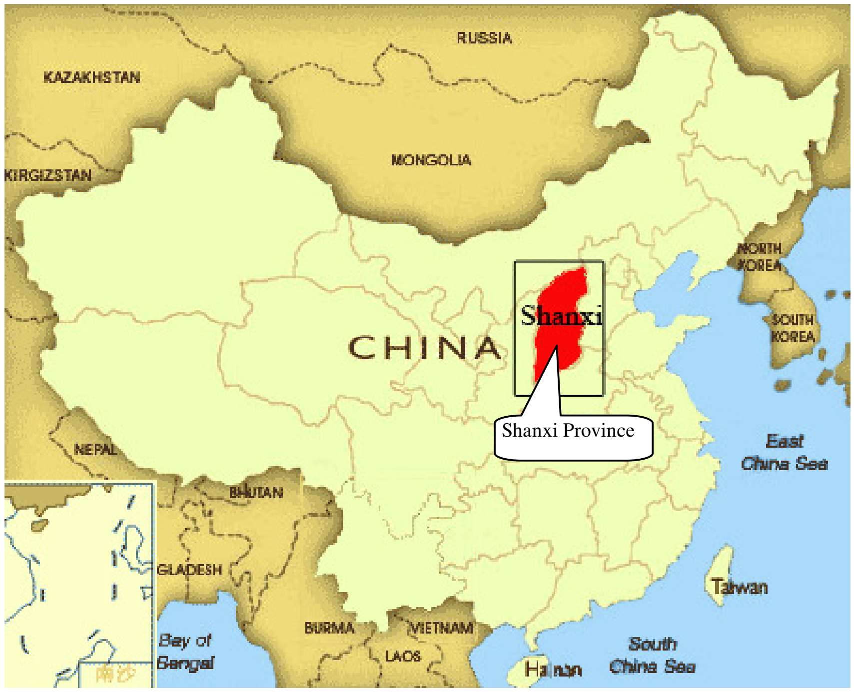

Figure A1 Location of Shanxi Province in China

Figure A2 Location of the Project site in Shanxi province

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

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The category would fall within sectoral scope 8: mining/mineral production, and sectoral scope 10: fugitive emissions from fuels (solid, oil and gas).

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

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Scenario existing prior to the start of the implementation of the project:

Prior to the implementation of the project, methane has been extracted from the mine for safety reasons. There were 2 principal extraction methods:

(i) Powerful ventilation fans that blow large volumes of air through the mine, thereby diluting CMM to safer concentrations and removing it from the mine as ventilation air methane (VAM);

(ii) A gas drainage system to pump higher concentration coal mine methane to the surface of the mine. At Shaqu mine, there are two surface extraction stations, one for the north wing of the mine (established in 2004) and one for the south wing (established in 1999).

Table A1: Existing gas extraction equipment at Shaqu mine

Drainage station	Drainage pump type	Quantity	Power (kW)	Rated flow rate (m^3/min)
South wing	CBF410A-2BV	2	185	150
North wing	2BEC67A	4	450	350

Of the CMM drained from the existing gas extraction stations, some CMM was fed into a common gas pipeline to Liulin Towngas Company to be used for heating for local residents and the rest was released into the atmosphere directly. All ventilation air methane (VAM) is vented to the atmosphere. The buildings at the site of the coal mine were heated using coal-fired boilers. The electricity used by Shaqu Mine was totally purchased from the North China Power Grid (NCPG).

This project will use the CMM drained from the existing gas extraction station to generate electricity. The Project doesn't involve any utilization or destruction of ventilation air methane (VAM) which will still be vented in Shaqu Coalmine.

Technology to be employed by the Project:

The Project involves two components: power generation and waste heat recovery.

For power generation, the Project will install 20 sets of internal-combustion engines using coalmine gas and associated generators with a capacity of 700 KW each; total installed capacity will be 14MW. The net power supplied is estimated to be 60.515GWh annually and will be used to meet the on-site power demand of Shaqu Coalmine. Initially, the gas extracted is directly supplied to the gas engines after treatment. In the future, a gas tank will be installed and the recovered CMM will be sent to the gas tank first and then delivered to the compression station and injected to the gas engines for power generation.
As to waste heat recovery, the project will install waste heat recovery boilers (WHRs) to utilize the thermal energy of the exhaust gas from the generators supply to coalmine buildings. The supplied heat is

estimated to be 40,156 GJ per year. The waste heat utilization system mainly consists of four WHRs (three for operation and one as back-up), three water circulation pump (two for operation and one as back-up), water softening equipment and water supply equipment.

By operation of the Project, the annual CH_4 consumption could be up to 21.704 million m^3, the power generation supplied will be 60.515GWh per year, and the recovered heat is estimated as 40,156 GJ annually. The project participants decided not to claim CERs for the CO_2 emissions from the recovered heat. Therefore, the Project will achieve GHG emission reductions by destroying CH_4 that would be emitted directly and avoiding CO_2 emissions from replacing electricity generated by those fossil fuel-fired power plants connected into NCPG. The estimated annual emission reductions will be 324,133 tCO_2e. Baseline users will continue to be supplied.

The key technical parameters of main equipment are listed in following Table A2 and Table A3:

Table A2. Key technical parameters of the gas engine and the generator

Gas engine		Generator	
Type	G12V190Z_LDW	Generator Type	700GF-WK
Rated speed	1500 r/min	Rated speed	1500 r/min
Least stable speed	700 r/min	Rated power	700 kW
Rated power	800 kW	Rated voltage	400 V
Gas pressure	15-20 kPa	Rated current	1263 A
Rate of thermal consumption	11000 kJ/kWh	Rated power factor	0.8

Table A3. Key technical parameters of the WHR

WHR	
Rated capacity	2.3 MW
Working pressure	0.8 MPa
Temperature of in-water	80 ℃
Temperature of out-water	110 ℃

With all technologies and facilities provided domestically, the Project involves no technology transfer from abroad.

Experienced technical personnel are required for operation and maintenance of the engines. The staffs working in the project have received training on operation regulation, maintenance procedures and other required knowledge regarding operation of the project. Along with the running of the project, operational training will be also given to the new personnel.

Baseline Scenario:

The baseline scenario of the Project is the same as the scenario existing prior to the start of implementation of the project.

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

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It is expected that the Project will generate GHG emission reductions for about 324,133 tCO_2e totally over the fixed 10-year crediting period from Mar. 1, 2010 to Feb. 28, 2020.

Years	Estimation of annual emission reductions in tones of CO_2e
2010 (01/03/2010 – 31/12/2010)	270,110
2011	324,133
2012	324,133
2013	324,133
2014	324,133
2015	324,133
2016	324,133
2017	324,133
2018	324,133
2019	324,133
2020 (01/01/2020 – 28/02/2020)	54,022
Total estimated reductions (tonnes of CO_2e)	3,241,330
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**324,133**

A.4.5. Public funding of the project activity:

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No public funding from Annex I Parties is involved in the 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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ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation" (Version 06).

In addition, ACM0008 refers to "Tool to calculate the emission factor for an electricity system" (Version 2), "Tool for the demonstration and assessment of additionality" (Version 05.2) and "Tool to determine project emissions from flaring gases containing Methane" (Version 01).

For more information please refer to the link:

http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

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

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The methodology ACM0008 (Version 06) is applicable to the Project based on the following reasons:

Applicability Criteria	This Project
This methodology applies to projects that involve the use of any of the following extraction activities: • *surface drainage wells to capture CBM associated with mining activities* • *underground boreholes in the mine to capture pre mining CMM ;* • *surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM* • *ventilation air methane that would normally be vented*	This project activity uses CMM from "underground boreholes in the mine to capture pre mining CMM" and "surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM". The project activity does not involve the extraction or utilisation of VAM or CBM.
This methodology applies to CMM and VAM capture, utilisation and destruction project activities at a working coal mine, where the baseline is the partial or total atmospheric release of the methane and the project activities include the following method to treat the gas captured: • *The methane is captured and destroyed through flaring; and/or* • *The methane is captured and destroyed through utilisation to produce electricity, motive power and/or thermal energy; emission reductions may or may not be claimed for displacing or avoiding energy from other sources;*	This project activity involves the capture and utilization of CMM for power generation at a working coal mine where the baseline is partial usage of the methane and the atmospheric release of the remainder of the methane. The remaining unused share of the methane is vented for safety reasons and no additional CMM is captured by the project activity that would not otherwise have been vented in the baseline.

• *The remaining share of the methane, to be diluted for safety reason, may still be vented* • *All the CBM or CMM captured by the project should either be used or destroyed, and cannot be vented.*	Baseline users will continue to be supplied
Project participants must be able to supply the necessary data for ex-ante projections of methane demand as described in Sections Baseline Emissions and Leakage in order to use this methodology	The project participants can provide the data necessary for ex-ante estimations of methane demand as described in the relevant sections of the consolidated baseline methodology ACM0008.
The methodology applies to both new and existing mining activities.	Shaqu is an existing coal mine so the project activity complies with this applicability criterion.
The methodology does not apply to project activities with any of the following features: • *Operate in open cast mines* • *Capture methane from abandoned/decommissioned coalmines* • *Capture/use of virgin coal-bed methane, e.g. methane of high quality extracted from coal seams independently of any mining activities* • *Use CO_2 or any other fluid/gas to enhance CBM drainage before mining takes place*	The project activity does not use CMM from open cast mining, or abandoned/decommissioned mines. The project does not involve the extraction or utilisation of coal bed methane.

Therefore, ACM0008 (Version 06) is applicable to the Project.

In addition, since the electricity generated by the project will displace electricity from NCPG, according to ACM0008 (Version 06), the emission factor of NCPG will be calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (Version 2). And the latest version of the "Tool for the demonstration and assessment of additionality" (Version 05.2) is also used to demonstrate the additionality of the project.

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

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The extraction station was installed prior to the project for the safety reasons, and is not therefore part of the project boundary. There is no equipment for the compression of CMM, and CMM will be used on-site. Therefore, based on the methodology ACM0008 (Version 6), the spatial extent of the project boundary comprises:

- The facilities for power generation and waste heat recovery.
- All the power plants physically connected into NCPG.

According to *Notification on Determining Baseline Emission Factors of China Power Grid*[1] issued by the National Development and Reform Commission of the Government of China (China DNA), NCPG is

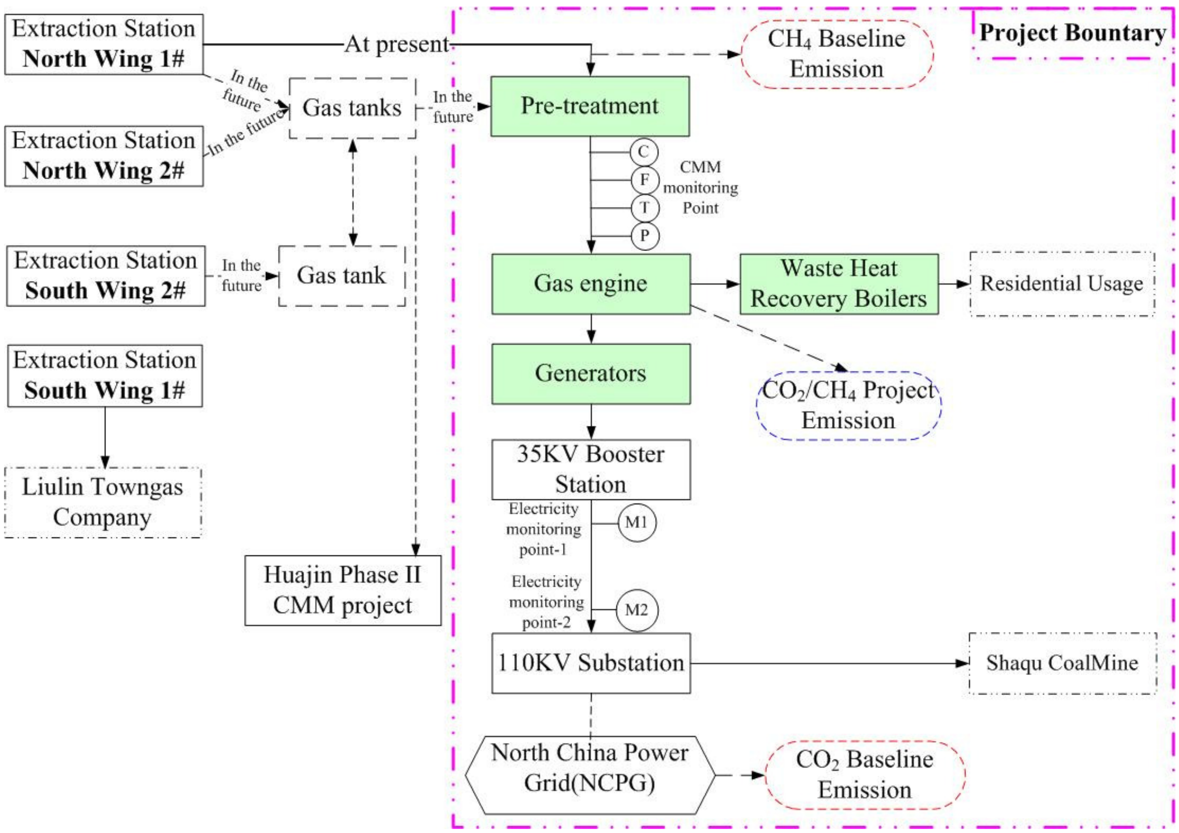
[1] China DNA (http://cdm.ccchina.gov.cn), issued on Jul. 18th ,2008 (Dec. 30th, 2008 updated)

composed of six provincial power grids: Beijing Power Grid, Tianjin Power Grid, Hebei Power Grid, Shanxi Power Grid, Shandong Power Grid and Inner Mongolia Power Grid.

The sources and gases included in the project boundary are shown as follows:

	Sources	Gas	Included or Excluded	Justification/Explanation
Baseline	Emissions of methane as a result of venting for current mining activities	CH_4	Included	Main emission source.
	Emissions from destruction of methane in the baseline	CO_2	Included	Partial methane was supplied to Liulin Towngas Company in the baseline scenario.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Grid electricity generation (electricity provided to the grid)	CO_2	Included	Only CO_2 emissions associated with the same quantity of electricity as electricity generated as a result of the use of methane included as baseline emissions will be counted Use of combined margin as described in the "Tool for calculation of emission factor for electricity system" should be made
		CH_4	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Captive power and/or heat, and vehicle fuel use	CO_2	Excluded	Project participants decided not to claim this emission reduction.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
Project activity	Emissions of methane as a result of continued venting	CH_4	Excluded	Only the change in CMM emissions released will be taken into account, by monitoring the methane used or destroyed by the project activity.
	On-site fuel consumption due to the project activity, including transport of the gas	CO_2	Included	Emissions from the electricity used by the Project activity.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from methane destruction	CO_2	Included	Emissions from the combustion of methane in power generation.
	Emissions from NMHC destruction	CO_2	Included	From the combustion of NMHC in power generation, if NMHC accounts for more than 1% by volume of extracted coal mine gas.
	Fugitive emissions of unburned methane	CH_4	Included	Small amount of methane will remain unburned in power generation.
	Fugitive methane emissions from on-site equipment	CH_4	Excluded	Excluded for simplification.
	Fugitive methane emissions from gas supply pipeline or in relation to use in vehicles	CH_4	Excluded	Excluded for simplification. However taken into account among other potential leakage effects (see leakage section).
	Accidental methane release	CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.

The project boundary can be shown by the following diagram:



Remark:
At present, only the CMM from the north wing 1# is utilized by phase I project. In the future, the gas tanks will be installed along with the construction of phase II project and CMM distribution system from both wings will be connected via to be installed gas tanks. The gas tanks are outside the project boundary.
The investment costs of the tanks are not considered in the FSR of phase I project and also not included in the investment costs applied for the IRR calculation.

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

The methodology ACM0008 (Version 06) is applied to identify baseline scenario:

Step 1. Identify technically feasible options for capturing and/or using CBM or CMM or VAM

Step 1a. Options for CBM and CMM or VAM extraction

Currently Shaqu Coalmine does not extract any of CBM and doesn't have any plans to extract CBM in the future. Therefore, CBM options are not considered in the following discussion of the baseline scenarios, and options for CMM extraction may include:

A. Ventilation air methane (VAM);
B. Pre mining CMM extraction;
C. Post mining CMM extraction;
D. The combinations of options A, B and C. This is the continuation of the current extraction practice in Shaqu Coalmine.

Step 1b. Options for extracted CBM and CMM or VAM treatment

Options for CMM or VAM treatment in Shaqu Coalmine could include:

i. Venting. This is the continuation of current situation in Shaqu Coalmine;
ii. Using/destroying ventilation air methane rather than venting it;
iii. Flaring of CMM;
iv. Use for additional grid power generation;
v. Use for additional captive power generation; this is the project activity not undertaken as a CDM project.
vi. Use for additional heat generation;
vii. The gas was feeded into gas pipeline to be used as fuel for vehicles or heat/power generation;
viii. Possible combinations of options i to vii with the relative shares of gas treated under each option specified.

Step 1c. Options for energy production

The options for power production in Shaqu Coalmine could include:

(1) The equivalent amount of power supply by NCPG;
(2) Construction of a fossil fuel-fired power plant with the same installed capacity as the Project;
(3) Construction of a CMM power plant. This is the project activity not undertaken as a CDM project;
(4) Construction of renewable energy power plant with the same installed capacity as the Project.

Since the project participants decided not to claim CERs for the CO_2 emissions from the recovered heat and the proposed project does not involve fueling vehicles, the alternative options for heat production and fuel to vehicles need not to be considered here.

Step 2. Eliminate baseline options that do not comply with legal or regulatory requirements

Step 2a. Options for CMM extraction

With respect to options of methane extraction, the applicable regulatory requirement is that the maximum methane concentration in the air within the coalmine should be below 1% to avoid the risk of explosion[2]. Shaqu Coalmine is a CMM-rich coalmine, and in CMM drainage, solely adopting only one of the CMM extraction options (VAM, pre mining CMM extraction and post mining CMM extraction) would not satisfy the 1% requirement. Therefore, Option A, B and C in *Step 1a* are eliminated from the baseline scenario alternatives of the Project.

Step 2b. Options for extracted CMM treatment

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[2] *National Coalmine Safety Regulation* (2005 version).

All the options of CMM treatment are in line with the legal requirement. Note that for this project, the Emission Standard of CBM/CMM (on trial) GB21522-2008 is not considered in the baseline selection.

The Emission Standard of CBM/CMM (on trial) GB21522-2008 states that from 01 January 2010 onwards it will be forbidden to vent CMM with a concentration of >30%. Local governments at or above the county level shall be responsible for implementing and monitoring compliance with the regulation. The standard is not considered in the baseline analysis for the project for the following reasons:

(i) The standard was published on 02 April 2008. The timeline for the project (see table below) clearly shows that the decision to proceed with the project was made a long time before this standard was even published. Indeed, the FSR and EIA were approved and the project actually commissioned before the publication of this standard. The standard cannot therefore be considered the reason for implementing the project.

Key milestones in the development of the project:

Date	**Main Events**	**Reviewed document during validation (as listed in Annex 2 of the submitted validation report)**
06-2006	The Environmental Impact Registration Form was finished.	IRL 13
09-08-2006	The EIA was approved by the local government.	IRL 14
09-2006	The *Feasibility Study Report* was finished by *Coal Industry Handan Design Academe* and the IRR evaluated was lower than the benchmark IRR, but taken into account the income from selling CERs, the IRR was higher than the benchmark.	IRL 11
05-09-2006	The board meeting was held to make decision that the project was implemented as a CDM project.	IRL 16
13-09-2006	The design and service agreement of CDM was signed between the project owner and the Beijing Xidiaimu Technological Consultant Company.	IRL 19
20-09-2006	The Project owner held a meeting to collect local stakeholders' attitudes and comments on the Project for the CDM development with the assistance of the consultant company.	IRL 39
28-09-2006	The FSR was approved by *Shanxi DRC*.	IRL 12
02-11-2006	The general contract of the project construction was signed by three parties; that of the project owner, Jinan Diesel Engine Co. Ltd and Handan Design Engineering Chinacoal Co. Ltd.	IRL 17
15-11-2006	The equipment purchase contract was signed between the project owner and Jinan Diesel Engine Co. Ltd.	IRL 18
05-12-2006	The construction of the project was started.	IRL 21
15~06-03-2007	Beijing Xidiaimu Technological Consultant collected and checked the documentation on site.	IRL 43
20-04-2007 and 06-06-2007	Beijing Xidiaimu Technological Consultant Company had contact with TUV SUD (Beijing).	IRL 68
12-06-2007	The CDM development work was transferred to Cleanergy	IRL 20

Date	Main Events	Reviewed document during validation (as listed in Annex 2 of the submitted validation report)
	Investment Service Co. Ltd.	
21-09-2007	Due to the project owner wanting to speed up the CDM application process, the project owner decided to submit the PDD and related documents to NDRC by themselves (without any buyers). On Sep. 21th, 2007, the project was approved by NDRC.	IRL 87
11-2007	The project was commissioned	IRL 22

(ii) The Standard was issued to encourage CMM utilization, in accordance with the Eleventh Five Year plan published by the Chinese government (see Reference 3 in Annex 1 attached to this response):

“In the period of the 11th “Five-Year Plan” stress will lie on gas extraction aiming at ensuring mine safety, establishment and improvement of a complete legislation and standard system for gas drainage, tackling key scientific and technological problems, construction of demonstration projects and gradual increase of gas drainage and utilization rates”.

However, no further guidance or legislation has been published by the Chinese government to date giving details about how the standard will be enforced or what penalties will be given to mines that do not comply with the standard. This has also been confirmed by Huajin Coking Coal (see Reference 6 in Annex 1 attached to this response). Furthermore, it seems that no additional resources have so far been allocated to the provincial level governments to monitor compliance with the legislation.

(iii) Equally, no additional funding has been given to coal mine operators to help them comply with the Standard. Attracting finance for CMM fired power projects can be difficult and typically projects are unattractive to investors: (i) many mines have poor credit ratings with banks and are unable to get loans to undertake projects themselves; (ii) Chinese enterprises have a lack of funds to invest in such projects and many schemes are too small to attract financial institutions; (iii) it is not core business of the coal mines who tend to support coal fired power generation for their electricity needs and investment in coal production.

Of the CMM fired power projects that have been constructed in Shanxi Province in recent years, all have been financially unattractive and have applied for CDM status to attract additional funding to overcome this barrier (see common practice section of PDD and validation report). It is not conceivable that coal mine owners will be able to comply with this Standard without the CDM or additional funding from another source.

(iv) Further, although the regulation published in 2008 in China required CMM utilization where gas concentration was >30%, according to a statement issued in July 2009 (see Reference 4 in Annex 1 attached to this response), the attitude of the Chinese government is that they “encourage companies to achieve the standard required by the regulation with help from the CDM. This is because the real IRR of most CMM projects (except for a few demonstration projects) is almost negative. With this situation, the implementation of this CMM regulation in China definitely cannot be accomplished by even 50% without CDM”.

Step 2c. Options for energy production

According to the current regulations in China, construction of coal-fired power plants with capacity of less than 135 MW are forbidden in the areas which can be covered by large grids[3] and fossil fuel-fired power units with capacity of less than 100 MW are strictly limited for installation[4]. Therefore, Option (2) in *Step 1c* is not in compliance with current laws and regulations of China, and should not be the baseline scenario of the Project.

All other options listed in Step1 comply with legal and regulatory requirements.

Step 3. Formulate baseline scenario alternatives

All of the baseline scenario alternatives based on the discussion in Step 1 and Step 2 are as follows:

Step 3a. Alternatives for CMM extraction

<u>Alternative Scenario D</u>: This is the continuation of extraction practice in Shaqu Coalmine.

Step 3b. Alternatives for CMM treatment

<u>Alternative scenario i</u>: One possible baseline scenario is the supply of some CMM to Liulin Towngas Company via the gas pipeline and the rest is directly released into the atmosphere. This is the current treatment practice in Shaqu Coalmine.

<u>Alternative scenario ii</u>: Utilization or destruction of ventilation air methane.

<u>Alternative scenario iii</u>: Destruction of the extracted CMM by flare.

<u>Alternative scenario iv</u>: Utilization of the collected CMM for grid power generation.

<u>Alternative scenario v</u>: Utilization of the collected CMM for captive power generation. This is the project activity not undertaken as a CDM project.

<u>Alternative scenario vi</u>: Utilization of the collected CMM in gas boiler to produce thermal energy.

<u>Alternative scenario vii</u>: The collected CMM is supplied to neighboring gas pipeline (to be used as fuel for vehicles or heat/power generation).

<u>Alternative scenario viii</u>: Possible combinations of above options.

Step 3c. Alternatives for energy production

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[3] *Notice on Strictly Prohibiting the Installation of Fuel-fired Generators with the Capacity of 135 MW or below* issued by the General Office of the State Council, decree no. 2002-6.

[4] *Interim Rules on the Installation and Management of Small-scale Fuel-fired Generators* (issued in Aug., 1997).

Alternative scenarios for electricity production include:

Alternative scenario (1): Continuation of power supply by NCPG.

Alternative scenario (3): CMM power generation. This is the project activity not undertaken as a CDM project.

Alternative scenario (4): Construction of renewable energy power plant with the same installed capacity as the Project.

Step 4. Elimination baseline scenario alternatives that face prohibitive barriers

Step 4a. Barriers analysis of the alternatives for CMM extraction

Alternative Scenario D: This is a business-as-usual (BAU) scenario and there is no barrier.

Step 4b. Barriers analysis of the alternatives for CMM treatment

Alternative scenario i: This is a BAU scenario and there is no barrier.

Alternative scenario ii: Technologies that destroy VAM (without usage) are available although not widely adopted in China or elsewhere. For VAM abatement, the only potential revenue stream is from the sale of carbon credits. Considering a carbon price of €10/ tonne (which, given current market conditions, is optimistic), the payback time is up to 5 years[5]. Given uncertainty in the future of the carbon market post-2012 however, a carbon revenue can only be guaranteed until the end of 2012 i.e. less than 5 years. For this reason, debt funding is unlikely to be available for VAM abatement projects and coal mine operators would be unlikely to take the risk of investing in this kind of project themselves. For this reason, this option faces prohibitive investment barriers.

Technologies that oxidize VAM for electricity or heat generation are also available although they too face barriers:

- Barriers due to prevailing practice: there is only one operating VAM utilization project in China (and not in the same region as the proposed project) and only a handful worldwide (in the US, UK and Australia)[6]
- Technical barriers: given the few operating projects globally, this technology can be considered immature and not technically proven. Further, to operate VAM technologies successfully, a minimum VAM concentration of about 1% concentration is required (although some systems can operate at concentrations less than this, the system is operating less efficiently and payback times will increase)[7]. In Chinese mines, VAM concentrations are often lower than this, typically <0.5%

[5] http://www.unece.org/energy/se/pdfs/cmm/4ahge_cmm/9_Kallstrand.pdf

[6] http://www.unece.org/energy/se/pdfs/cmm/4ahge_cmm/9_Kallstrand.pdf, http://www.environmental-expert.com/resultEachPressRelease.aspx?cid=273&codi=48519&lr=1&word=vamox, http://www.cmmclearinghouse.cmpdi.co.in/VAM_USEPA.pdf.

[7] http://www.cmmclearinghouse.cmpdi.co.in/VAM_USEPA.pdf

and, by law, cannot increase above 1%[8]. In this case, supplemental methane (drained CMM gas) to would be needed to raise VAM inlet concentrations to near 1%, thereby significantly increasing the expense and complexity associated with the project.

- Investment barriers: VAM abatement technologies are generally expensive making them commercially unattractive to private investors[9]. Of the operating VAM projects worldwide, all have received additional government support or revenue from the sale of carbon credits[10]. As discussed above, uncertainty in regulatory regimes make revenue from carbon credits risky. Projects of this type are therefore likely to have difficulty in attracting debt finance.

For these reasons VAM abatement and utilization technologies face prohibitive barriers and this scenario is excluded.

Alternative scenario iii: China's National Climate Change Programme[11] emphasises the importance of the "exploration, development and utilisation" of CMM in China. Flaring CMM does not count as utilization of CMM, nor does it contribute to addressing the energy shortage issues that exist in China. Flaring is not a legal requirement in China and further, flaring requires investment in a new combustion facility which would not generate any returns and is thus not financially attractive to the project owner. For these reasons, this option (Flaring of CMM) is not widely adopted in China and faces the investment barrier and therefore is excluded.

Alternative scenario iv: In China, the price for electricity imported from the grid company is always higher than the tariff for electricity exports to the grid. In the case of Shaqu coalmine, the price that the grid company sells electricity to Shaqu coalmine for is 0.3211yuan/kWh and the tariff for power sold to the grid company is 0.23yuan/kWh. Therefore, for a captive power plant, revenue will be the electricity price (0.3211yuan/kWh) multiplied by the electricity generated by the project, i.e. the saving from avoided purchases of electricity from the grid. However, if the project is a grid power plant, the revenue will be determined on the basis of the electricity tariff (0.23yuan/kWh) multiplied by the electricity generated by the project. Henceforth, the construction of a grid power generation plant is much more unattractive than that of building a plant for captive power generation. This project (Shaqu phase I power plant) is thus designed as a captive project and the electricity generated by the project will be totally used by Shaqu coalmine. Furthermore, considering that captive power generation is economically unfeasible (_Alternative scenario v)_ based on the analysis in Section B5, the scenario to build a grid power plant will be even less viable. This option should therefore be eliminated.

Alternative scenario v: This is the project activity not undertaken as a CDM project. This scenario is economically unattractive but cannot be eliminated here.

Alternative scenario vi: Heat requirements stem mainly from the living quarters at the project site. The amounts for this are very small and there is no additional heat demand from nearby industry. So far the

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[8] China coal mine safety regulations, 2005 version, paragraphs 135-6

[9]http://www.asiapacificpartnership.org/pdf/Projects/Coal%20Mining%20Task%20Force%20Action%20Plan%2003 0507.pdf, page 56 and http://www.unece.org/energy/se/pdfs/cmm/AHGE_Letter_Misconceptions_CMM.pdf

[10] http://www.unece.org/energy/se/pdfs/cmm/4ahge_cmm/9_Kallstrand.pdf, http://www.cmmclearinghouse.cmpdi.co.in/VAM_USEPA.pdf

[11] National Development and Reform Commission of China, China's National Climate Change Programme, June 2007 (available at http://en.ndrc.gov.cn/newsrelease/P020070604561191006823.pdf)

heat required by Shaqu Coalmine has been totally met by existing coal-fired boilers which are using unmarketable coal from Shaqu Coalmine. The heat supply of Shaqu Coalmine is thus low-cost. The utilization of the collected CMM to provide heat would lead to a large amount of investment and does not constitute a necessary scenario. Moreover, the concentration of the drained gas at Shaqu Coalmine will occasionally fluctuate, which will impact the stability of the heat supply. The concentration is dependent on a variety of factors including the amount of coal mined, methane drainage techniques etc. Therefore this alternative scenario faces investment and technology barriers and should be eliminated. In summary, due to missing further heat demand by the coal mine or any other opportunity for commercial heat distribution an additional investment is no option. The replacement of the existing coal-fired boilers is part of the project activity and is discussed in section B5 below.

Alternative scenario vii:, Prior to the implementation of the project, some CMM at Shaqu coalmine is supplied to Liulin Towngas Company via the gas pipeline built by the Liulin Towngas Company. According to the documentation between the project owners and local government, the amount of CMM supplied to is to remain constant at the amount currently supplied and not increase in the future. This leaves a significant amount of CMM that would not be needed by baseline users. In addition, for the project owner, supply of CMM to the town directly would require construction of a new pipeline from the mine which would constitute a large amount of investment for the Project owner. Shanxi, where Shaqu Coalmine is located, is the main coal producing region of China and coal is easily accessible and affordable to the local residents. Switching to CMM is not considered economic. Further, the ongoing operation and maintenance costs of the pipeline system would mean that it is impossible for the CMM system to compete in terms of cost with coal. Therefore this alternative scenario faces investment barriers and should be eliminated.

Alternative scenario viii : is the combination of options i-vii. No further examination of these combinations is necessary since options i - vii are considered individually in further discussions on extracted CMM treatment.

Step 4c. Barriers analysis of the alternatives for energy production

Alternative scenario (1): This is a BAU scenario and there is no barrier.

Alternative scenario (3): This is the project activity not undertaken as a CDM project. This scenario is economically unattractive but cannot be eliminated here.

Alternative scenario (4): Construction of renewable energy power plant with the same installed capacity as the Project. The alternative is in compliance with current laws and regulations of China. However, Liulin County, where the Project is located, lacks feasible wind resources, hydro resources and/or solar resources for constructing a wind and/or hydropower and/or solar farm[12]. Furthermore, there are also no waves and tidal sources or geothermal sources for constructing a power plant with the same grid power as the Project. In China, biomass power plants need high investment and can only bring poor economic benefits which are difficult to be operated without policies& financial support[13]. Moreover, since the

[12] http://cwera.cma.gov.cn/cn/; http://www.chinawater.com.cn/newscenter/cmss/200612/t20061228_197108.htm

[13] Source: Biomass generation needs policy supply due to the high investment cost. The investment cost of the first biomass generation project (Shandong Shanxian Biomass Generation Project) which was put into delivery in Dec 2006 is around RMB 13 thousand/kW. The investment cost of the proposed project is RMB 4.7 thousand/kW (total

core investment domain for the project owner is coal mining, they have little experience in power generation. So, it's impossible for the project owner to invest into a biomass power plant. Therefore, alternative (4) is not feasible and should not be the baseline scenario of the Project.

In conclusion, the following scenarios are eliminated at this stage:

- For CMM treatment: scenarios ii, iii, iv, vi and vii
- For energy production: scenario 4

The following scenarios remain:

- For CMM extraction: scenario D
- For CMM treatment: scenarios i and v
- For energy production: scenarios (1) and (3)

In response to the request for review the following further substantiation on the exclusion of the baseline alternatives CMM flaring, additional captive power plant and heat energy generation was given:

Baseline scenario	**Comments**	**Conclusion**
CMM flaring	Flaring of CMM is not a legal requirement in China and further, flaring requires investment in a new combustion facility which would not generate any returns and is thus not financially attractive to the project owner. For these reasons, this option (Flaring of CMM) is not widely adopted in China and faces investment barriers.	This scenario is eliminated in step 4 of ACM008v6 (Eliminate baseline scenario alternatives that face prohibitive barriers)
Additional captive power plant	This is the project implemented without the CDM. The equity IRR of the project without CDM revenues, as shown in section B.5 of the PDD, is calculated to be 1.54% without CDM revenue. This is below the benchmark for the project.	This scenario is eliminated in step 5 of ACM0008v6 (Identify most economically attractive baseline scenario alternative) as it has been demonstrated that it is financially unattractive
Heat energy generation	Heat requirements arise mainly from the living quarters at the project site. The amounts for this are very small and there is no additional heat demand from nearby industry. So far the heat required by Shaqu Coalmine has been totally met by existing coal-fired boilers which are using unmarketable coal from Shaqu Coalmine. The heat supply of Shaqu Coalmine is thus low-cost. The utilization of the collected CMM to provide heat would lead to a large amount of investment and does not constitute a necessary scenario. Moreover, the concentration of the drained gas at Shaqu Coalmine will occasionally fluctuate,	This scenario is eliminated in step 4 of ACM008v6 (Eliminate baseline scenario alternatives that face prohibitive barriers).

investment cost / installed capacity). Therefore, it can be seen clearly that the unit investment of biomass is much higher than that of the proposed project. http://www.newenergy.org.cn/Html/0084/4100816608.html.

Baseline scenario	Comments	Conclusion
	which will impact the stability of the heat supply. The concentration is dependent on a variety of factors including the amount of coal mined, methane drainage techniques etc (see IRL 82 of Annex 2 of the validation report, which states that "even within one coal mine, gas quality fluctuations occur daily or even more frequently"; see also IRL 72, which are gas drainage records showing the fluctuating concentration at the coal mine). Therefore this alternative scenario faces investment and technology barriers. In summary, due to missing further heat demand by the coal mine or any other opportunity for commercial heat distribution an additional investment is no option. The replacement of the existing coal-fired boilers is part of the project activity and is therefore also discussed in B.5 of the PDD (which equals step 5 of the identification of the baseline scenario).	

Step 5. Identify the most economically attractive baseline scenario alternative

According to ACM008, step 2 (investment analysis) of the latest approved version of the "Tool for the demonstration and assessment of additionality" shall be used to identify the most plausible baseline scenarios by eliminating options which are clearly economically unattractive.

According to the methodology an investment comparison analysis should be applied, except in cases where the alternative does not involve an investment (e.g. consumption of electricity from the grid) where a benchmark analysis should be applied.

In this case, the BAU scenario (scenario i for CMM treatment and (1) for energy production) does not involve an investment. Therefore an analysis of the BAU scenario is not considered. A benchmark analysis is applied to show that the other remaining option (scenario v for CMM treatment and (3) for energy production) is economically unattractive.

The IRR is chosen as the financial indicator and the equity IRR of the project without CDM revenues (scenario v for CMM treatment and scenario (3) for energy production), as shown in section B.5 below, is calculated to be 1.54% without CDM revenue. This is below the coal mining sector benchmark of 15%. Thus, this scenario is eliminated as it has been demonstrated that they are financially unattractive.

The BAU scenario (the combination of *Alternative Scenario D*, *Alternative scenario i*, *Alternative scenario (1)*) is therefore the only feasible scenario and should be identified as the baseline scenario of the Project. In absence of the Project, the Project owner will continue the current CMM extraction practice, release the extracted CMM into the atmosphere, import electricity used in coalmine from NCPG.

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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On 1st December 2004 a major annual event in the coal mining industry in China, the 4th International Symposium on CBM/CMM was held in Beijing, China. At the symposium, CDM was a major topic to encourage coalmines to utilize CMM. After the symposium, the concept of CDM spread out around major Shanxi mining groups. Furthermore, in December 2005, a CDM meeting was organized by the Shanxi Development and Reform Committee to introduce CDM more actively to the coal producer in Shanxi Province[14]. Therefore, Huajin – as a large-scale coal producer in Shanxi Province – came into contact with the CDM very early on. Consequently and in light of the economic unattractiveness of this project; when the project owner intended to develop this project activity, the CDM as a very important factor was seriously considered and also implemented in parallel with the construction of the project activity. Detailed information is shown as follows:

Date	Main Events
06-2006	The Environmental Impact Registration Form was finished.
09-08-2006	The EIA was approved by the local government.
09-2006	The *Feasibility Study Report* was finished by *Coal Industry Handan Design Academe* and the IRR evaluated was lower than the benchmark IRR of 15%, but taken into account the income from selling CERs, the IRR was higher than the benchmark of 15%.
05-09-2006	The board meeting was held to make decision that the project was implemented as a CDM project.
13-09-2006	The design and service agreement of CDM was signed between the project owner and the Beijing Xidiaimu Technological Consultant Company.
20-09-2006	The Project owner held a meeting to collect local stakeholders' attitudes and comments on the Project for the CDM development with the assistance of the consultant company.
28-09-2006	The FSR was approved by *Shanxi DRC*.
02-11-2006	The general contract of the project construction was signed by three parties; that of the project owner, Jinan Diesel Engine Co. Ltd and Handan Design Engineering Chinacoal Co. Ltd.
15-11-2006	The equipment purchase contract was signed between the project owner and Jinan Diesel Engine Co. Ltd.
05-12-2006	The construction of the project was started.
15~06-03-2007	Beijing Xidiaimu Technological Consultant collected and checked the documentation on site.
20-04-2007 and 06-06-2007	Beijing Xidiaimu Technological Consultant Company had contact with TUV SUD (Beijing).
12-06-2007	The CDM development work was transferred to Cleanergy Investment Service Co. Ltd.
21-09-2007	Due to the project owner wanting to speed up the CDM application process, the project owner decided to submit the PDD and related documents to

[14] http://www.sxdrc.gov.cn/0wzly/NewsShow.aspx?NID=8A03DD854A27B60D

	NDRC by themselves (without any buyers). On Sep. 21th, 2007, the project was approved by NDRC.[15]
25-11-2007	The project was commissioned.
2-2008	The validation contract was signed.
06-2008	After assessment, the project owner finally decided to find a buyer for this project. Therefore, through a cautious selection and lengthy negotiations with the Buyer, the framework agreement between Noble Carbon Credits Limited and the project owner was signed.
15-01-2009	Date of ERPA between Noble Carbon Credits Limited and the project owner.
05-2009	GSP

The additionality of the Project is demonstrated by using the *Tool for the Demonstration and Assessment of Additionality* (Version 05.2) approved by the CDM EB and requested by the methodology ACM0008. The *Tool for the Demonstration and Assessment of Additionality* provides for a step-wise approach to demonstrate and assess the additionality. These steps include:

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

According to methodology ACM0008, step 1 can be ignored.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Three methods can be applied for the investment analysis: the simple cost analysis, the investment comparison analysis and the benchmark analysis. The project is a captive power plant. The electricity generated by the project will be totally used to meet the on-site power demand of Shaqu Coalmine, then reducing the electricity purchased from NCPG by Shaqu Coal Mine. According to *the Economic Evaluation Methods and Parameters for Construction Projects (Version 3)*, the saved cost could be considered as income; therefore, the simple cost analysis is not applicable. Moreover, according to *Guidance on the Assessment of Investment Analysis* issued by EB, if the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate, therefore the benchmark analysis was selected for the project.

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

The internal rate of return (IRR) is adopted here for the benchmark analysis. The IRR is a typical measure adopted by project sponsors or investment companies and is a common factor in the feasibility reports for such projects in China. This rate of return can be influenced by perceived technical and/or political risk and by the cost of money.

In the FSR, the project was designed as a captive power station using the CMM currently emitted to the air and the electricity generated by the project will be totally used by Shaqu Coalmine itself, that

[15] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1497.pdf

reducing the purchased electricity by Shaqu Coalmine from the Grid[16]. The FSR was approved by Shanxi Development and Reform Commission. Moreover, the issue was also confirmed by the Grid Connection Approval of the project issued by the Shanxi Electric Power Corporation in November 2007, which showed that the electricity generated by the project should be used by the Coalmine totally followed the Notice of the Opinion of the Work of Generating Electricity with Coal Mine Methane (document No. fagainengyuan [2007]721) issued by National Development and Reform Commission Promulgates.

Since the project is a captive power plant and can only be developed by the project owner, according to *Guidance on the Assessment of Investment Analysis*, internal company benchmarks/expected returns should be used. For this project, the Coalmine industry benchmark should be adopted. With reference to *Methods and Parameters for Economic Assessment of Construction Project* (Version 03) issued by National Development and Reform Commission and Ministry of Construction P. R. China, the benchmark equity IRR for coal mine industry is 15%(after tax). This is a common practice for coal mine industry.

The assumption is conservative. Since the core investment domain for the project owner is coal mining and they have little experience in power generation and CMM utilization, therefore the construction of the project would make significant risk to their investment decision. They would therefore expect higher returns than they would normally expect from an investment in their core business.

Therefore, as CMM projects have additional risk for the project owner, using a coalmine benchmark of 15% is reasonable. On the basis of the benchmark, the calculation and comparison of financial indicators are carried out in sub-step 2c. If the equity IRR of the Project is less than 15%, the Project will be financially unfeasible and then be additional.

Sub-step 2c. Calculation and comparison of financial indicators

The basic parameters to calculate the financial indicators of the Project are listed in Table B1.

[16] The FSR of the project, finished in September 2006

Table B1 Basic parameters for calculation of financial indicators of the Project

Parameters	Unit	Value	Source
Installed capacity (rated)	MW	14	FSR
Installed capacity (actual)	MW	9.8	FSR
Operation hour	hours	6500	FSR
Gross electricity generation	GWh	63.7	FSR
Auxiliary power consumption	%	5	FSR
Estimated annual electricity supplied	GWh	60.515	FSR
Electricity tariff (incl. VAT)	RMB/KWh	0.3011[17]	FSR
Estimated annual heat supply	GJ	40,156	FSR
Price of heat supply (excl. VAT)	RMB/GJ	8	FSR
Construction period	Years	1	FSR
Project lifetime	Years	15	FSR
Total static investment	Million RMB	65.8456	FSR
Equity investment	Million RMB	30.00	FSR
Loan	Million RMB	35.8456	FSR
VAT for electricity sale	%	17	FSR
Tax of expense for city maintenance and construction	%	5	FSR
Tax of education fee addition	%	3	FSR
Depreciation period	year	15	FSR
Depreciation Rate	%	6.4	FSR
Rate of statutory surplus reserve	%	10	FSR
Rate of statutory welfare reserve	%	5	FSR
Income Tax	%	33	FSR
Annual O&M cost	Million RMB	9.4523	FSR

Note that the heat price used in the IRR calculation here is taken from the FSR for the project. The waste heat from the proposed project activity will partially displace the heat that would otherwise be generated by coal-fired boilers which use unmarketable (i.e. low quality) coal from Shaqu coalmine. Therefore, the

[17]For a captive power plant, the system reserve fee was required by the grid company. Therefore, the electricity price used in the IRR calculation is the tariff on the invoice (0.3211yuan/kWh) minus the system reserve fee of this project (0.02yuan/kWh).

heating price in the FSR was determined based on the price and net calorific value of this coal using the following values:

- NCV for coal = 20,908 MJ/tonne; and
- Coal price = 167.14 RMB/tonne (excl. VAT) (since coal is from the coalmine itself rather than the market, the price was determined as the cost for Shaqu Coalmine to produce coal)

Using these values, the heat price in the FSR is calculated as:

- Heat price = 167.14/ 20.908 = 8 RMB/GJ (excl. VAT).

And this value is used in the IRR calculation here.

No policies on tax exemptions and/or VAT refunds are applicable to the project, as shown in the following sections. Relevant policies relating to subsidies (incl. tax exemptions and VAT refunds) that are potentially applicable for enterprises undertaking CMM projects are as follows:

No	Document	Date	Published by	Content	Applicability for the project activity
1	Notification on Preferential tax policies for Development of Western China	December 2001	Ministry of Finance, State Administration of Taxation and General Administration of Customs	Income tax exemption for the first two years of operation and a 50% discount for the subsequent three years for enterprises of new transportation, power generation, water conservation, post or broadcast business located in the western provinces of China (in order to encourage their economic development)	Not applicable. The Project Activity is not located in western area of China (i.e. Shanxi province (the location of this project) is not covered).
2	Suggestion on Drainage and Utilization of CBM /CMM	June 2006	General Office of the State Council	Policy on the appropriate tariff for grid connected CMM fired power plants.	Not applicable. The RfR question refers to policies for VAT refunds. Further, the project is a captive power project and not a grid connected one.
3	Announcement on accelerating the implementation of the tax policy for CBM/CMM	February 2007	Ministry of Finance and State Administration of Taxation	This policy applies to CMM/CBM extraction companies and states that a VAT refund can be given when the CMM is sold to a separate company.	Not applicable. The coal mine owner is also the owner of the CMM fired power generation project, hence no sales of CMM is involved in this project.

No	Document	Date	Published by	Content	Applicability for the project activity
	extraction				
4	Implementation suggestion on subsidy for CMM/CBM development	April 2007	Ministry of Finance	A subsidy of 0.2 RMB/m^3 pure CMM will be given to CMM extraction companies. This is not applicable for projects that use CMM for power generation.	Not applicable. The CMM use for power generation is excluded.
5	Implementation suggestion on CBM/CMM utilization for power	April 2007	National Development and Reform Commission of China	Policy on the appropriate tariff for grid connected CMM fired power plants.	Not applicable. The RfR question refers to policies for VAT refunds. Further, the project is a captive power project and not a grid connected one.
6	National Climate Change Program	June 2007	National Development and Reform Commission	CMM extraction and utilization companies should be provided with preferential tax treatment	Not applicable. There were no details specified in this policy document which requires local implementing measures.
7	Implementation suggestion on accelerating the comprehensive treatment and utilization of CMM	October 2007	General office of the Shanxi Province Government	VAT for sales of CBM (CMM) can be reimbursed at the time of payment for CBM (CMM) extraction companies.	Not applicable. The CMM used for power generation is extracted by the project owner itself, no sales of CMM is involved in the Project Activity.
8	Income tax law	October 2007 (adopted in 1991)	State Administration of Taxation	Five-year income tax holiday can be applied for companies owned by foreign enterprises.	Not applicable. The project owner is a state owned enterprise and hence does not qualify for this subsidy. It was therefore not included in the FSR IRR calculation or the IRR calculation in the PDD.

- The FSR for the proposed project was completed and approved by Shanxi Development and Reform Commission in September 2006. The decision to proceed with the proposed project and to seek to achieve CDM status for it was in the same month. The project starting date and the final investment decision was made in early November 2006. At this point, only items (1) , (2) and (8) which was originally adopted in 1991 from the table above were in place. The reasons why these items are not applicable for the given project activity are outlined in the right hand column of the table above.

Calculation is based on the data listed above, and the equtiy IRR is 1.54% without the income from selling CERs. It is lower than the financial benchmark IRR (15%), showing that the Project is financially unfeasible and demonstrating its additionality.

Moreover, even when the power industry benchmark of 10% (equity IRR after tax) from Methods and Parameters for Economic Assessment of Construction Project (Version 03) issued by National Development and Reform Commission and Ministry of Construction P. R. China is adopted, the project is still additional.

Taking into account the income from selling CERs (calculated with the price of 8 EUR/tCO_2e), the IRR of the Project will be increased to 84.12%, which is much higher than the benchmark IRR of 15%. The Project is economically attractive, which means that the CDM revenues could help the Project overcome the investment barrier.

Sub-step 2d. Sensitivity Analysis

The purpose of this step is to show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions.

Four factors are considered in following sensitivity analysis:

- ✧ Electricity supplied
- ✧ Electricity tariff
- ✧ Total investment
- ✧ Annual O&M cost

Assuming that the above factors fluctuate within the range of –10%~10%, the corresponding impacts on the IRR of the Project are shown in Table B2 and Figure B1.

Table B2. Data of sensitivity analysis

Range / Factor	-10%	-5%	0	+5%	+10%
Electricity supplied	negative	negative	1.54%	2.78%	3.62%
Electricity Tariff	negative	negative	1.54%	2.78%	3.62%

Total investment	2.59%	2.09%	1.54%	0.98%	0.41%
Annual O&M Cost	3.01%	2.40%	1.54%	0.49%	negative

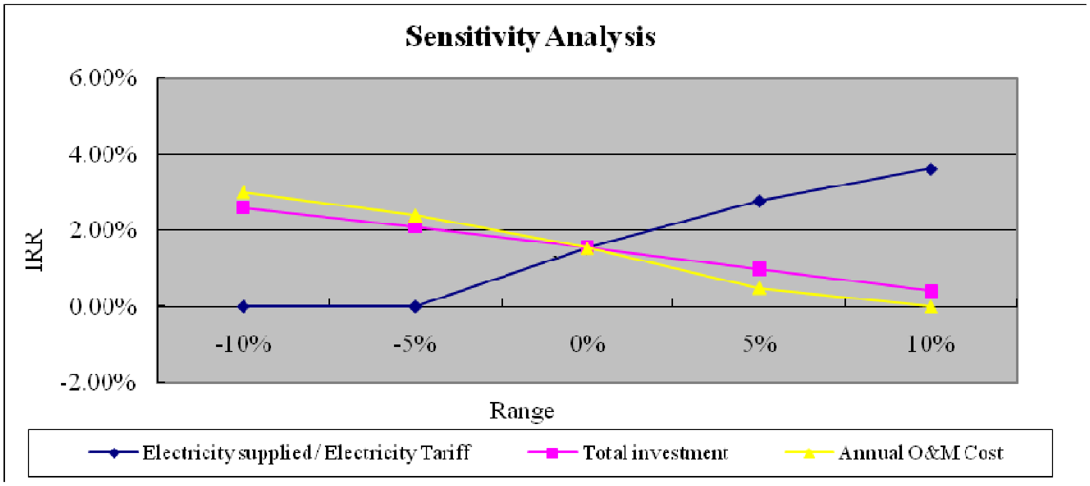

Figure B1. The sensitivity analysis of the equity IRR

As shown in the sensitivity analysis above, even when the factors fluctuated in the range of 10%, the IRR of the Project could not reach the benchmark and the conclusion stated above is still tenable.

More analysis regarding the four indicators is shown as follows:

Parameter / IRR	The Project			
	Total Investment	Electricity Generation	Grid Tariff	Annual O&M Cost
15%	↓77% (to 15.14 million RMB)	↑114% (to 129,502MWh)	↑114% (to 0.644 yuan/kWh)	/

➢ Total investment

When the total investment of the project decreases by 77%, the IRR could reach the benchmark of 15%. However, this scenario is extremely unlikely as investment costs of this type (e.g. materials, equipment) have been increasing in China in the years since the FSR was completed[18]. In practice there is a general trend in China at the present time for increasing investment costs as a result of rising prices for fuel, raw materials and power. In 2003, 2004, 2005, and 2006 (the most recent years for which data is available), the national general growth rate of purchasing prices of raw materials, fuels and power were 4.8%, 11.4%, 8.3% and 6% respectively. Also in 2003, 2004, 2005 and 2006 the national total price indices of investment in fixed assets were 2.2% and 5.6%, and 1.6%, 1.3% respectively[19]. At present, the construction of the project was completed, only the investment of generators has reached to 26.43 million

[18] http://cn.chinagate.com.cn/economics/2007-10/31/content_9153888_2.htm
[19] China Statistic Year Book, 2004, 2005, 2006, 2007

which can be seen from the invoice[20]. The total investment of the project is about 69.00 million up to Dec. 2008[21] . Therefore, there will be no possibility for the decrease by 77% to 15.14 million for the project.

➢ Total generated Electricity

Chinese-made engines are still not mature. They can not operate stably in the long run. The power supply by the project is calculated under the optimistic conditions as the FSR assumes consistent volumes of CMM and that all gas extracted is of a concentration sufficient for it to be used for power generation. In reality, coal mine gas is a variable resource, both in quality and in quantity. Only gas of certain purity can be safely harnessed in industrial applications. CMM quantities and quality are determined by a complex range of inter-related factors, most notably by the rate of coal extraction; the gas concentrations in the working coal face and in the surrounding seams; and by the gas drainage techniques employed. This means that the volume and concentration (and therefore the operation hours and the amount of electricity generated) will fluctuate significantly according to factors outside the control of the power plant operator. So the annual power supply is not expected to increase significantly in the crediting period.

➢ Grid Tariff

When the grid tariff of the project increases to 214% (equivalent to 0.644 yuan/kWh), the IRR could reach the benchmark of 15%. In relation to the price that the grid company sells electricity to industries, an increase of 114% is very unlikely since there are strict price controls in China and a policy to limit inflation through these controls. Additionally, when there is such a price increase it tends to be at a period of high inflation. As such it would also be expected that along with any power price increase there would also be similar increase to the annual operation and maintenance costs since the price of materials and the cost of labor would also increase. Furthermore, the decision to go ahead with the project was made in 2006 and at that time the electricity tariff was just increased. The electricity tariff used in the FSR and the IRR calculation above is 301 RMB/MWh (including VAT). This is the actual tariff in Sep. 2006. Therefore, it is unlikely for the electricity tariff to increase by 114% to 0.664 yuan/kWh.

➢ Annual O&M Cost

Even when the annual O&M cost would reduce to zero, the IRR of the project could not reach the benchmark. Moreover, due to the vast price increasing in raw material, regular staff wages and other relevant stuff, the operation cost of the projects will exceed the estimation calculated in the FSR.

Step 3. Barrier Analysis

No barrier analysis has been applied.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the Project activity

The table below lists other CMM projects in Shanxi province. The following sources of data were used to identify projects:

➢ The Methane to Markets CMM projects database (accessed on 26 February 2009 and available at

[20] The invoice of generators
[21] The settlement report from the planning department of Huajin,

http://www2.ergweb.com/cmm/index.aspx).

- The UNFCCC website showing details of registered CDM projects and CDM projects under development (accessed on 11 December 2008 and available at http://cdm.unfccc.int/index.html)

The common practice analysis is limited to projects in Shanxi province only as:

- The unique geological conditions in Shanxi result in particularly gassy conditions in the coal mines in this province, compared to mines in other provinces in the North China Power Grid Area[22].
- The electricity tariff in every province in China is different. This hence affects the investment analysis of the projects.
- The investment environment of each province in China is different. This is due to a number of factors including the economic development level, the industrial structure, the fundamental infrastructure of the province, the development strategy and the policy framework. These can all affect the final investment decision.
- Finally, a number of other key economic factors vary from province to province. These include tariff rates of products, the cost of materials, the cost of electricity and other utilities such as water, the cost of labour and services and the types of loan that can be obtained. These all vary between provinces.

[22] The Eleventh Five Year Plan for Utilisation and Development of CMM and CBM (available at www.ndrc.gov.cn/nyjt/nyzywx/t20060626_74591.htm)

Province	Name of project	Installed Capacity	Domestic/ international technology	Notes
Shanxi	Yangquan Coal Mine Methane Advanced Industrial Furnace Utilisation Project	n/a	n/a	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1169825227.22/view
Shanxi	Yangquan Coal Mine Methane (CMM) Utilization for Power Generation Project, Shanxi Province	90.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1169658303.93/view
Shanxi	Shanxi Liulin Coal Mine Methane Utilization Project	12.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1183560834.33/view
Shanxi	Shanxi Yangcheng Coal Mine Methane Utilization Project, China	15.5	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1185280806.49/view
Shanxi	Shanxi Coal Transport Market Co., Ltd. Yangquan Branch CMM Utilization Project	30.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1188563868.33/view
Shanxi	Shanxi Datuhe Coal Mine Methane Utilization Project	17.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1207732414.72/view
Shanxi	Jincheng Sihe 120MW Coal Mine Methane Power Generation Project	120.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/DB/DNV-CUK1214826895.32/view
Shanxi	Duerping Coal Mine Methane Utilization Project	12.0	Not specified.	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1214838535.8/view
Shanxi	Jincheng Fengrun CMM Utilisation from Nine Mines in Jincheng City Shanxi Province	24.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/DNV-CUK1214933294.15/view
Shanxi	Daning Coal Mine Methane Power Generation Project in Jincheng City Shanxi Province	16.3	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/DNV-CUK1214928829.28/view

				(rejected , under re-submission)
Shanxi	Yangquan Yinying Coal Mine Methane (CMM) Power Generation Project of Yangquan City, Shanxi Province	5.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/FZF0THXKGW39VI3UGRDKO9WCP03P00/view.html
Shanxi	Shanxi Fengtai Coal Mine Methane (CMM) Utilization Project	6.3	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/C18W3BCEGCLCIFALUA4JKSW3VYOBZG/view.html
Shanxi	Shanxi Yangquan 13MW Coal Mine Methane Co-generation Project	13.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/P3WQKFD07NCG3WBGCIFV7GUD5CRC2Q/view.html
Shanxi	Jincheng Chengzhuang 18 MW Coal Mine Methane Power Generation Project	18.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/0V2QKYT8QPEP2M7O4M1GWQ3EYEB9OQ/view.html
Shanxi	Lanjin CMM Power Generation Project	33.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/506OKN4Y6CM2HPZT6BG0KI5IFKNK8Y/view.html
Shanxi	Yangquan Nanmei (Group) Co., Ltd. Coalmine Methane Utilization Project	12.5	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/6NKHSLXJWF8HBL90LMZAKGJESSHY9I/view.html
Shanxi	Duanwang CMM Power Generation Project	4.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/68F6RTI2LQCM9I7EXXSLT5VDGMM3JN/view.html
Shanxi	Yangquan CMM Power Generation Project	6.5	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/S197RAQV3TLCG2W8PO491IKLT9YX6E/view.html
Shanxi	Shanxi Jincheng Beishidian 36MW Coal Mine Methane Power Generation Project	36.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/Valid

				ation/DB/O9I00KATZDHNP4G3T3CN82K98MWS5I/view.html
Shanxi	Malan Coal Mine Methane Utilisation Project	7.5	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/XRJQ3MEI95NHZ46CH4VA25EU0GE2CY/view.html
Shanxi	Tunlan Coal Mine Methane Utilization Project, Shanxi Province	34.8	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/B6HFFEUCK1EGVP1IN41O1ZV1RH0VDK/view.html
Shanxi	Lu'an MTM Mine Methane Power Generation Project	62.0	Domestic & international	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/SM9PB4E6E9S8B0151G53SYRX7KP2MW/view.html
Shanxi	Shanxi Herui Coal Mine Methane Power Generation ProjectTop of Form	45.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/UKLMN824TUIYJ8PEWAPX96273EQ01L/view.html
Shanxi	Lanhua Daning Coal Mine Methane Power Generation Project, Shanxi Province, P. R. China	35.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/65ZYEOOPAZ5P3XBXX2LYPVLO8CJ1OH/view.html

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

All the similar projects in Shanxi Province are applying for CDM, and without the incentive of CDM these projects would not be carried out. Therefore, the development of a power project using CMM not undertaken as a CDM project is not a common practice in Shanxi Province, which means that the common practice analysis also supports the additionality of the Project.

To summarize, the Project passed all criteria of the *Tool for the Demonstration and Assessment of Additionality*. It is economically unfeasible and should not be implemented without CDM revenues. Therefore, the Project is additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices:

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1. Project Emissions (PE_y)

Project emissions are defined by the following equation：

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (1)$$

Where:

PE_y	Project emissions in year *y* (tCO_2e)
PE_{ME}	Project emissions from energy use to capture and use methane (tCO_2e)
PE_{MD}	Project emissions from methane destroyed (tCO_2e)
PE_{UM}	Project emissions from un-combusted methane (tCO_2e)

1.1 Combustion emissions from additional energy required for CBM/CMM/VAM capture and use (PE_{ME})

Additional energy may be used for the capture, transport, compression and use for CMM. Emissions from this energy use should be included as project emissions.

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC} + CONS_{HEAT,PJ} \times CEF_{HEAT} + CONS_{FOSSFUEL,PJ} \times CEF_{FOSSFUEL} \quad (2)$$

where:

PE_{ME}	Project emissions from energy use to capture and use methane (tCO_2e)
$CONS_{ELEC,PJ}$	Additional electricity consumption for capture and use of methane, if any (MWh)
CEF_{ELEC}	Carbon emissions factor of electricity used by coal mine (tCO_2e/MWh)
$CONS_{HEAT,PJ}$	Additional heat consumption for capture and use of methane, if any (GJ)
CEF_{HEAT}	Carbon emissions factor of heat used by coal mine (tCO_2/GJ)
$CONS_{FOSSFUEL,PJ}$	Additional fossil fuel consumption for capture and use of methane, if any (GJ)
$CEF_{FOSSFUEL}$	Carbon emissions factor of fossil fuel used by coal mine (tCO_2/GJ)

The Project will use no additional heat energy or other fossil fuel to the electricity supplied by it. The amount of electricity for auxiliary consumption has been estimated at a rate of 5% in the Feasibility Study Report of Shaqu CMM utilization project. During normal operation of the power plant, electricity will only be supplied by the project to the power grid after meeting the demand of auxiliary facilities at the power plant site i.e. the auxiliary electricity consumed on site will be excluded automatically and the electricity meter at the power plant measures the electricity net of site use.

When the gen sets are not in operation, electricity will be drawn from the grid to support auxiliary functions or for maintenance use. The amount of electricity consumed during this period will be monitored by an electricity meter continuously. The emission factor of electricity used by the coal mine is equal to the emission factor of the North China Power Grid Therefore, for the proposed project activity,

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC}$$

However, in the emission reduction calculations that follow this amount is assumed to be zero as it is assumed that when the power plant is not in operation, auxiliary facilities will also not operate, and the remaining electricity demand for maintenance is very small and no reliable prognosis data exists. .

1.2 Combustion emissions from use of captured methane (PE_{MD})

The proposed project activity doesn't involve catalytic oxidation of VAM, CMM fuelled boilers, gas for residential or vehicle utilization, or flaring. Therefore, project emissions from combustion and destruction of captured methane can be calculated as follows:

$$PE_{MD} = MD_{ELEC} \times (CEF_{CH4} + r \times CEF_{NMHC}) \qquad (3)$$

with:

$$r = PC_{NMHC} / PC_{CH4}$$

where:

PE_{MD}	Project emissions from CMM destroyed (tCO_2)
MD_{ELEC}	Methane destroyed through power generation (tCH_4)
CEF_{CH4}	Carbon emission factor of combusted methane (2.75 tCO_2/tCH_4)
r	Relative proportion of NMHC compared to methane;
CEF_{NMHC}	Carbon emission factor of combusted non methane hydrocarbons ($tCO_2e/tNMHC$)
PC_{NMHC}	NMHC concentration (in mass) in coal mine gas (%)
PC_{CH4}	Concentration of methane (in mass) in extracted gas (%), measured on wet basis

According to gas sample analysis in Shaqu Coalmine, the NMHC concentration in the proposed project is less than 1% of the coalmine gas, thus the combustion emissions from non-methane hydrocarbons will be ignored. The NMHC concentration will be monitored annually in Shaqu Coalmine to check whether its concentration is below or above 1% to determine whether NMHC combustion is to be included in the project emissions.

MD_{ELEC} is calculated with the formulae below:

$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC}$ (4)

where:

MD_{ELEC}	Methane destroyed through power generation (tCH_4)
MM_{ELEC}	Methane measured sent to power plant (tCH_4)
Eff_{ELEC}	Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)

1.3 Un-combusted methane from power generation (PE_{UM})

Since CMM is only used for power generation in the Project, $PE_{flare}=0$, $PE_{ox}=0$, so the emission of un-combusted methane from power generation can be simplified as follows:

$PE_{UM} = GWP_{CH4} \times MM_{ELEC} \times (1- Eff_{ELEC})$ (5)

where:

PE_{UM}	Project emissions from un-combusted methane (tCO_2e)
GWP_{CH4}	Global warming potential of methane ($21tCO_2e/tCH_4$)
MM_{ELEC}	Methane measured sent to power plant (tCH_4)
Eff_{ELEC}	Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)

Therefore, equation (1) of the project emissions is defined as follows:

$PE_y = PE_{ME} + PE_{MD} + PE_{UM}$ (6)

2. Baseline emissions (BE_y)

Baseline emissions are given by the following equation:

$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$ (7)

where:

BE_y	Baseline emissions in year *y* (tCO_2e)
$BE_{MD,y}$	Baseline emissions from destruction of methane in the baseline scenario in year *y* (tCO_2e)
$BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere in year *y* that is avoided by the project activity (tCO_2e)
$BE_{Use,y}$	Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year *y* (tCO_2e)

2.1 Baseline emissions from methane destroyed ($BE_{MD, y}$)

Baseline emissions should account for the CO_2 emissions resulting from the destruction of methane in the baseline scenario.

$BE_{MD,y} = (CEF_{CH4} + r \times CEF_{NMHC}) \times \sum(CMM_{BL,i,y} + PMM_{BL,i,,y})$ (8)

Where:

$BE_{MD,y}$	Baseline emissions from destruction of methane in the baseline scenario in year y(tCO_2e)
$CMM_{BL,i,y}$	Pre-mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y (tCH_4)
$PMM_{BL,i,y}$	Post mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y (tCH_4)
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons ($tCO_2eq/tNMHC$)
r	Relative proportion of NMHC compared to methane

with:

$r = PC_{NMHC} / PC_{CH4}$

PC_{CH4}	Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC}	NMHC concentration (in mass) in extracted gas (%)

In the Project, both pre-mining CMM and post-mining CMM are drawn out of each well via a common drainage system for safety purposes and so no breakdown can be provided between them. The mix of pre-mining CMM and post-mining CMM will be sent to the generators, and it is impossible to differentiate one from the other, so only the total amount of the CMM sent to the power generation station will be measured. These individual streams of CMM are therefore combined and referred to in the PDD as 'CMM', i.e.:

$$BE_{MD,y} = (CEF_{CH4} + r \times CEF_{NMHC}) \times \sum CMM_{BL,i,y} \quad (9)$$

To conservatively estimate methane destruction in the baseline over time, it is important to understand the characteristics of ex ante thermal demand for methane in the baseline scenario.

Calculation of the mean annual demand for each year of the crediting period

For thermal demand, which include on-site heat generation and supply to the gas grid for various combustion end uses, demand can vary within the year. Under some circumstances, some portion of the CMM used by a project for power generation might otherwise have gone to produce thermal energy under the baseline. Emissions from the project are reduced only to the extent that the power generation uses methane that would have been *emitted* in the baseline.

For this project, residential loads are preferred loads and electricity will only be generated from excess gas, once these base load uses have been satisfied. Therefore, a conservative estimate of the baseline gas demand is made here and this amount of gas removed from the total estimated volume of CMM available, in order that the amount of gas available for power generation can be estimated.

(i) Ex ante projection of baseline thermal energy demand.

According to ACM0008, there are three possible methods for estimating this:

a) Engineering/ economic study of thermal energy demand
b) Statistical projection

c) Maximum throughput on the distribution system

In this case, method c) is used. It was not possible to use method a) and method b) for the following reasons:

- Detailed information on the end users of the CMM supplied to Liulin Towngas Company is not available.
- Less than 5 years's data is available. CMM from Huajin started to be supplied in September 2005.
- Huajin kept no record of the volumes of CMM supplied to Liulin Towngas Company as the gas was supplied free of charge.
- Liulin Towngas Company have paper records of the total volume of CMM supplied to them from Huajin each year but of this total, any excess gas was vented and the volume of gas vented has not been recorded.
- Liulin Towngas Company has records of the volume of gas consumed historically by end-users. However, gas supplied to end-users is from 3 sources (one of which is Huajin) and no breakdown of this by source is available.

According to ACM0008, prospective baseline demand in the absence of the project may be estimated from the maximum amount of CMM that could be delivered to end users through existing pipelines. This approach assumes that thermal energy demand for CMM in all future years will be equal to the maximum amount of CMM that can be delivered.

Residential loads are preferred loads and electricity will only be generated from excess gas, once these base load uses have been satisfied. Therefore, baseline thermal demand is removed from the total amount of gas available, and the remaining amount of gas is assumed available for power generation. In the calculations that follow it is this figure for remaining gas that is used; therefore $\boldsymbol{BE_{MD,y}}$ is zero.

2.2 Baseline emissions from release of methane into the atmosphere ($BE_{MR,y}$)

Considering that this project does not involve the utilisation or destruction of CBM and VAM, so the emissions of methane released into the atmosphere can be calculated as follows:

$$BE_{MR,y} = GWP_{CH4} \times [\sum (CMM_{PJ,i,y} - CMM_{BLi,y}) + \sum (PMM_{PJ,i,y} - PMM_{BL,i,y})] \quad (12)$$

where:

$BE_{MR,y}$	Emissions from the release of methane into the atmosphere in the year y that is avoided by the project activity (tCO_2e)
GWP_{CH4}	Global warming potential of methane ($21tCO_2e/tCH_4$)
$CMM_{PJ,i,y}$	Pre-mining CMM captured, sent to and destroyed by use i in year y (tCH_4)
$CMM_{BL,i,y}$	Pre-mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y(tCH_4)
$PMM_{PJ,i,y}$	Post-mining CMM captured, sent to and destroyed by power generation in year y (tCH_4)
$PMM_{BL,i,y}$	Post-mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y(tCH_4)

In the Project, both pre-mining CMM and post-mining CMM are drawn out of each mine via a common drainage system for safety purposes and so no breakdown can be provided between them. The mix of pre-mining CMM and post-mining CMM will be sent to the generators, and it is impossible to differentiate one from the other, so only the total amount of the CMM sent to the power generation station will be measured. These individual streams of CMM are therefore combined and referred to in the PDD as 'CMM'. Therefore, the equation above can be simplified as follows: i.e.:

$$BE_{MR,y} = 21 \times [\sum (CMM_{PJ,i,y} - CMM_{BLi,y})] \quad (13)$$

where:

$CMM_{PJ,i,,y}$ The total CMM captured, sent to and destroyed by use i in year *y* (tCH_4)
$CMM_{Bl,,i,,y}$ The total CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y(tCH_4)

2.3 Baseline emissions from power replaced by project ($BE_{Use,y}$)

The electricity generated by the project will be totally used by Shaqu Coalmine, therefore reducing the electricity purchased from NCPG by Shaqu Coal Mine. Since the project participants decided not to claim CERs from the recovered heat, so the baseline emissions from power generation replaced can be calculated as follows:

$$BE_{Use,y} = GEN_y \times EF_{ELEC} \quad (14)$$

where:

$BE_{Use,y}$ Baseline emissions from the production of power and heat replaced by the Project in year *y* (tCO_2e)
GEN_y Net electricity supplied by the Project to NCPG in year *y* (MWh)
EF_{ELEC} Emissions factor of NCPG (tCO_2/MWh)

2.3.1 Emissions factor of NCPG ($EF_{ELEC,y}$)

According to methodology ACM0008, if the baseline scenario includes grid power supply that would be replaced by the project activity, the emissions factor for displaced electricity is calculated as per *Tool to calculate the emission factor for an electricity system*. Therefore the emission factor of NCPG ($EF_{ELEC,y}$) is adopted here, which means:

$$EF_{ELEC,y} = EF_{grid,CM,y} \quad (15)$$

where:

$EF_{grid,CM,y}$ Combined margin CO_2 emission factor of NCPG in year *y,* calculated using the latest version of the *Tool to calculate the emission factor for an electricity system.*

The *Tool to calculate the emission factor for an electricity system* provides for a step-wise approach to calculate the $EF_{grid,CM,y}$. These steps include:

Step 1. Identify the relevant electric power system

The electricity produced by the Project will be supplied to NCPG, therefore the project electricity system is defined as NCPG.

For NCPG, there are electricity imports from North-east China Power Grid[23] (NEPG) and China Central Power Grid (CCPG), therefore the connected electricity system is defined as NEPG and CCPG. When determining the operating margin (OM) emission factor of NCPG, this PDD uses the weighted average operating margin emission factor of NEPG and CCPG as the emission factor of net electricity imports ($EF_{grid,import,y}$) from NEPG and CCPG to NCPG, and the data used for calculation are adopted from the most recent 3 years. For detail information please refers to Annex3.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

For this project, Option I is chosen i.e. only grid power plants are included in the calculation.

Step 3. Select an operating margin (OM) method

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

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

From 2002 to 2006, among the total electricity generation of NCPG that the Project is connected into, the amount of low-cost/must run resources accounts for 0.8%, 0.89%, 0.86%, 0.76% and 0.75% respectively[24], all less than 50%, therefore, method (a), simple OM is adopted to calculate the operating margin emission factor of NCPG in this PDD.

To calculate the simple OM emission factor of NCPG, the *ex-ante* option is adopted with using the data vintage as a 3-year generation-weighted average based on the most recent data.

Step 4. Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

Option A: Based on data on fuel consumption and net electricity generation of each power plant / unit, or

Option B: Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit, or

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[23] http://www.sp.com.cn/zgdl/spw/05_01y/05_01_dljh.htm, etc

[24] China Electric Power Yearbook, 2003-2007 Edition.

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 project electricity system.

Option A should be preferred. However, the data on fuel consumption and net electricity generation of each power plant / unit is not publicly available. Thus, Option A cannot be adopted. Similarly, the data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit are not available too, thus Option B cannot be adopted.

According to the *Notification on Determining Baseline Emission Factors of China Power Grid*, only nuclear and renewable power generation are considered as low-cost / must-run power sources in China. Furthermore, the quantity of electricity supplied to the grid by low-cost / must-run power sources is known. Therefore, Option C is adopted to calculate the simple OM emission factor of NCPG.

The simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost / must-run power plants / units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{co2,i.y}}{EG_y} \quad (16)$$

where:

$EF_{grid,OMsimple,y}$ Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh).

$FC_{i,y}$ Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit).

$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit).

$EF_{co2.i.y}$ CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ).

EG_y Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year *y* (MWh).

i All fossil fuel types combusted in power sources in the project electricity system in year

y The three most recent years.

The data on net electricity generation are obtained from the *China Electric Power Yearbook* from 2005 to 2007 (published annually). The data on different fuel consumptions for power generation and the net caloric values of the fuels are obtained from the *China Energy Statistical Yearbook* from 2005 to 2007 (published annually). The emission factors adopted are obtained from *Table 1.3* and *Table 1.4* of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 2, Chap 1, Page 1.21-1.24.

Step 5. Identify the cohort of power units to be included in the build margin

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

(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.

Since the set of power units described as (b) in NCPG comprises the larger annual generation than that of (a), the sample group (b) should be used for calculating the build margin of NCPG.

In terms of vintage of data, the PDD choose the options as below:

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 CDM-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.

Step 6. Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (17)$$

Where:

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year *y* (tCO_2/MWh).

$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).

$EF_{EL,m,y}$ CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).

m Power units included in the build margin.

y Most recent historical year for which power generation data is available.

Currently in China, the data of sampling power units group *m* are publicly unavailable. Taking notice of this situation, CDM EB accepts the following deviation when calculating the build margin emission factors for grid electricity in China[25]:

- ✧ Use of capacity additions exceeds 20% of total generation for estimating the build margin emission factor for grid electricity.
- ✧ Use of weights estimated using installed capacity in place of annual electricity generation.

[25] http://cdm.unfccc.int/Projects/Deviations

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: Firstly, calculate the share of different power generation technology in recent capacity additions. Secondly, 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.

Since data of installed capacities can not be separated to coal-based, oil-based and gas-based at present, BM is calculated with following steps and formula:

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

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}} \tag{18}$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}} \tag{19}$$

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}} \tag{20}$$

where:

$F_{i,j,y}$ The amount of fuel *i* (in a mass or volume unit) consumed by province *j* in year(s) *y*.

$NCV_{i,j}$ Net calorific value (energy content) of fossil fuel type *i* consumed by province *j* (GJ / mass or volume unit).

$EF_{co2.i.j}$ CO_2 emission factor of fossil fuel type *i* consumed by province *j* (tCO_2/GJ).

COAL, *OIL* and *GAS* are footnote group for solid fuels, liquid fuels and gas fuels.

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

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \tag{21}$$

Where $EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ represent the efficiency level of the best coal-based, oil-based and gas-based power generation technology commercially available in China.

Substep c. Calculate BM of the grid based on the result of Substep b and the share of thermal power of recent 20% capacity additions.

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \tag{22}$$

Where CAP_{Total} is total capacity additions while $CAP_{Thermal}$ is capacity additions of thermal power.

The data for the calculation of BM emission factor are obtained from the *China Electric Power Yearbook* from 2005 to 2007 (published annually) and the *China Energy Statistical Yearbook* from 2005 to 2007 (published annually). The emission factors of the fuels adopted are obtained from *Table 1.3* and *Table 1.4* of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 2, Chap 1, Page 1.21-1.24.

With reference to the *Notification on Determining Baseline Emission Factors of China Power Grid,* the weighted average fuel consumption for power generation of 600 MW sub-critical coal-fired power generators built in 2006 (329.94 gCe/kWh) and the 200 MW oil/gas based combined cycle power generators (252 gCe/kWh) are taken as the efficiency level of the best technology commercially available in China.

Step 7. Calculate the combined emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \tag{23}$$

Where:

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

The weight w_{OM} and the weight w_{BM} are both take 0.5 as default for the fixed crediting period.

3. Leakage (LE_y)

The formula for leakage is given as follows:

$$LE_y = LE_{d,y} + LE_{o,y} \tag{24}$$

where:

LE_y	Leakage emissions in year *y* (tCO_2e)
$LE_{d,y}$	Leakage emissions due to displacement of other baseline thermal energy uses of methane in year *y* (tCO_2e)
$LE_{o,y}$	Leakage emissions due to other uncertainties in year *y* (tCO_2e)

4. Emission Reductions (ER_y)

The emissions reductions (ER_y) by the project activity during a given year *y* is the difference between the baseline emissions (BE_y), project emissions (PE_y) and leakage (LE_y), as follows:

$$ER_y = BE_y - PE_y - LE_y \tag{25}$$

where:

ER_y	Emission reductions of the project activity during the year *y* (tCO_2e)
BE_y	Baseline emissions during the year *y* (tCO_2e)
PE_y	Project emissions during the year *y* (tCO_2e)
LE_y	Leakage emissions in year *y* (tCO_2e)

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

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Note: According to the latest guidelines for completing the Project Design Document (EB41, Annex 12), data that is calculated with equations provided in the methodology or default values specified in the methodology should not be included here. Therefore, the following parameters are not included below: Eff_{ELEC}, GWP_{CH4}, CEF_{CH4}, EF_{ELEC}, EF_{BM} and EF_{OM}.

Data / Parameter:	$TH_{BL,y}$
Data unit:	tCH_4
Description:	Projected annual baseline CMM demand for thermal energy uses
Source of data used:	Project owner
Value applied:	17.82 million m^3 of methane (pure)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimated according to option c) maximum throughput through the system, according to ACM0008.
Any comment:	No further comments

Data / Parameter:	$CMM_{BL,i}$
Data unit:	tCH_4
Description:	CMM that would have been captured, used and destroyed by use *i* in the baseline scenario in year *y*
Source of data used:	Project owner
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	For this project, residential loads are preferred loads and electricity will only be generated from excess gas, once these base load uses have been satisfied. Therefore, a conservative estimate of the baseline gas demand is made and this amount of gas removed from the total estimated volume of CMM available for power generation.
Any comment:	Estimated *ex ante* at start of project

Data / Parameter:	$F_{i,j,y}$
Data unit:	in mass or volume unit
Description:	Total amount of fuel i consumed for power generation in province j in year y
Source of data used:	*China Energy Statistical Yearbook 2005-07*
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 the *China Energy Statistical Yearbook* is reliable.
Any comment:	No further comments

Data / Parameter:	NCV_i
Data unit:	TJ per mass or volume unit of fuel i
Description:	Net caloric value of fuel i
Source of data used:	*China Energy Statistical Yearbook 2005-07*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the methodology, national data should be used, if available.
Any comment:	No further comments

Data / Parameter:	$OXID_i$
Data unit:	%
Description:	Oxidation factor of the fuel i
Source of data used:	*IPCC Guideline for National Greenhouse Gas Inventories 2006*
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the methodology, IPCC default values can be used
Any comment:	No further comments

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tC/TJ
Description:	CO_2 emission factor per unit of energy of the fuel i
Source of data used:	*IPCC Guideline for National Greenhouse Gas Inventories 2006*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the methodology, IPCC default values can be used
Any comment:	This parameter is equivalent to $COEF_{i,k}$ in ACM0008.

Data / Parameter:	$CAP_{i,j,y}$
Data unit:	MW
Description:	Total capacity of plants in province j burning fuel i in year y
Source of data used:	*China Electric Power Yearbook 2005-07*
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 the *China Electric Power Yearbook* is reliable.

Any comment:	No further comments

Data / Parameter:	$GEN_{i,j,y}$
Data unit:	MWh
Description:	Electricity supplied to the grid by plants burning fuel i (not including low cost and must run sources) in province j
Source of data used:	*China Electric Power Yearbook 2005-07*
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 the *China Electric Power Yearbook* is reliable.
Any comment:	No further comments

Data / Parameter:	Eff_i
Data unit:	%
Description:	Optimal efficiency of commercially best available technology of fuel i
Source of data used:	China's DNA
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 the website of China's DNA is reliable.
Any comment:	No further comments

B.6.3 Ex-ante calculation of emission reductions:

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1. Calculation of project emissions (PE_y)

1.1 Combustion emissions from additional energy required for CBM/CMM capture and use (PE_{ME})

As described in Section B.6.1, for the Project, $PE_{ME} = 0$.

1.2 Combustion emissions from use of captured methane (PE_{MD})

According to the *Feasibility Study Report* of the Project, MM_{ELEC} = 21.704 Mm^3/y = 21.704 × 670 = 14,541 tCH_4/y.

Therefore, $PE_{MD} = MM_{ELEC} \times Eff_{ELEC} \times CEF_{CH4}$ = 14,541 × 99.5% × 2.75 = 39,789 tCO_2e/y.

1.3 Un-combusted methane from power generation (PE_{UM})

$PE_{UM} = GWP_{CH4} \times MM_{ELEC} \times (1- Eff_{ELEC})$ = 21 ×14,541 × (1-99.5%) = 1,527 tCO_2e/y.

Based on formula (6) in Section B.6.1, the project emissions (PE_y) are calculated as:

$PE_y = PE_{ME} + PE_{MD} + PE_{UM} = 0 + 39,789 + 1,527 = 41,316$ tCO_2e.

2. Calculation of baseline emissions (BE_y)

2.1 Baseline emissions from methane destroyed ($BE_{MD, y}$)

At Shaqu Mine, there is existing baseline thermal demand of supplying gas to Liulin Towngas Company for use by residents for heating. According to ACM0008, baseline thermal demand is estimated as follows:

For this project, residential loads are preferred loads and electricity will only be generated from excess gas, once these base load uses have been satisfied. Therefore, a conservative estimate of the baseline gas demand is made here and this amount of gas removed from the total estimated volume of CMM available, in order that the amount of gas available for power generation can be estimated.

(i) Ex ante projection of baseline thermal energy demand.
According to ACM0008, there are three possible methods for estimating this:

a) Engineering/ economic study of thermal energy demand
b) Statistical projection
c) Maximum throughput on the distribution system

In this case, method c) is used. It was not possible to use method a) and method b) for the following reasons:

- Detailed information on the end users of the CMM supplied to Liulin Towngas Company is not available.
- Less than 5 years's data is available. CMM from Huajin started to be supplied in September 2005.
- Huajin kept no record of the volumes of CMM supplied to Liulin Towngas Company as the gas was supplied free of charge.
- Liulin Towngas Company have paper records of the total volume of CMM supplied to them from Huajin each year but of this total, any excess gas was vented and the volume of gas vented has not been recorded.
- Liulin Towngas Company has records of the volume of gas consumed historically by end-users. However, gas supplied to end-users is from 3 sources (one of which is Huajin) and no breakdown of this by source is available.

According to ACM0008, prospective baseline demand in the absence of the project may be estimated from the maximum amount of CMM that could be delivered to end users through existing pipelines. This approach assumes that thermal energy demand for CMM in all future years will be equal to the maximum amount of CMM that can be delivered.

There are 2 key factors that could limit the amount of methane supplied: the pump extracting the methane from the coal mine and the size of the pipeline delivering methane to end users. For this project, the limiting factor is the pump that extracts CMM from the coal mine as explained below.

CMM to baseline users is supplied from the south wing number 1 drainage station. According to information from the manufacturer, this pump has a rated flow rate of 150m^3/min and an operational flow rate of 125m^3/min[26].

Conservatively assuming operation hours of 7920 (330d[27] × 24h) per annum and a concentration of 30%, the maximum annual volume of methane that could be supplied to Liulin Towngas Company is 17.82 (125 m^3/min x 60minutes x 24h x 330d x 30% = 17.82) million m^3.

This is extremely conservative as not all gas drained from the mine by this pump is sent to baseline users; some is vented. Further, Liulin Towngas Company's basic records of gas supplied by Huajin show that over the past 3 years, the volume of methane supplied was between 10-11.5 million m^3, which is significantly lower than the 17.82 million m^3 calculated above.

(ii) Gas available for power generation

This was calculated as per the steps below:

- Firstly, the total gas available (not taking account of any baseline usage) was estimated based on the drainage stations at the site and projections of the amount of coal to be mined.
- From this total amount, baseline usage was removed as residential and other thermal loads are preferred loads and electricity will only be generated from excess gas, once these baseload uses have been satisfied.
- It was assumed that all this gas was available for power generation and any excess gas was vented.

Residential loads are preferred loads and electricity will only be generated from excess gas, once these base load uses have been satisfied. Therefore, baseline thermal demand is removed from the total amount of gas available, and the remaining amount of gas is assumed available for power generation. In the calculations that follow it is this figure for remaining gas that is used; therefore $BE_{MD,y}$ is zero.

For the details regarding the calculations on CMM sent to residential users, please see Annex 3.

2.2 Baseline emissions from release of methane into the atmosphere ($BE_{MR,y}$)

$BE_{MR,y} = GWP_{CH4} \times [\sum (CMM_{PJ,i,y} - CMM_{BLi,y})] = 21 \times (14,541-0) = 305,369$ tCO_2e/y.

2.3 Baseline emissions from power replaced by project ($BE_{Use,y}$)

2.3.1 Emissions factor of NCPG ($EF_{ELEC,y}$)

With reference to the *Notification on Determining Baseline Emission Factors of China Power Grid* issued by Chinese DNA on July 18th, 2008, the OM emission factor ($EF_{grid,OM,y}$) of NCPG is calculated as 1.1169 tCO_2e/MWh, and the build margin emission factor ($EF_{grid,BM,y}$) of NCPG is calculated as 0.8687 tCO_2e/MWh. The detailed calculations and data are listed in Annex 3.

[26] The value is from the manufacturers' specification. In fact, historical records show that the actual operational flow rate is less than 125m^3/min. This value is used in the calculations that follow however to be conservative.

[27] The maximal operation days are 300 days; please refer to http://gov.people.com.cn/GB/46737/4520205.html

Based on formula (21) in section B.6.1, the baseline emissions factor of NCPG is calculated as:

$EF_{ELEC,y}$ = $EF_{grid,CM,y}$ = 0.5 × $EF_{grid,OM,y}$ +0.5 × $EF_{grid,BM,y}$ =0.5 × 1.1169 + 0.5 × 0.8687 = 0.9928 tCO_2e/MWh.

According to the *Feasibility Study Report* of the Project, annual power generation by the Project is estimated to be 63.7 GWh with a self consumption rate of 5%, which means that the net electricity supplied by the project to NCPG (GEN_y) should be 60.515 MWh/y.

Therefore, based on formula (12) in Section B.6.1, the baseline emissions from power replaced by the Project ($BE_{Use,y}$) should be calculated as:

$BE_{Use,y}$ = GEN_y × EF_{ELEC} = 60,515 × 0.9928 = 60,079 tCO_2e.

Based on formula (8) in Section B.6.1, the baseline emissions BE_y = $BE_{MR,y}$ + $BE_{Use,y}$= 305,369 + 60,241079 = 365,449 tCO_2e.

3. Calculation of leakage (LE_y)

3.1 Displacement of baseline thermal energy uses

Leakage may occur if the project activity prevents CMM from being used to meet baseline thermal energy demand, whether as a result of physical constraints on delivery, or price changes. Where regulations require that local thermal demand is met before all other uses, which is common in many jurisdictions, then this leakage can be ignored.

At present, the amount of gas drained from Shaqu Coalmine was 95.72 Mm^3 in 2008 and in the following years will be 180 Mm^3. As demonstrated above, residential loads are preferred loads and electricity will only be generated from excess gas, once these base load uses have been satisfied.

According to the data from Liulin Towngas Company, the gas supplied by Huajin over the past 3 years was between 10-11.5 million m^3, significantly lower than the 17.82 million m^3 used in the PDD. There will be a significant amount of CMM left that would not be needed and would be vented. Considering that the amount of gas needed by the project activity is 21.074 Mm^3, there is still a large amount of gas released. Therefore, there would not be an instance where the project activity prevents CMM from being used to meet baseline thermal energy demand. Moreover, in case of the proposed project activity, Liulin Towngas Company thermal loads are treated as preferred loads. Therefore this leakage can be ignored.

3.2 CBM drainage from outside the de-stressed zone

Since there is no CBM drainage involved in the Project, CBM drainage from outside the de-stressed zone is not considered in the Project.

3.3 Impact of CDM project activity on coal production

There is no noticeable impact of CDM project activity on coal production since the baseline scenario involves methane extraction, not ventilation only.

3.4 Impact of CDM project activity on coal prices and market dynamics

No reliable scientific information is currently available to assess the risk of impact of CDM project activity on coal prices and market dynamics. Therefore, no leakage effects need to be accounted for here.

Based on analysis above, the leakage of the Project is zero, i.e. LEy =0.

4. Calculation of emission reductions (ER_y)

Based on formula (24) in Section B.6.1, the emission reductions (ER_y) generated by the Project should be calculated as:

$ER_y = BE_y – PE_y – LE_y = 365{,}449 – 41{,}316 –0 = 324{,}133$ tCO_2e.

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

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It is expected that the Project will generate GHG emission reductions for about 324,133 tCO_2e totally over the fixed 10-year crediting period from Mar. 1, 2010 to Feb. 28, 2020.

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 (01/03/2010 – 31/12/2010)	34,430	304,541	0	270,111
2011	41,316	365,449	0	324,133
2012	41,316	365,449	0	324,133
2013	41,316	365,449	0	324,133
2014	41,316	365,449	0	324,133
2015	41,316	365,449	0	324,133
2016	41,316	365,449	0	324,133
2017	41,316	365,449	0	324,133
2018	41,316	365,449	0	324,133
2019	41,316	365,449	0	324,133
2020 (01/01/2020 – 28/02/2020)	6,886	60,908	0	54,022
Total (tCO_2e)	**413,160**	**3,654,490**	**0**	**3,241,330**

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

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B.7.1 Data and parameters monitored:

Data / Parameter:	***MM_{ELEC}***
Data unit:	t CH_4
Description:	*Methane sent to power plant.*
Source of data to be used:	*Data used in the PDD are obtained from feasibility study report. Actual data are to be measured on-site continuously.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*See section B6.3*
Description of measurement methods and procedures to be applied:	*Gas flow rate, temperature, pressure and methane concentration measured continuously with individual meters and recorded electronically. The accuracy of the pressure meter will be 1% or better; the accuracy of the temperature, concentration and flow meter will be 2.5% or better.* *Further back-up using a conservative energy balance calculation based on total net power output (exclusive of auxiliary power & internal use) and manufacturer's maximum engine efficiency.*
QA/QC procedures to be applied:	*Regular calibration by qualified parties.*
Any comment:	*Density of methane under normal conditions of temperature and pressure is 0.67kg/m3 (Revised 1996 IPCC Reference Manual p1.24 and 1.16)*

Data / Parameter:	$CMM_{PJ,\ i,y}$
Data unit:	tCH_4
Description:	*Pre-mining CMM captured, sent to and destroyed by use i in the project activity in year y*
Source of data to be used:	*Data used in the PDD are obtained from feasibility study report. Actual data are to be measured on-site continuously.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*See section B6.3*
Description of measurement methods and procedures to be applied:	$CMM_{PJ,\ i,y}$ *is measured together with* $PMM_{PJ,\ i,y}$ *as a common extraction system is located in the underground mine, such that* $PMM_{BL,i,y} + CMM_{BL,i,y} = MM_{ELEC}$
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	*$PMM_{PJ, i,y}$*
Data unit:	*tCH_4*
Description:	*Post-mining CMM captured, sent to and destroyed by use i in the project activity in year y*
Source of data to be used:	*Data used in the PDD are obtained from feasibility study report. Actual data are to be measured on-site continuously.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*See section B6.3*
Description of measurement methods and procedures to be applied:	*$PMM_{PJ, i,y}$ is measured together with $CMM_{PJ, i,y}$ as a common extraction system is located in the underground mine, such that* $PMM_{BL,i,y} + CMM_{BL,i,y} = MM_{ELEC}$
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	***PC_{CH4}***
Data unit:	*%*
Description:	*Concentration (in mass) of methane in extracted gas (%), measured on wet basis*
Source of data to be used:	*Data used in the PDD are obtained from Testing Reports*[28] *Actual data are to be measured periodically.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*31.14% (sample 1) and 30.04% (sample 2)*
Description of measurement methods and procedures to be applied:	*For monitoring MM_{ELEC}, methane concentration is obtained at least hourly with online analyzer;* *For calculating r (relative proportion of NMHC compared to methane), methane concentration is obtained through annual analysis.*
QA/QC procedures to be applied:	*Gas analyser periodically calibrated according to manufacturer's recommendations.* *Analysis of will be carried out by a qualified party.*
Any comment:	-

[28] Testing report, Chinese Academy of Sciences, Shanxi Coal Chemistry Institute, June 2009

Data / Parameter:	***PC_{NMHC}***
Data unit:	*%*
Description:	*NMHC concentration (in mass) in extracted gas*
Source of data to be used:	*Data used in the PDD are obtained from Testing Reports. Actual data are to be measured annually.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*0 (percentage of NMHCs in both samples is <0.01% according to testing report)*
Description of measurement methods and procedures to be applied:	*To be obtained through annual analysis*
QA/QC procedures to be applied:	*To be tested by a qualified party.*
Any comment:	-

Data / Parameter:	***CEF_{NMHC}***
Data unit:	*$tCO_2e/tNMHC$*
Description:	*Carbon emission factor for combusted non methane hydrocarbons (various)*
Source of data to be used:	*Data used in the PDD are obtained from the project owner. Actual data will be obtained annually.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*Not applicable as NMHCs represent less than 1% by volume of the extracted coal mine gas.*
Description of measurement methods and procedures to be applied:	*Calculated from the fractional composition of hydrocarbons in the gas as given by the sample analysed (as described below).*
QA/QC procedures to be applied:	*To be calculated based on results of tests by a qualified party.*
Any comment:	-

Data / Parameter:	***GEN_y***
Data unit:	*MWh*
Description:	*Electricity generated by the project activity in the year y*
Source of data to be used:	*Data used in the PDD are obtained from feasibility study report. Actual data are to be measured on-site continuously.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*60,515*
Description of measurement methods and procedures to be applied:	*Power meters shall have an accuracy of 0.5% or better.* *Continuously measured with meters and recorded per month.*
QA/QC procedures to be applied:	*Power meters will be calibrated by a qualified party annually.* *Cross-checked by the net power meter(s) installed on the interconnection line between the power plant and the substation.*
Any comment:	-

Data / Parameter:	$CONS_{ELEC,PJ}$
Data unit:	*MWh*
Description:	*Additional electricity consumption for capture and use or destruction of methane.*
Source of data to be used:	*Data used in the PDD are obtained from project owner. Actual data are to be measured on-site continuously.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*0* *When the gen sets are not in operation, electricity may be drawn from the grid to support auxiliary functions or for maintenance use at the power plant site. The amount of electricity used will be monitored using an electricity meter.*
Description of measurement methods and procedures to be applied:	*Continuously measured with meters and recorded per month. Power meters shall have an accuracy of 0.5% or better.*
QA/QC procedures to be applied:	*Power meters will be calibrated by a qualified party annually.*
Any comment:	*No further comments.*

Data / Parameter:	CEF_{ELEC}
Data unit:	tCO_2/MWh
Description:	*Carbon emission factor of electricity used by the coal mine.*
Source of data to be used:	*Refer to Annex 3*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	*0.9928*
Description of measurement methods and procedures to be applied:	*Determined ex ante according to ACM0008*
QA/QC procedures to be applied:	*Chinese government data can be considered reliable.*
Any comment:	*No further comments.*

B.7.2 Description of the monitoring plan:

The objective of monitoring plan is to ensure that all of the parameters needed to calculate GHG emission reductions can be monitored, recorded and reported in a reliable and appropriate manner. The Project owner will take the responsibility of the implementation of the monitoring plan as follows:

1. Monitoring Organization

To monitor the project emission reductions and any leakage effects, the project owner will set up a CDM Monitoring Office and identify qualified staff to be responsible for all relevant matters, including monitoring of emission reductions, data collection and archiving, QC/QA, and verification.

The structure of the CDM Monitoring Office and relevant responsibilities are outlined in figure B.3 and table B.6.

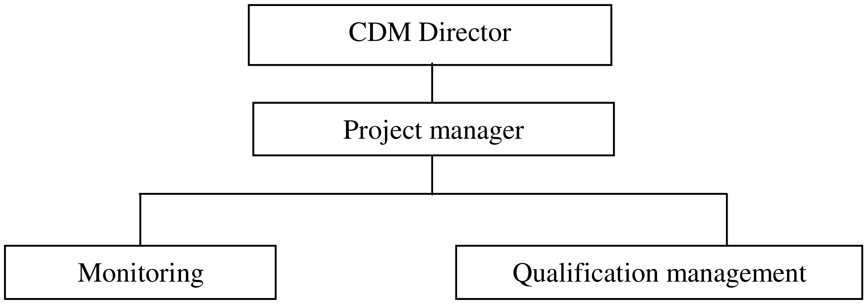


Figure B.3. Management structure of the monitoring plan

Table B.6 monitoring responsibilities

Position	Responsibility
CDM Director	The CDM Director will be in charge of all CDM related matters, including report and invoice collection, internal and external communications, external report writing, and operating and maintaining systems
Project manager	The Project Manager will be in charge of the implementation of this Monitoring Plan and summarizing the results. The monthly summary results will be checked by the CDM Director ensuring the quality and accuracy of the data monitored. The Project Manager will calculate the emission reductions of the proposed project and develop reports, as well as training the related monitoring staff.
Monitoring	Monitoring staff will be in charge of the monitoring and calibration of meters; collecting data (including flow, temperature, concentration, and pressure of CMM, imported and exported electricity generation) as well as maintenance of equipment and preparing daily reports.
Qualification management	Qualification management staff will have responsibility for collecting, recording and archiving all the data reported from the monitoring department, testing the system and periodically maintaining the monitoring equipment.

2. Monitoring plan

Data to be monitored

The data that need to be monitored are shown in Section B 7.1.

Methane mass flow to the gen sets will be calculated based on direct measurements of flow, methane concentration, pressure and temperature. All relevant parameters will be measured using meters sited on the main methane supply to the engines. The accuracy of the pressure meter will be 1% or better; the accuracy of the temperature, concentration and flow meter will be 2.5% or better.

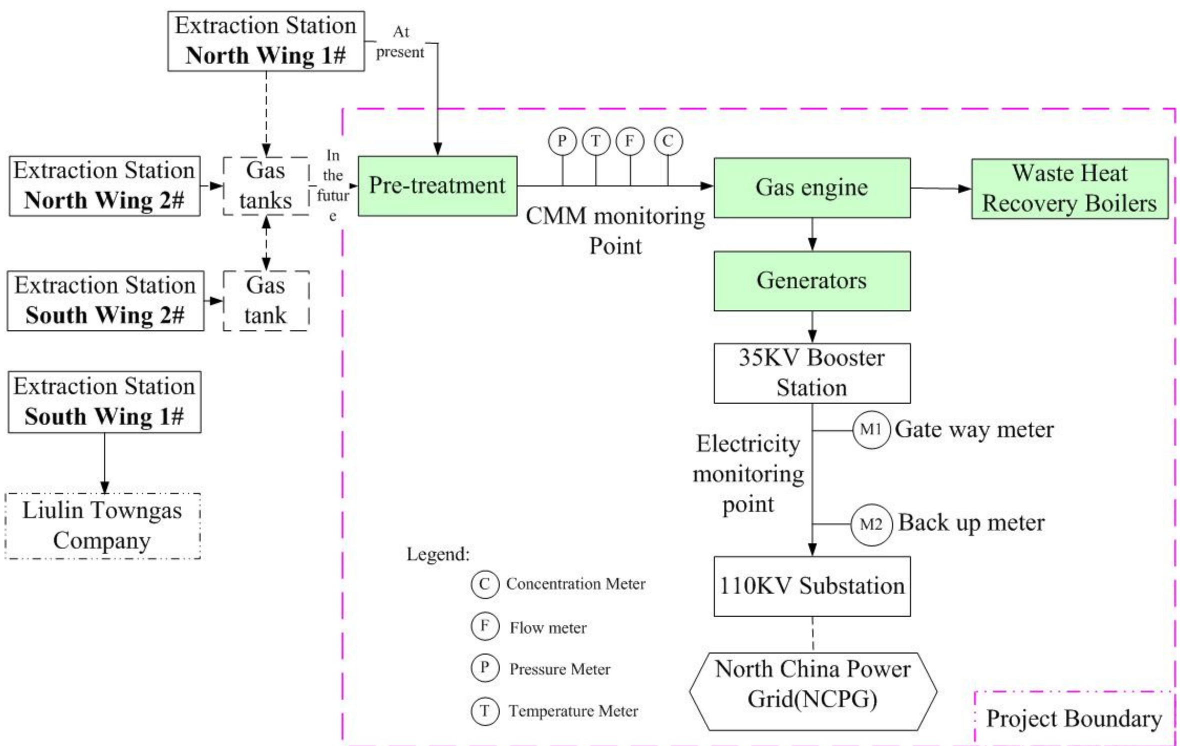
The primary meter for methane concentration is an online analyser installed on the main supply pipe. The secondary (backup) meter is a portable methane analyser, and a gas sample is taken at the drainage station.

Power is measured continuously with electricity meters accurate to 0.5% or better.

During normal operation of the power plant, electricity will only be supplied by the project to the power grid after meeting the demand of auxiliary facilities at the power plant site i.e. the auxiliary electricity consumed at the power plant site will be excluded automatically. Therefore, electricity generation by the project (GENy) is measured net of plant auxiliary consumption at the sub-station where the electricity generated by the project is sent to the grid.

When the gen sets are not in operation, electricity may be drawn from the grid to support auxiliary functions or for maintenance use. Electricity from this source constitutes $CONS_{ELEC,PJ}$ and the emissions included as project emissions.

The position of the relevant meters was shown as follows:



The diagram of monitoring point of the project

Non methane hydrocarbons (NMHCs) will be measured annually by sending a sample of gas to a qualified analytical laboratory for analysis of methane, ethane, propane and higher hydrocarbons.

Data management

All data associated with power generation such as methane send to the generators (which is measured by the flow meters) as well as the net power supplied (measured by the kilowatt-hour meter installed on site) will be recorded. Records will be paper or computer-based and any paper records transferred to computer files. Paper records will be archived for at least 2 years after the end of the crediting period or the last issuance of CERs for the project, whichever occurs later.

CDM director is responsible for all data collecting and archiving activity. He/She checks and reviews all of the monitored data records, calculates the emission reductions by the project activity monthly, and prepares the Monitoring Report for verification. Furthermore, all the relevant records of QA/QC e.g. records of maintenance and calibration for monitoring meters (flow meter, concentration meter, kilowatt-hour meter, etc.) will be collected, checked and archived for verification.

In case of possible problems, the monitoring team will take quick and appropriate corrective actions.

3. Calibration of meters

Meters will be maintained and calibrated regularly to assure that they function accurately. Calibration will be undertaken by a qualified third party

4. Verification

It is expected that the verification of emission reductions generated from the Project will be done regularly.

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)

>>

The application of the baseline study and monitoring methodology was completed by Cleanergy Investment Service (Beijing) Co., Ltd and Mr. Yuichi ABE (Independent Consultant) together on 29/04/2009. Either Cleanergy Investment Service (Beijing) Co., Ltd or Mr. Yuichi ABE is not the project participants listed in Annex 1. The contact information is shown as below:

Entity: Cleanergy Investment Service (Beijing) Co., Ltd.

Address: Capital Times Square, 88 Xichangan Jie, Beijing, China, 100031.

Tel: +86-10-83914567

Fax: +86-10-83914555

Person: Mr. Yuichi ABE

Address: 9-15 Kaigan 3-chome, Minato-ku, Tokyo 108-0022, JAPAN

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:

>>

02/11/2006 (The date of signing the general contract)

The date of signing the general contract for the project construction was considered as the starting date of the project. After signing the general contract, the equipment purchase contract was signed and then the construction was started.

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

>>

15 years.

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

C.2.1. Renewable crediting period

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

>>

Not applicable.

C.2.1.2. Length of the first crediting period:

>>

Not applicable.

C.2.2. Fixed crediting period:

>>

C.2.2.1. Starting date:

>>

01/03/2010

C.2.2.2. Length:

>>

10 years.

SECTION D. Environmental impacts

>>

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

>>

The *Environmental* Impact Registration Form of the Project was completed by Shanxi Environment Science Research Academy in Jun. 2006 and approved by the Environment Protection Bureau of Shanxi Province in Aug. 9th, 2006 (Document No.: Jinhuanhan [2006] 312).

According to the *Environmental Impact Registration Form,* main environmental impacts possibly caused by the Project and measures of protection and guard adopted by the project owner are analyzed as follows:

Air quality

Dust emissions may be generated because of excavation of earth, mix of concrete, transportation and dump of raw construction materials during the construction period. However, the pollution lasts only a short time and is light in intensity. The project owner will reduce these impacts by means of sprinkling at irregular intervals, limiting the vehicles' speed in the construction zone and covering materials easily causing dust, etc. These impacts will be eliminated with the achievement of the Project construction.

During operation period, the exhaust gas emissions from power plant will comply with *Stand of thermal power plant waste gas emissions* (GB13223-2003) of the People's Republic of China. As CMM is one of the clean energy, therefore, there will be no significant impact on the air quality.

Water quality

Most of the cooled water from the generator unit is circulated and the rest is used for gardening and dust containment after sedimentation. Boiler waste water and domestic sewage are discharged after treatment in the existing sewage treatment plant. Therefore, the Project will have little impacts on water quality.

Acoustic environment

Although the noise generated by machinery during the construction period may interrupt the acoustic environment, normal life of the villagers around will not be impacted because of the short construction period and long distance to the surrounding villages.

The main source of noise during operation stems from the generator unit, which is designed with strict measures such as isolation of high-noise equipment in an enclosed room, installation of noise shielding facilities, and installation of vibration reduction facilities. The greenery can also considerably decrease the contribution of the highly noisy equipment. By these ways, the diminishing noise will hardly impact the nearest village 1.2km away.

Solid waste

Waste soil and residential waste will be generated during the construction and operation of the Project. Solid construction waste will be dumped in specific waste residues sites and transported outwards under the requirements of the local environment and sanitation authority. Residential garbage will be collected and treated by the Project owner according to the requirements of solid waste treatment.

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 does not have significant impacts on the local environment and the *Environmental Impact Registration Form* of the Project has been approved by the local environmental protection authority.

SECTION E. Stakeholders' comments

>>

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

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On September 20th 2006, the Project owner, Huajin Coking Coal Co., Ltd., held a meeting to collect local stakeholders' attitudes and comments on the Project, with the coordination of the consultant company. Over 20 stakeholders were invited, including government officials, staffs of the power plant, representative from the construction side, representative from the Grid Company and local neighbouring residents probably impacted by the Project. As the Project would not occupy additional lands, the key stakeholders are the neighbouring residents.

Some months before the stakeholders meeting, the project owner contacted with the chief of village nearby and introduced the basic information of the project personally. Then the chief of village helped the project owner to present the meeting schedule and project information to the local residents by calling at their homes or face to face. This way to present the project information is an accepted way and it's the common practice in that rural area. Therefore, local residents knew about the meeting.

On September 20th 2006, the representative of local residents attended the stakeholder meeting held by the project owner. Government officials including local Development and Reform Commission, local Environmental Protection Bureau and local government, and representative from the Grid Company had also been invited to attend the stakeholders meeting.

During the meeting, the consultant company first introduced basic information about the Project followed by an explanation of the CDM and the clarification of the objective of this meeting i.e. the attendants were invited to discuss the pros and cons of the Project and how the positive effect of the Project could be further enhanced.

At the end of the meeting, a survey was carried out among all participants via interview and questionnaire. The major issues contained in the questionnaire included:

(1) The comments on the status of the local environment
(2) The comments on the disposal of CMM in Shaqu Coalmine
(3) Impacts on the local environment by the Project
(4) Impacts on the residents' lives by the Project
(5) Overall attitude towards the Project

Moreover, on March 19th, 2009, the second stakeholders' meeting was held before GSP. There were mainly two purposes: one to further confirm the attitude of local residents toward the construction of the phase 1 power plant and the other to collect local stakeholders' attitudes and comments on the phase 2 Project. There are no negative comments toward the construction of phase 1.

E.2. Summary of the comments received:

>>

No negative comments were heard during the meeting. Based on the results of the discussion and the questionnaire, all stakeholders support the construction of the Project and consider that the Project will generate positive environmental and social benefits. Some of stakeholders expressed the wish for early operation because the implementation of the Project would be able to not only generate power out of waste gas but also reduce GHG emissions through replacement of petroleum fuels.

For the environmental impacts of the Project, some stakeholders expressed the main concern about how to deal with noise probably created by the Project.

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

>>
The Project owner has paid much attention to the comments and suggestions of stakeholders.

For the concern about noise, firstly the distance between the surrounding village and the Project site is quite large, so the noise impact on residents is very small; secondly, the Project owner will strictly enforce noise mitigation measures designed in the Environmental Impact Registration Form and partly stated in Section D.1 to minimize noise impact during the construction and operation period.
To sum up, the local stakeholders are very supportive of the Project. The Project owner has taken full consideration of the comments and suggestions given by stakeholders during the project implementation, 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

Organization:	Huajin Coking Coal Co., Ltd.
Street/P.O.Box:	Shaqu coal mine
Building:	-
City:	Liulin County, Luliang City
State/Region:	Shanxi Province
Postfix/ZIP:	033315
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FAX:	+86-358-4302068
E-Mail:	-
URL:	-
Represented by:	Cao Haiqi
Title:	-
Salutation:	Mr
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex I Parties is involved in the Project.

Annex 3
BASELINE INFORMATION

Part One Baseline Information regarding the gas for baseline usage

It is assumed that 67% of gas drained is of a purity >30% and can therefore be used for power generation.

Year	Coal mined	Total Drained CH4 Volume	CH4/ tonne	High Purity Volume	Low Purity Volume (vented)	Gas sent to baseline users	Gas available for power generation	Methane used by phase 1	Excess Methane (vented)
Unit	*tonnes*	*Nm3 - CH4*	*Nm3/tonne*	*Nm3 - CH4*	*Nm3 - CH4*	*Nm3 - CH4*	*Nm3 - CH4*	*Nm3 - CH4*	*Nm3 - CH4*
Source	*Project owner*	*Project owner*	*Calculated*	*Calculated*	*Calculated*	*Calculated*	*Calculated*	*Calculated*	*Calculated*
2006	2,270,900	63,097,634	27.79	42,275,415	20,822,219	17,820,000	24,455,415	-	24,455,415
2007	2,180,000	75,514,598	34.64	50,594,781	24,919,817	17,820,000	32,774,781	21,703,578	11,071,203
2008	2,450,000	95,723,481	39.07	64,134,732	31,588,749	17,820,000	46,314,732	21,703,578	24,611,154
2009	2,600,000	130,000,000	50.00	87,100,000	42,900,000	17,820,000	69,280,000	21,703,578	47,576,422
2010	3,000,000	160,000,000	53.33	107,200,000	52,800,000	17,820,000	89,380,000	21,703,578	67,676,422
2011	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2012	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2013	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2014	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2015	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2016	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2017	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2018	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2019	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422
2020	3,000,000	180,000,000	60.00	120,600,000	59,400,000	17,820,000	102,780,000	21,703,578	81,076,422

Part two Baseline Information regarding the electricity

Data and method of calculation recommended in *Notification on Determining Baseline Emission Factors of China power Grid* for NCPG (issued by Chinese DNA on Jul. 18th, 2008, Dec. 30th, 2008 updated) are adopted for the Project.

1. Calculation of OM Emission Factor of NCPG

Table A1. Thermal power generation data within NCPG in 2004

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	18579000	7.94	17103827
Tianjin	33952000	6.35	31796048
Hebei	124970000	6.5	116846950
Shanxi	104926000	7.7	96846698
Inner Mongolia	80427000	7.17	74660384
Shandong	163918000	7.32	151919202
Total			489173110

Data source: China Electric Power Yearbook 2005Edition.

Table A2. Thermal power generation data within NCPG in 2005

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	20880000	7.73	19,265,976
Tianjin	36993000	6.63	34,540,364
Hebei	134348000	6.57	125,521,336
Shanxi	128785000	7.42	119,229,153
Inner Mongolia	92345000	7.01	85,871,616
Shandong	189880000	7.14	176,322,568
Total			560,751,013

Data source: China Electric Power Yearbook 2006 Edition.

Table A3. Thermal power generation data within NCPG in 2006

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	20705000	7.51	19150054.5
Tianjin	35924000	6.86	33459613.6
Hebei	143888000	6.63	134348225.6
Shanxi	150250000	7.45	139056375
Inner Mongolia	139593000	7.58	129011850.6
Shandong	230922000	7.12	214480353.6
Total			669506472.9

Data source: China Electric Power Yearbook 2007Edition.

With reference to the *Notification on Determining Baseline Emission Factors of China Power Grid*, Table A4 shows the low calorific values, emission factors and oxidation rates of fuels consumed for electricity generation that are to be used in the following OM emission factor calculation and BM emission factor calculation.

Table A4. Data of fuels consumed for electricity generation

Fuel type	Low calorific value	Emission factor (tC/TJ)
Raw coal	20908 kJ/kg	25.80
Cleaned coal	26344 kJ/kg	25.80
Other washed coal	8363 kJ/kg	25.80
Briquettes	20908 kJ/kg	26.20
Coke	28435 kJ/kg	29.20
Other coking products	28435 kJ/kg	25.80
Crude oil	41816 kJ/kg	20.00
Gasoline	43070 kJ/kg	18.90
Kerosene	43070 kJ/kg	19.60
Diesel	42652 kJ/kg	20.20
Fuel oil	41816 kJ/kg	21.10
Other petroleum products	38369 kJ/kg	20.00
Natural gas	38931 kJ/m^3	15.30
Coke over gas	16726 kJ/m^3	12.10
Other coal gas	5227 kJ/m^3	12.10
LPG	50179 kJ/m^3	17.20
Refinery gas	46055 kJ/m^3	15.70

Data sources: China Energy Statistical Yearbook 2007 Edition;
"2006 IPCC Guidelines for National Greenhouse Gas Inventories", Volume2.

Table A5. Emissions and Power Supply Data of NCPG in 2004

Fuel type	Unit	Beijing	Tianjin	Heibei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	NCV	CO_2 emissions （tCO_2e）
									(tc/TJ)	($MJ/t,km^3$)	J= G*H*I*44/12/10000 （mass unit）
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	J=G*H*I*44/12/1000 (volume unit)
Raw coal	10^4t	823.09	1410	6299.8	5213.2	4932.2	8550	**27228.29**	25.8	20908	538547477
Clean washed coal	10^4t	0	0	0	0	0	40	**40**	25.8	26344	996857
Other washed coal	10^4t	6.48	0	101.04	354.17	0	284.22	**745.91**	25.8	8363	5901191
Coke	10^4t	0	0	0	0	0.22	0	**0.22**	29.2	28435	6698
Coke oven gas	10^8m^3	0.55	0	0.54	5.32	0.4	8.73	**15.54**	12.1	16726	1153187
Other gas	10^8m^3	17.74	0	24.25	8.2	16.47	1.41	**68.07**	12.1	5227	1578574
Crude oil	10^4t	0	0	0	0	0	0	**0**	20	41816	0
Gasoline	10^4t	0	0	0	0	0	0	**0**	18.9	43070	0
Diesel	10^4t	0.39	0.84	4.66	0	0	0	**5.89**	20.2	42652	186070
Fuel oil	10^4t	14.66	0	0.16	0	0	0	**14.82**	21.1	41816	479451
LPG	10^4t	0	0	0	0	0	0	**0**	17.2	50179	0.00
Refined gas	10^4t	0	0.55	1.42	0	0	0	**1.97**	15.7	46055	52229
Natural gas	10^8m^3	0	0.37	0	0.19	0	0	**0.56**	15.3	38931	122306
Other petroleum products	10^4t	0	0	0	0	0	0	**0**	20	38369	0
Other coking products	10^4t	0	0	0	0	0	0	**0**	25.8	28435	0
Other energy	10^4t Ce	9.41	0	34.64	109.73	4.48	0	**158.26**	**158.26**	0	0
						MWh		**Emission rate (tCO_2e/MWh)**			**Emissions (tCO_2e)**
Thermal power supplied to NCPG						489173110					549024040
Imports from NEPG						4514550		1.1738371			5299346
Total						493687660					554323387

Data sources: China Energy Statistical Yearbook 2005 Edition; China Electric Yearbook 2005 Edition.

Table A6. Emissions and Power Supply Data of NCPG in 2005

Fuel type	Unit	Beijing	Tianjin	Heibei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	NCV	CO_2 emissions (tCO_2e)
									(tc/TJ)	($MJ/t,km^3$)	J= G*H*I*44/12/10000 (mass unit)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J=G*H*I*44/12/1000 (volume unit)
Raw coal	10^4t	897.75	1675.2	6726.5	6176.5	6277.23	10405.4	**32158.53**	25.8	20908	636063524.75
Clean washed coal	10^4t	0	0	0	0	0	42.18	**42.18**	25.8	26344	1051185.66
Other washed coal	10^4t	6.57	0	167.45	373.65	0	108.69	**656.36**	25.8	8363	5192725.19
Coke	10^4t	0	0	0	0	0.21	0.11	**0.32**	29.2	28435	9742.21
Coke oven gas	10^8m^3	0.64	0.75	0.62	21.08	0.39	0	**23.48**	12.1	16726	1742396.48
Other gas	10^8m^3	16.09	7.86	38.83	9.88	18.37	0	**91.03**	12.1	5227	2111027.27
Crude oil	10^4t	0	0	0	0	0.73	0	**0.73**	20	41816	22385.50
Gasoline	10^4t	0	0	0.01	0	0	0	**0.01**	18.9	43070	298.48
Diesel	10^4t	0.48	0	3.54	0	0.12	0	**4.14**	20.2	42652	130786.39
Fuel oil	10^4t	12.25	0	0.23	0	0.06	0	**12.54**	21.1	41816	405689.63
LPG	10^4t	0	0	0	0	0	0	**0**	17.2	50179	0.00
Refined gas	10^4t	0	0	9.02	0	0	0	**9.02**	15.7	46055	239141.20
Natural gas	10^8m^3	0.28	0.08	0	2.76	0	0	**3.12**	15.3	38931	681417.08
Other petroleum products	10^4t	0	0	0	0	0	0	**0**	20	38369	0.00
Other coking products	10^4t	0	0	0	0	0	0	**0**	25.8	28435	0.00
Other energy	10^4t Ce	8.58	0	32.35	69.31	7.27	118.9	**236.41**	0	0	0.00
						MWh		**Emission rate (tCO_2e/MWh)**			**Emissions (tCO_2e)**
Thermal power supplied to NCPG						560751013					647649331
Imports from NEPG						3929000		1.15763963			4548366
Total						564680013					652197697

Data sources: China Energy Statistical Yearbook 2006 Edition; China Electric Yearbook 2006 Edition.

Table A7. Emissions and Power Supply Data of NCPG in 2006

Fuel type	Unit	Beijing	Tianjin	Heibei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	NCV	CO_2 emissions（tCO_2e）
									（tc/TJ）	（MJ/t,km^3）	J= G*H*I*44/12/10000（mass unit）
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J=G*H*I*44/12/1000 (volume unit)
Raw coal	10^4t	796.63	1639	6868	6969	8404.05	10930.66	**35607.41**	25.8	20908	704277823
Clean washed coal	10^4t						39.77	**39.77**	25.8	26344	991125.0325
Other washed coal	10^4t	6.36		214.13	371.1	61.77	544.6	**1198**	25.8	8363	9477854.804
Briquettes	10^4t	7.97					27.77	**35.74**	26.6	20908	728819.706
Coke	10^4t						3.23	**3.23**	29.2	28435	98335.43353
Coke oven gas	10^8m^3	0.38	0.63	5.8	22.32	0.64	5.79	**35.56**	12.1	16726	2638825.338
Other gas	10^8m^3	20.66	6.58	69.72	13.79	22.76	7.22	**140.73**	12.1	5227	3263592.967
Crude oil	10^4t					0.74		**0.74**	20	41816	22692.14933
Gasoline	10^4t			0.01				**0.01**	18.9	43070	298.4751
Diesel	10^4t	0.21		3.01		0.07	6.32	**9.61**	20.2	42652	303588.6899
Fuel oil	10^4t	6.38		0.08			4.1	**10.56**	21.1	41816	341633.3747
LPG	10^4t						0.01	**0.01**	17.2	50179	316.4622267
Refined gas	10^4t			2.43			2.32	**4.75**	15.7	46055	125933.5596
Natural gas	10^8m^3	3.41	0.73		0.53			**4.67**	15.3	38931	1019941.59
Other petroleum products	10^4t						0.28	**0.28**	20	38369	7878.434667
Other coking products	10^4t							**0**	25.8	28435	0
Other energy	10^4t Ce	6.83		47.11	230.8	12.51	132.29	**429.5**	0	0	0
						MWh		**Emission rate (tCO_2e/MWh)**			**Emissions (tCO_2e)**
Thermal power supplied to NCPG						669506473					723298659
Imports from NEPG						2618060		1.16687886			3054959
Imports from CCPG						497060		0.87599			435420
Total						672621593					726789038

Data sources: China Energy Statistical Yearbook 2007 Edition; China Electric Yearbook 2007 Edition.

The simple OM emission factor is weighted average value of simple OM emission factors of NCPG in 2004, 2005 and 2006, as fellows:

$EF_{grid,OM,y}$ = (554323387 + 652197697 +726789038)/(493687660 + 564680013 + 672621593) = 1.11688 tCO_2e/MWh.

2. Calculation of BM Emission Factor of NCPG

Table A8 is data of the efficiency level of the best electricity generation technologies commercially available in China and the corresponding emission factors with reference to the *Notification on Determining Baseline Emission Factors of China Power Grid* issued by Chinese DNA.

Table A8. The efficiency level of the best electricity generation technology commercially available in China

	Parameter	**Efficiency**	**Fuel emission factors**	**Emission factors**
			(tC/TJ)	**(tCO_2/MWh)**
		A	B	D=3.6/A/1000*B *44/12
Coal-fired power	$EF_{Coal,Adv}$	37.28%	25.8	0.9135
Gas-fired power	$EF_{Gas,Adv}$	48.81%	15.3	0.4138
Oil-fired power	$EF_{Oil,Adv}$	47.67%	21.1	0.5706

Table A9 shows the CO_2 emissions of NCPG in 2006.

Table A9. Calculation of simple OM emission factor of NCPG in 2006

Fuel type	Unit	Beijing **A**	Tianjin **B**	Hebei **C**	Shanxi **D**	Mongolia **E**	Shandong **F**	Total **G=A+B+C+D+E+F**	Emission factor (tc/TJ) **H**	NCV (MJ/t,km3) **I**	CO_2 emissions (tCO_2e) **J=H*G*I*44/12/100**
Raw coal	10^4t	796.63	1639.2	6867.9	6968.8	10930.66	8404.05	35607.41	20908	25.8	704277823
Cleaned coal	10^4t	0	0	0	0	39.77	0	39.77	26344	25.8	991125
Other washed coal	10^4t	6.36	0	214.13	371.14	544.6	61.77	1198	8363	25.8	9477855
Briquettes	10^4t	7.97	0	0	0	27.77	0	35.74	20908	26.6	728820
Coke	10^4t	0	0	0	0	3.23	0	3.23	28435	29.2	98335
Sub-total											715573958
Crude oil	10^4t	0	0	0	0	0	0.74	0.74	41816	20	22692
Gasoline	10^4t	0	0	0.01	0	0	0	0.01	43070	18.9	298
Kerosene	10^4t	0	0	0	0	0	0	0	43070	19.6	0
Diesel	10^4t	0.21	0	3.01	0	6.32	0.07	9.61	42652	20.2	303589
Fuel oil	10^4t	6.38	0	0.08	0	4.1	0	10.56	41816	21.1	341633
Other petroleum	10^4t	0	0	0	0	0.28	0	0.28	38369	20	7878
Other coking	10^4t	0	0	0	0	0	0	0	28435	25.8	0
Sub-total											676091
Natural gas	10^7m^3	34.1	7.3	0	5.3	0	0	46.7	38931	15.3	1019942
Coke oven gas	10^7m^3	3.8	6.3	58	223.2	57.9	6.4	355.6	16726	12.1	2638825
Other gas	10^7m^3	206.6	65.8	697.2	137.9	72.2	227.6	1407.3	5227	12.1	3263593
LPG	10^4t	0	0	0	0	0.01	0	0.01	50179	17.2	316
Refinery gas	10^4t	0	0	2.43	0	2.32	0	4.75	46055	15.7	125934
Sub-total											7048610
Total											723298659

Data sources: China Energy Statistical Yearbook 2007 Edition.

Calculate with the data provided in Table A9, the value for λ_{Coal} is 98.93%, the value for λ_{Oil} is 0.09% and the value for λ_{Gas} is 0.98%.

Therefore, with the data provided in Table A8, the emission factor for thermal power of NCPG ($EF_{Thermal}$) can be calculate as:

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} = 0.9083 \text{ tCO}_2\text{e/MWh.}$$

Table A10. Basic data of NCPG in 2006

Installed Capacity	Beijing	Tianjin	Hebei	Shanxi	Shandong	Mongolia	Total
Thermal power(MW)	3984	6512	26087	26661	28899	49395	141538
Hydro power(MW)	1053	5	785	790	818	553	4004
Nuclear power(MW)	0	0	0	0	0	0	0
Wind power and Other(MW)	24	24	218	0	565	106	937
Total(MW)	5061	6541	27090	27451	30282	50054	146479

Data sources: China Electric Power Yearbook 2007 Edition.

Table A11. Basic data of NCPG in 2005

Installed Capacity	**Unit**	**Beijing**	**Tianjin**	**Hebei**	**Shanxi**	**Inner Mongolia**	**Shandong**	**Total**
Fuel-fired power	MW	3833.5	6149.9	22333.2	22246.8	19173.3	37332	111068.7
Hydro Power	MW	1025	5	784.5	783	567.9	50.8	3216.2
Nuclear Power	MW	0	0	0	0	0	0	0
Wind power & others	MW	24	24	48	0	208.9	30.6	355.5
Total	MW	4882.5	6178.9	23165.7	23029.8	19950.2	37413.4	**114620.5**

Data source: China Electric Power Yearbook 2006Edition.

Table A12. Basic data of NCPG in 2004

Installed Capacity	**Unit**	**Beijing**	**Tianjin**	**Hebei**	**Shanxi**	**Inner Mongolia**	**Shandong**	**Total**
Fuel-fired power	MW	3458.5	6008.5	19932.7	17693.3	13641.5	32860.4	93594.9
Hydro Power	MW	1055.9	5	783.8	787.3	567.9	50.8	3250.7
Nuclear Power	MW	0	0	0	0	0		0
Wind power & others	MW	0	0	13.5	0	111.8	12.4	137.7
Total	MW	4514.4	6013.5	20730	18480.5	14321.2	32936.6	**96832.2**

Data source: China Electric Power Yearbook 2005 Edition.

Table A13. Calculation of BM emission factor of NCPG

	Installed capacity in 2004 (MW) A	**Installed capacity in 2005 (MW) B**	**Installed capacity in 2006 (MW) C**	**Capacity additions during 2005-2006 (MW) D=C-B**	**Share in total capacity Additions (MW)**
Thermal power	93594.9	111069	141538	30469.3	95.64%
Hydro power	3250.7	3216.2	4004	787.8	2.47%
Nuclear power	0	0	0	0	0.00%
Wind power and Other	137.5	335.5	937	601.5	1.89%
Total	96983.1	114620	146479	31858.6	100.00%
Proportion to the installed capacity in 2006	66.21%	78.25%	100.00%		

Based on Table A13 and formula in section B.6.1, calculate the BM emission factor of NCPG as

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} = 0.8687 \text{ tCO}_2\text{/MWh}$$

Annex 4

MONITORING INFORMATION

Please refer to section B.7. No need to complement more information here.