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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

SDIC Xiyang Baiyangling CMM to Power Generation Project

Version number: 05

Date: 6/12/2010

Version number	Date	Description and reason for revision
01	5 May 2009	GSP version of PDD
02	13 November 2009	PDD updated after DOE site visit
03	07 Dec. 2009	PDD updated after DOE draft report
04	21st Dec. 2009	PDD updated based on DOE minor issues
05	6 December 2010	PDD updated based on questions raised at 'request for review' and 'review'

A.2. Description of the project activity:

SDIC Xiyang Baiyangling CMM to Power Generation Project (hereafter referred to as the project) is located within the Baiyangling Mine of SDIC Xiyang Energy Co., Ltd., Xiyang County, Jinzhong City, Shanxi Province, P.R.China.

The purpose of the project activity:

Prior to 2006, annual coal production at the mine was just 450,000 tonnes pa and coal mine methane (CMM) was drained from the mine using an underground, moveable drainage system. From 2006 to the present, however, a series of major improvements are being carried out at the mine to enable annual coal production to increase to up to 2.4 million tonnes pa. During this period, no coal is being mined.

At the end of 2009, coal production will resume at the mine. As coal production will be increased, the methane concentration in the mine cannot be kept at safe levels using the existing drainage methods. The project owner will therefore introduced improved CMM drainage activities. At present, all CMM and ventilation air methane (VAM) drained from the mine is vented directly to the atmosphere.

The project activity will use CMM for power generation and supply the power generated to the North China Power Grid (NCPG). The project will install up to a total of 16MWgas engines consuming over 29 million m^3 of methane each year and generating 97,978 MWh of electricity (net). A flare will also be installed to combust CMM when the gen sets are not in operation. In addition, waste heat recovery boilers will use waste heat from the gensets to supply heat in the form of steam to the buildings at the coal mine site, displacing some of the existing coal boilers. The estimated annual GHG emission reductions are estimated to be 449,997tCO_2e during the 10-year crediting period.

Electricity supplied from the project activity will be sold to the predominantly coal powered North China Power Grid, thereby reducing the amount of coal burned.

Without implementation of the proposed project, the baseline scenario is the same as the scenario existing prior to the implementation of the project i.e. that all CMM and VAM will be vented to the atmosphere.

How the project reduces GHG emissions:

Emission reductions will be achieved through:

- Destruction of methane, a potent greenhouse gas
- Supply of electricity to the North China Power Grid, that would otherwise be generated by predominantly coal fired power stations.
- Reduction in coal used for heating of buildings at the coal mine site (although no CERs will be claimed for this element of the project).

Contributions of the project to sustainable development:

The project participants believe the project activity contributes to sustainable development in the following ways:

- By avoiding emissions of GHGs and other pollutants from conventional power generation processes, and significantly reducing GHG emissions from coal mining, compared to a business-as-usual scenario
- By improving the comprehensive use of resources, a policy strongly supported by the Government of China
- By promoting mine safety through the utilisation of CMM which will lead to improved CMM drainage & utilisation practices
- By providing employment opportunities for local people in the operation of the power plants

A.3. Project participants:

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)	SDIC Xiyang Energy Co., Ltd. (project owner)	No
United Kingdom of Great Britain and Northern Ireland	Camco Carbon Limited	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:

A.4.1.1. Host Party(ies):

People's Republic of China.

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

Shanxi Province

A.4.1.3. City/Town/Community etc:

Xiyang Town, Jinzhong City

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

The project is located at Baiyangling Mine, Xiyang Town, Jinzhong City, Shanxi Province, P.R. China. The project has geographical coordinates of 113°37'29" east longitude and 37°30'41" north latitude[1]. Figure A.1 shows the location of Shanxi province in China and figure A.2 shows the location of the Project in Shanxi province.

Figure A.1. Location of Shanxi province in China

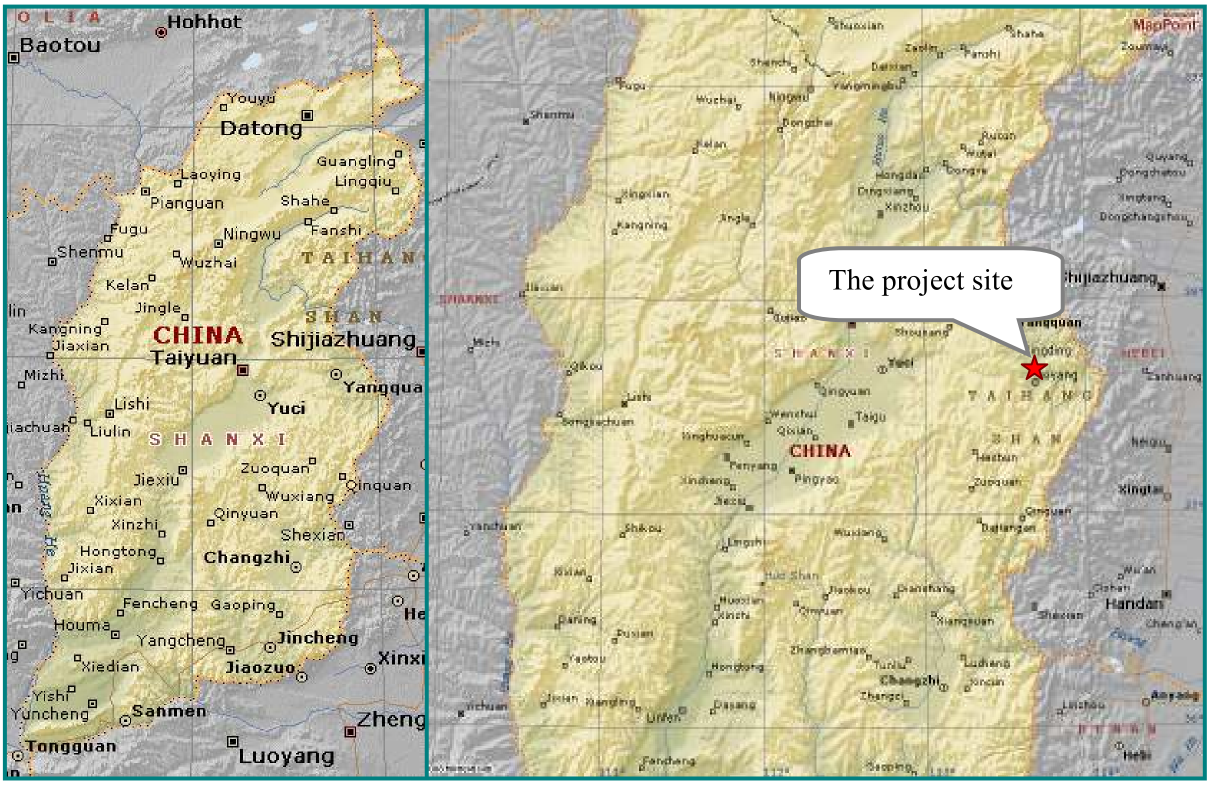

Figure A.2. Location of the project

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[1] Test by GPS Machine from Project owner

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

The project falls into category of:

8: Mining/mineral production, and
10: Fugitive emissions from fuels (solid, oil and gas).

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

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

Prior to 2006, annual coal production at the mine was just 450,000 tonnes pa and coal mine methane (CMM) was drained from the mine using 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. The gas drainage methods used by Baiyangling mine comprised of an underground moveable gas drainage system with a maximum extraction capacity of 123.8m^3/min.

The VAM and CMM was not utilized or destroyed but released directly to the atmosphere.

From 2006 to the present, however, a series of major improvements are being carried out at the mine to enable annual coal production to increase to up to 2.4 million tonnes pa. During this period, no coal is being mined.

At the end of 2009, coal production will resume at the mine.

Baseline Activity Scenario

The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity, i.e. all CMM and VAM is vented to the atmosphere without destruction or utilisation.

Project Activity Scenario

The project activity will recover, utilize and destroy CMM for power generation and supply the power generated to the North China Power Grid (NCPG). Note: the project activity does not include CBM or VAM utilization.

The equipment to be installed in the project activity includes:

- One 20,000m^3 gas storage tank
- Gas pre-treatment system,
- 16MW of gas engines[2],
- Waste heat recovery boilers[3]

[2] The project will progressively install up to a total of 16MW of gas engines for generation of electricity from CMM over the course of the crediting period. In the ER and IRR calculations in the PDD however, it is assumed that all power gen equipment is installed in the first half of 2010 and is all operational by July 2010.

- A flare will also be installed for the destruction of CMM when the gen sets are not in operation[4].
- Monitoring equipment to measure and record the amount of methane sent to the gas engines and the amount of electricity produced by them.

The gas captured in the project activity will be dehydrated, compressed, filtered and cooled during pre-treatment and then injected to the gas generator sets for power generation. Electricity produced by the project will be exported to the grid via the substation within Baiyangling Mine.

The key parameters of the equipment to be installed through this project are not yet confirmed. However, it is expected that the gas engines used will be produced by foreign manufacturers, such as Caterpillar G3520C Gas Gen-set. In this way, the project will contribute to the transfer of foreign technology and expertise to China.

Alongside the project activity (but outside of the project boundary), the project owner will make improvements to the gas drainage system to increase the amount of high concentration of CMM available (and thereby reducing the amount of VAM). Underground improvements to the gas drainage system will be carried out and surface drainage pumps installed (see table below).

Table A.2. Surface gas extraction equipment to be installed at Baiyangling Mine alongside the project activity.

Drainage pump type	Quantity	Flow rate (m^3/min)
2BE3670	4	295

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

A fixed crediting period (10yrs×1) is selected for the project and it is expected that the project activities will generate emission reductions of 4,499,975tCO_2e emission reductions during the whole of the crediting period. Estimated annual emission reductions for the project are summarized below:

Years	Annual estimation of emission reductions in tonnes of CO_2e
2010 (01/07/2010 – 31/12/2010)	224,999
2011	449,997
2012	449,997
2013	449,997
2014	449,997
2015	449,997
2016	449,997
2017	449,997
2018	449,997
2019	449,997
2020 (01/01/2020 – 30/06/2020)	224,999
Total estimated reductions (tonnes of CO_2e)	**4,499,975**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**449,997**

[3] The waste heat recover boilers will be used to provide heat to buildings at the project site replacing some of the existing coal fired boilers, although no CERs will be claimed for the coal displaced as a result of this part of the project.

[4] In the ER calculations in the PDD therefore, it is assumed that the gas sent to the flare is zero.

A.4.5. Public funding of the project activity:

There are no public funds used for the project.

SECTION B. Application of a baseline methodology

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

'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.'ACM0008 (Version 06);
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

'Tool for the Demonstration and Assessment of Additionality' (Version 05.2) is used to demonstrate and access the additionality of the project;
http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

Version 02 of the 'Tool for calculation of emission factor for electricity systems' is adopted to calculate the emission factor of the North China Power Grid.
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf

The "Tool to determine project emissions from flaring gases containing methane" is used to calculate project emissions from methane sent to the flare. http://cdm.unfccc.int/methodologies/Tools/eb28_repan13.pdf.

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

The project meets all the applicability criteria proposed by the methodology ACM0008 (Version 6).
The conditions and how they are fully met by the project are listed in table below.

Applicability Criteria	**This Project**
This methodology applies to the projects that involve the use of any of the following extraction activities: *1.Surface drainage wells to capture CBM associated with mining activities;* *2.Underground boreholes in the mine to capture pre mining CMM;* *3.Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM;* *4. Ventilation CMM that would normally be vented.*	The project activity uses CMM from 'Underground boreholes in the mine to capture pre mining CMM' and 'surface goaf well, 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 utilization of VAM or CBM.

The methodology applies to CMM and VAM capture, utilization 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: *1.The methane is captured and destroyed through flaring; and/or* *2.The methane is captured and destroyed through catalytic oxidation with or without utilization of thermal energy; and/or* *3.The methane is captured and destroyed through utilization 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;* *4.The remaining share of the methane to be diluted for safety reason may still be vented;* *5. All the CBM or CMM captured by the project should either be used or destroyed, and cannot be vented.*	The project activity involves the capture and utilization of CMM for power generation at a working coal mine where the baseline is the total atmospheric release of the methane. Waste heat from the gen sets will be recovered and used to provide heat to buildings at the coal mine site. When the gen sets are not in operation, methane will be destroyed by flaring. The remaining unused share of the methane is vented for safety reasons.
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.	Baiyangling 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: *1.Operate in open cast mines;* *2.Capture methane from abandoned/decommissioned coalmines* *3. Capture/use of virgin coal-bed methane, e.g. methane of high quality extracted from coal seams independently of any mining activities.* *4. 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 utilization of coal bed methane.

Since electricity generated from the project will displace electricity from the North China Power Grid (NCPG), according to ACM0008 (version 6), the emission factor of the NCPG will be calculated according to the latest version of the ‘Tool for calculation of emission factor for an electricity system’.

The latest version of the ‘Tool for the demonstration and assessment of additionality’ is used to demonstrate the additionality of the project.

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

For the purpose of determining *project activity emissions*, the following emission sources are included:

- CO_2 emissions from the combustion of methane in the flare and power plant;
- CO_2 emissions from the combustion of non methane hydrocarbons (NMHCs), if they represent more than 1% by volume of the extracted coal mine gas;
- Fugitive emissions from unburned methane.

For the purpose of determining *baseline emissions*, the following emission sources are included:

- CH_4 emissions as a result of venting gas that would be captured in the project scenario;
- CO_2 emissions from the production of power (electrical) that is replaced by the project activity.

Note: CO_2 emissions from the production of heat that is replaced by the project activity are not included in the baseline emission calculations as the project owner is not claiming CERs for this element of the project.

The *spatial extent* of the project boundary comprises:

- All equipment installed and used as part of the project activity for the extraction and storage of CMM at the project site.
- Flaring, power and heat generation facilities installed and used as part of the project activity.
- Power plants connected to the electricity grid, as per the definition of project electricity system and connected electricity system given in the 'Tool for calculation of the emission factor for an electricity system'. For the project this is power plants connected to the NCPG, which covers Beijing, Tianjin, Hebei province, Shanxi province, Shandong province and Inner Mongolia according to the published information by the China DNA[5]

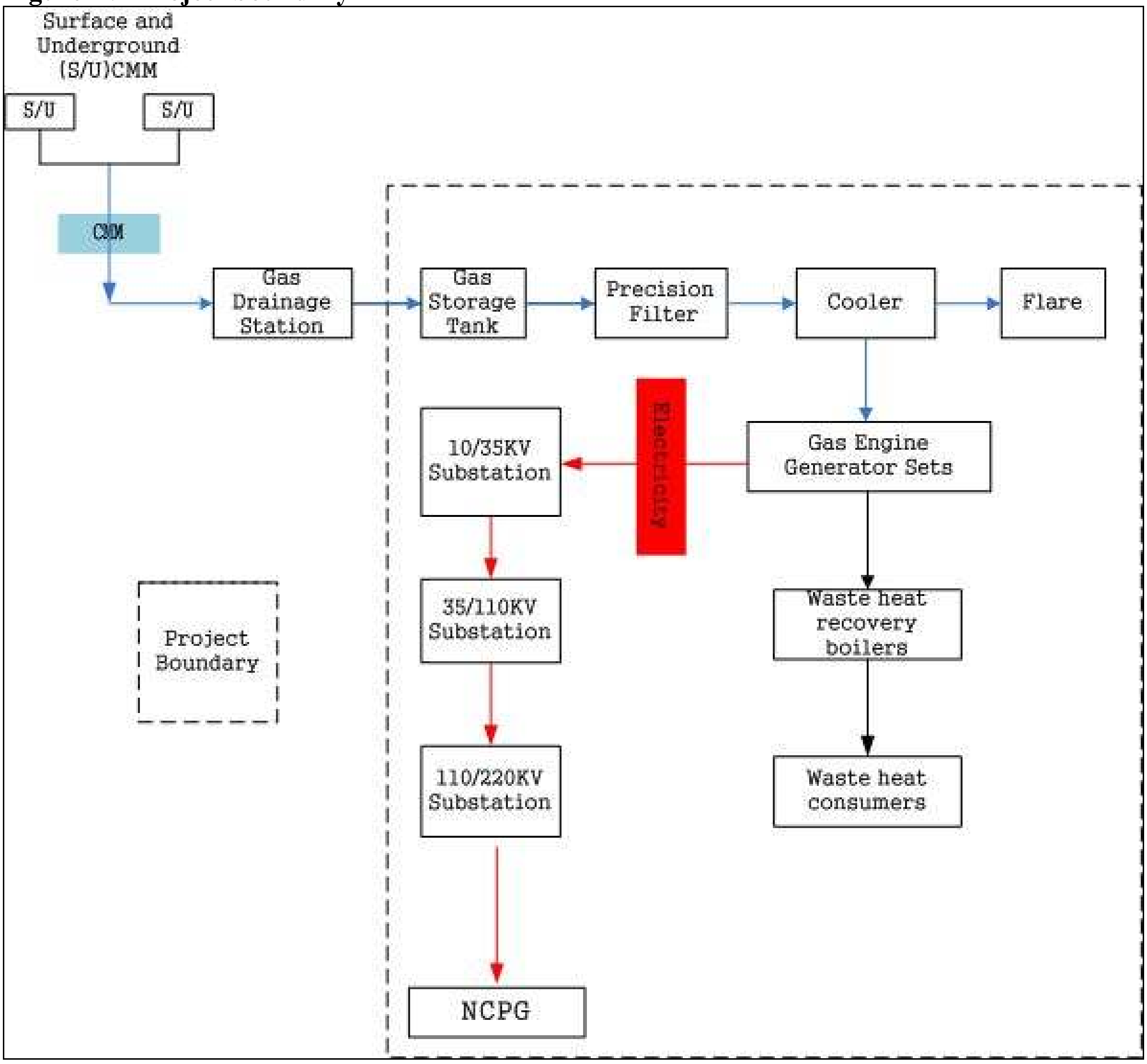
The table below illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions. Figure B.1 shows the schematic of the project boundary.

Source	Gas	Included?	Justification/Explanation
Baseline			
Emissions of methane as a result of venting	CH_4	Included	Main emission source.
Emissions from destruction of methane in the baseline	CO_2	Excluded	No CMM utilization in the baseline scenario of the project
	CH_4	Excluded	Excluded for simplification. This is conservative.
	N_2O	Excluded	Excluded for simplification. This is conservative.

[5] http://cdm.ccchina.gov.cn/website/CDM/upfile/file1051.pdf

Grid electricity Generation (electricity provided to the grid-north china power grid)	CO_2	Included	Main emission source. 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 method as described in 'Tool for calculation of emission factor for electricity systems' should be made.
	CH_4	Excluded	Excluded for simplification. This is conservative.
	N_2O	Excluded	Excluded for simplification. This is conservative.
Captive power and/or heat, and vehicle fuel use	CO_2	Excluded	No such usage in baseline scenario.
	CH_4	Excluded	Excluded for simplification. This is conservative.
	N_2O	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 release 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	Methane transportation system of the project employs methane extraction pump, dehydrator, etc. Emissions from the energy consumption of these additional facilities are taken into consideration.
	CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
Emissions from methane destruction	CO_2	Included	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 amounts of methane will remain unburned in power generation.
Fugitive methane emissions from onsite 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.

Figure B.1 Project boundary



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

Note: the project does not include extraction or usage of VAM or CBM. According to ACM0008, the baseline scenario is identified as follows:

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

The baseline scenario alternatives should include all possible options that are technically feasible to handle CBM and CMM or VAM to comply with safety regulations. These options could include:

A. Ventilation Air Methane
B. Pre-mining CMM extraction; including CBM to Goaf Drainage and/or Indirect CBM to Goaf drainage only (within the mining area); this option can be split into 2 sub-scenarios:
   I. Pre-mining CMM extraction including CBM
   II. Pre-mining CMM extraction excluding CBM
C. Post-mining CMM extraction;
D. Combinations of options A and B, with the relative shares of gas specified. This option can also be split into 2 sub-scenarios:
   I. Possible combinations of options A, BI and C i.e. including CBM
   II. Possible combinations of options A, BII and C i.e. excluding CBM

The methane at Baiyangling currently includes ventilation air methane (A) and pre-mining CMM (B) as well as post-mining CMM (C). Both pre-mining CMM and post-mining CMM are drawn out of the mine via a common drainage system for safety purposes and these are combined and referred to in the PDD as 'CMM'. There are currently no CBM drainage wells at Baiyangling mine and there are no plans to introduce this although this is, in theory, technically feasible.

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

The baseline scenario alternatives should include all possible options that are technically feasible to use the CBM and CMM or VAM and include:

I. Venting;
II. Using/destroying ventilation air methane rather than venting it;
III. Flaring of CBM/CMM;
IV. Use for additional grid power generation, i.e. the project not implemented as a CDM project;
V. Use for additional captive power generation;
VI. Use for additional heat generation;
VII. Feed into gas pipeline (to be used as fuel for vehicles or heat/power generation);
VIII. Possible combinations of options I to VII with relative shares of gas treated under each option specified.

Step 1c. Options for energy production

For electricity generation, the options could include:

1. Continuation of current status i.e. purchasing electricity from the NCPG
2. Construction of a fuel-fired power plant with equivalent amount of annual electricity generation;
3. Electricity generated from CBM/CMM/VAM destroyed in on-site captive power plants.

4. Electricity generated from CBM/CMM/VAM destroyed in grid-connected power plants (for CMM, this is the proposed project not implemented as a CDM project);
5. Electricity generated from other renewable energy sources.

Option 5 includes electricity generated from wind, hydro, biomass and solar PV. This option is however eliminated at this stage as, in the vicinity of the project, the resource for each of these is not sufficient[6]. This option is not therefore technically feasible and is eliminated.

For heat production at the coal mine:

The project involves the replacement of some existing coal fired boilers with boilers using waste heat from the gen sets. However, the project owner will not claim CERs for this element of the project. Therefore, the baseline options for heat production are not considered here.

To fuel vehicles:

The project does not claim CERs from the replacement of vehicle fuels with CBM/CMM/VAM therefore the baseline options for vehicle fuel are not considered here.

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

Any options for CBM/CMM/VAM management and use that do not meet with local legal or regulatory requirements should be eliminated.

Step 2a. Options for CBM and CMM or VAM extraction

Application of China's National Coalmine Safety Regulations (2005 version) at Baiyangling restrains methane concentration in the underground coal mine to below 1% to avoid the risk of explosion[7]. Baiyangling coal mine is classified as a gassy coal mine[8], so removing methane only as ventilation air methane will not keep the underground concentration less than 1% and cannot therefore meet the requirement of the *Special Provisions of the State Council on the Prevention of Work Safety Accidents of Coal Mines*[9].

Implementing either pre-mining capture (with or without CBM) or post-mining capture alone cannot fully satisfy the safety requirements for underground wells[10]. Pre mining CMM (with or without CBM) and post mining CMM must be used together with the ventilation system in order to ensure the methane concentration in the air be lower than 1%. Therefore, Options A, BI, BII and C cannot by themselves form a methane extraction alternative able to satisfy the requirements of relevant law and regulations and are therefore eliminated.

Option DI (possible combinations of options A, BI and C i.e. including CBM) and Option DII (possible combinations of options A, BII and C i.e. excluding CBM) satisfy China's regulations. Option DII represents the current situation at Baiyangling mine.

Step 2b. Options for extracted CBM and CMM or VAM treatment

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

[7] *National Coalmine Safety Regulations,* 2005 version, item 136

[8] Xiyang County Coal Industry Bureau, Annual Coal Mine Appraisal Report, 2009

[9] http://www.chinasafety.gov.cn/zuixinyaowen/2005-09/06/content_130692.htm.

[10] *National Coalmine Safety Regulations,* 2005 version, item 145.

According to Article 441 of the China Coal Mine Safety Regulations (2005 Edition), there must be 2 sources of electricity supplying power for coal mines (e.g. two grid connections or one grid connection and one onsite captive power supply). Either of the two electricity sources must be able to satisfy the entire electricity demand of the entire coal mining activity. Therefore, purely captive power generation is not allowed according to Chinese safety regulations. However, if there is a grid connection as well as onsite captive power generation then this allowed according to the safety regulations.

For CMM treatment, National Coalmine Safety Regulations state that for drainage CMM utilization, methane concentration cannot be lower than 30%[11]. This standard was also emphasized in the Coalmine Methane Treatment and Utilization Macro Plan published by National Development and Reform Committee (NDRC) in June 2005. Total *volumes* of methane released by the coal mines are not regulated in China. Providing that the concentration of the mines exceeds national regulations, then Options I to VIII all satisfy China's regulations.

Note: According to ACM008 version 6, if "based on an examination of current practice in the country or region in which the laws or regulation applies, those applicable legal or regulatory requirement are systematically not enforced and that non-compliance with those requirements is widespread in the country", then it need not be considered in the baseline selection analysis. The Emission Standard of CBM/CMM (on trial) GB21522-2008 states that from 1 January 2010, it will be forbidden to vent CMM with a concentration of >30%. This standard is not considered in the baseline analysis because:

1. Questions remain about implementation and subsequent enforcement of the Standard

The Standard itself is a high-level document giving only outline details of the content and its applicability. It refers to three further regulations for details of implementation and enforcement. These regulations are listed in table B.1 below, together with details of key components of them.

Table B.1: Regulations referred to in the Standard and key components of these regulations

Regulation	Key, relevant components
Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution[12]	Article 11. New construction projects, expansion or reconstruction projects which discharge atmospheric pollutants shall be governed by the State regulations concerning environmental protection for such projects. An environmental impact statement on construction projects shall include an assessment of the atmospheric pollution the project is likely to produce and its impact on the ecosystem; stipulate the preventive and curative measures. The statement shall be submitted, according to the specified procedure, to the administrative department of environmental protection concerned for examination and approval. When a construction project is to be put into operation or to use, its facilities for the prevention of atmospheric pollution must be checked and accepted by the administrative department of environmental protection. Construction projects that do not fulfil the requirements specified in the State regulations concerning environmental protection for such construction projects shall not be permitted to begin operation or to use. Article 13. Where atmospheric pollutants are discharged, the concentration of the said pollutants may not exceed the standards prescribed by the State and local authorities. Article 48. Whoever, in violation of the provisions of this Law, discharges pollutants to the atmosphere in excess of the national or local discharge standards shall make treatment thereof within a time limit, and shall also be imposed upon a fine of not less than 10,000 yuan but not more than 100,000 yuan by the administrative department of environmental protection under

[11] *National Coalmine Safety Regulations,* 2005 version, item 148.1

[12] *Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution* (Adopted at the Fifteenth Meeting of Standing Committee of the Ninth National People's Congress on April 29, 2000; promulgated by the President of the People's Republic of China on the same date, effective as of September 1, 2000.) http://english.mep.gov.cn/Policies_Regulations/laws/environmental_laws/200710/t20071009_109943.htm

	the local people's government at or above the county level. The power to decide on the treatment within a time limit and the administrative penalty for violation of the requirements for treatment within a time limit shall be prescribed by the State Council.
Measures for the Administration of Automatic Monitoring of Pollution Sources[13]	Article 2. The present Measures shall be applicable to the supervision and administration of the automatic monitoring system for the key sources of pollution. The present Measures shall be followed in the construction, management and operation maintenance of the automatic monitoring system for the discharge of water pollutants, air pollutants and noise at the key sources of pollution. Article 5. The State Environmental Protection Administration shall be responsible for guiding the work of automatic monitoring on key pollution sources countrywide, and formulate relevant work systems and technical specifications. The local environmental protection departments shall, on the basis of the requirements of the State Environmental Protection Administration, and in light of the principle of overall planning, … determine the key pollution sources that shall be subject to automatic monitoring, and formulate work plans. Article 11. The automatic monitoring equipments and their supporting facilities for any newly built, restructured or expanded technological reformation project shall be built and installed according to the approved documents of environmental impact assessment, and shall be designed, constructed and put into use simultaneously with that of the principal part of the project as a component part of the environmental protection facilities. Article 13. The expenses for the construction, operation and maintenance of the automatic monitoring equipments shall be collected by the pollutant-discharging entities themselves, and the environmental protection departments may grant subsidies thereto; as to the expenses for the operation and maintenance of the monitoring centers, the environmental protection departments shall make budgets and apply for funds for that purpose. Article 16. In case any existing pollutant-discharging entity violates the provisions of the present Measures, and does not complete the installation of any automatic monitoring equipment and its supporting facilities within the prescribed time limit, the environmental protection department at or above the county level shall order it to correct within a prescribed time limit, and impose upon it a fine of less than RMB 10,000 Yuan. Article 17. In case any entity violates the provisions of the present Measures, and officially puts into production or use the principal part of a newly built, restructured, expanded or technologically reformed project without installing the automatic monitoring equipment and its supporting facilities on such project, or without having the project checked and accepted or without passing the checking of the project, the environmental protection department that makes examination and approval on the documents of environmental impact assessment on the construction project shall, in accordance with the Regulation on the Administration of Environmental Protection on Construction Projects, order it to stop the production or use of the principal part of the project, and may impose upon it a fine of less than RMB 100,000 Yuan
Measures for the Administration of Environmental Surveillance[14]	Article 3. The environmental surveillance shall be a statutory responsibility of an environmental protection authority at or above the county level. An environmental protection authority at or above the county level shall build an advanced environmental surveillance system according to the requirements for accurate data, strong representativeness, scientific methods and timely transmission, so as to provide a policy basis for such environmental administrative work as fully reflecting the environmental quality and trend of changes, timely tracing the changes of pollution sources and accurately warning of various environmental emergencies.

[13] SEPA order no. 28, *Measures for the Administration of Automatic Monitoring of Pollution Sources*, 2005 and available at http://www.nnhb.gov.cn/uploadfile/2008314153359411.pdf (Chinese) and http://faolex.fao.org/docs/texts/chn61891.doc (English)

[14] SEPA order no. 39, *Measures for the Administration of Environmental Surveillance*, 2007 and available at http://www.zhb.gov.cn/info/gw/juling/200708/t20070807_107652.htm (Chinese) and http://faolex.fao.org/docs/texts/chn73543E.doc (English)

In addition to this, the provincial Environmental Protection Bureau in Shanxi Province (where the proposed project is located) issued further guidance[15] on measures to monitor the discharge of pollutants, re-iterating many of the clauses detailed in table B.1 above.

The regulations listed in table B.1 above broadly outline the requirements for compliance and potential penalties for coal mine operators as well as requirements for local Environmental Protection Bureaux (EPB) to monitor compliance. However, these regulations are broad in their scope, covering everything from spills of pollutants into rivers to monitoring of emissions of air pollutants from power stations. They do not contain any specific guidance for monitoring the concentration of vented CMM and, as such significant issues and questions around enforcement and monitoring of compliance with the Standard in practice remain. For example:

- The Standard, in common with other environmental legislation in China, was issued by the Ministry of Environmental Protection (MEP) in Beijing. According to the Standard, implementation will lie with local, county level EPB. However, to date, the MEP has not issued any specific technical guidance to local EPB on implementation of the Standard (for example, on monitoring the methane concentration of vented CMM). Furthermore no additional resources have been given to the EPB to undertake this role. Local EPB have no clear guidance therefore on how to conduct inspections of coal mines to see if they are in compliance with the Standard (or not) and both Shanxi Province EPB and Xiyang County EPB have confirmed that, to date, they have not conducted any inspections of coal mines to check compliance with the Standard[16].

  As identified by the Economics Institute of Shanxi Academy of Social Sciences[17]:

  "It is difficult for incentive policies from state government to be realized in local level. For example, State EPB issued the ...Emission Standard of CBM/CMM (on trial) GB21522-2008... However, the related guidance on implementation of the standard for both entity and local EPB has not been issued i.e. the monitoring system for the entity and the administration system of the government including the requirements for monitoring equipment and human resources, budgetary, training system have not been detailed."

  In Shanxi province, there are a total of 886 coal mines[18], many of which are located in remote, rural areas. It is therefore costly and time-consuming for local EPB to establish the monitoring system for coal mines in the first place and subsequently to inspect the compliance by local coal mines.

- Article 5 of the Standard states that automatic monitoring equipment should be installed at coal mines to monitor the concentration of vented CMM and should be connected to a central monitoring system at the local EPB. However, as explained above, no further guidance has been given by the Chinese government about how local EPB should set up these central monitoring systems or how the costs of this should be covered[19].

- Further, except for the general guidance detailed in table B.1, no guidance has been given to local EPB as to how assess compliance (or not) with the Standard. For example, an average should be

[15] For example, the "*Measures for Award and Punishment of Shanxi Province Key Entities with High Pollutant to Construct Automatic Monitoring System"*, Jinhuanfa No.521(2007) http://www.sxhb.gov.cn/news.do?action=info&id=7847

[16] See for example the statement by Xiyang Xian Environmental Protection Department dated 20 August 2010 and the statement by Shanxi Environmental Protection Department dated 9 October 2010

[17] Economics Institute of Shanxi Academy of Social Sciences, *Measures and Suggestions on Encouraging the Development of the CMM and Natural Gas Industry in Shanxi Province (2010 to 2020)*, October 2010

[18] http://www.sxcoal.gov.cn/cms/templet/default/ShowArticle_channel.jsp?id=28134

[19] Economics Institute of Shanxi Academy of Social Sciences, *Measures and Suggestions to Encourage the Development of the CMM and Natural Gas Industry in Shanxi Province*, October 2010

calculated to determine if, over the course of the year, concentration is above or below 30%. Coal mine gas is a variable resource, both in quality and in quantity (i.e. concentration of methane)[20]. 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 of gas extracted will fluctuate significantly according to factors outside the control of the coal mine owner and power plant operator. Without guidance to demonstrate how an average concentration is calculated, it will not be possible for local EPB to determine compliance or not.

- The Standard requires that coal mine operators monitor and record emissions of CMM on-line. However, to date coal mine owners have not received any training or guidance from local or central government on how to connect their own monitoring systems with that of the local government so that local EPB can collect emissions data on line and assess implementation of the Standard[21].

- Article 5.2 of the Standard states that automatic monitoring systems should be installed in new coal mines. However, there is no such provision requiring this for existing coal mines (who are expected though to comply with the Standard). Clearly without specific requirements to do this, it is unlikely that many existing coal mines will voluntarily go to the expense and trouble of installing such a system. In this case, the local EPB will be unable to systematically enforce compliance.

2. Gas utilisation and drainage data for Shanxi Province show that the majority of high concentration CMM will still be vented

Targets for CMM drainage and utilisation were set in the Eleventh Five Year plan (2006-2010)[22]:

- The drainage amount of CMM will reach 5 billion cubic meters by 2010
- The utilisation amount of CMM will reach 3 billion cubic meters by 2010 (i.e. a utilisation rate of 60%)

A year on year improvement has been seen since then, as shown in figure B.2 below, and the 2010 drainage target was hit and surpassed earlier than expected. Improvements in drainage stemmed from governments concerns over mine safety and additional funding that was made available for new drainage systems and the enhancement of existing systems[23]. Utilisation however remains relatively stable at around 30% of gas drained and the 2010 target is therefore unlikely to be hit.

Figure B.2: CMM drainage and usage in China, 2004-09[24]

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[20] UN Economic Commission for Europe, Ad Hoc Group of Experts on Coal Mine Methane.

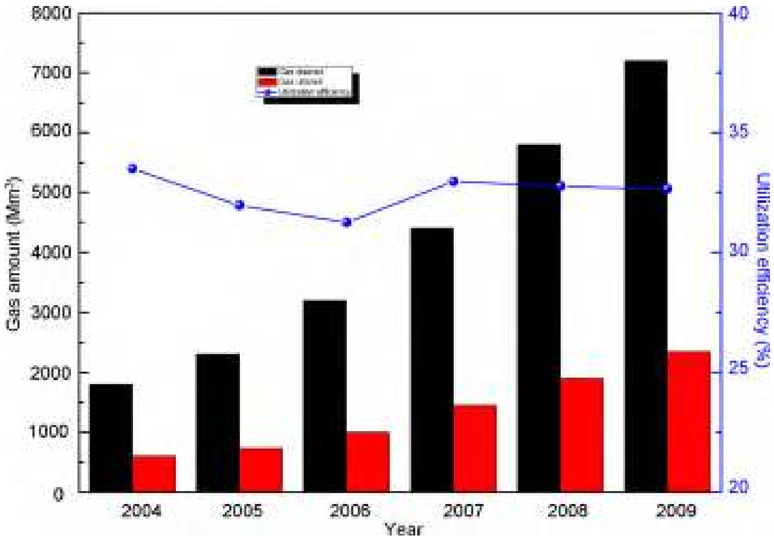
Response to Misconceptions about Coal Mine Methane Projects (Para. 9) (available at http://www.unece.org/energy/se/pdfs/cmm/AHGE_Letter_Misconceptions_CMM.pdf).

[21] See for example the statement by the project owner for this project dated 23 August 2010

[22] State Council of the P.R. of China, *11th Five-Year Plan for Development and Utilization of Coalbed Methane and Coal Mine Methane (2006-2010)* (available at http://www.methanetomarkets.org/documents/coal_cap_china.pdf).

[23] Energy Sector Management Assistance Program (the World Bank Group), *A Strategy for Coal Bed Methane (CBM) and Coal Mine Methane (CMM) Development and Utilization in China*, 2007 (available at http://web.worldbank.org/external/projects/main?pagePK=64256111&piPK=64256112&theSitePK=40941&menuPK=115635&entityID=000020953_20070828093241&siteName=PROJECTS)

[24] Cheng, Y-P et al, *Environmental Impact of coal mine methane emissions and responding strategies in China, International Journal of Greenhouse Gas Control*, 2010 (Article in press).



There are 886 coal mines in Shanxi Province[25], where the proposed project is located, and CMM drained in this province makes up over 40% of the total CMM drained in China[26]. Note: the review question refers to "the number of mines (if any) in the country or the region that abide by the regulation". It is not possible to provide this data because:

(i) As explained above, CMM is a variable resource both in quantity and quality (i.e. methane content). In the absence of detailed, technical guidance on how to calculate an average concentration over a period of time, it is not possible to ascertain which mines drain CMM with a methane conc. >30% and which do not.

(ii) One coal mine may have a number of drainage stations and it is possible that at one drainage station CMM is utilised and at another it is not i.e. partial compliance with the Standard could be possible.

However, data has been released by the State and Provincial governments of Shanxi on the volumes of CMM with a high concentration[27] of methane drained and utilised in Shanxi Province over the past few years (see table B.2 below). This can be used to give an indication of anticipated levels of compliance with the Standard.

Table B.2: CMM with a high concentration of methane drainage and usage in Shanxi province[28]

	Unit	**2006**	**2007**	**2008**	**2009**	**2010 (expected)**
Drainage	Billion m^3	1.611	2.080	2.160	2.250	2.5
Utilization	Billion m^3	0.327	0.558	0.767	0.873	1.0
% Utilisation	%	20.30	26.83	35.51	38.8	40

NB. The data above includes utilisation of CMM by CDM projects

This clearly shows that the majority of CMM with a high concentration of methane was vented prior to the Standard being published and implemented. This was still the situation following publication of the Standard in 2008 and subsequent implementation. Despite year-on-year improvement in utilisation of

[25] www.sxcoal.gov.cn/cms/templet/default/ShowArticle_channel.jsp?id=28134

[26] International Energy Agency, *Coal Mine Methane in China: A Budding Asset with the Potential to Bloom*, 2009 (available at http://www.iea.org/papers/2009/china_cmm_report.pdf).

[27] No exact definition of 'high concentration' is given but it is commonly understood that this is CMM where the methane content is generally >25-30%.

[28] Economics Institute of Shanxi Academy of Social Sciences, *Special Report on CMM Drainage and Utilisation In Shanxi Province*, October 2010

CMM with a high concentration of methane, in 2010 it is expected that utilisation rates will not be greater than 40%.

There are a number of reasons for this:

(i) No additional funding or training has been given to coal mine operators to help them comply with the Standard. As outlined in the PDD, there are many barriers facing the utilization of CMM in China, as elsewhere in the world:

- Investment barriers: Attracting finance for CMM utilization 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[29] (ii) Chinese enterprises have a lack of funds to invest in such projects and many schemes are too small to attract financial institutions[30]
- Purity Uncertainty: CMM production is linked to mining production and therefore the purity or flowrates are not under the control of the gas engine operator. This can lead to times when the gas supply is not >30% and therefore below the minimum safety threshold for use by the gas engine or other end-use[31]. This uncertainty increases investment risks which are not compensated for in the return.
- Technological barriers: Power generation from CMM has a low market share in China and involves certain risks due to equipment performance and management uncertainty. Power generation from CMM is a new area of business for the project owner, and therefore carries higher risks.

This is further recognised by the IEA[32],

> *"Many CMM projects are not cost-effective at standard market rates for power and natural gas. Further, many coal mines do not have adequate internal investment capital for project funding"*

In addition to this, Economics Institute of Shanxi Academy of Social Sciences identified that CMM utilisation is not core business for coal mine companies who would rather invest scarce financial resources in expanding coal production than in CMM utilization technologies[33]:

> *"To drain CMM has been deemed as a way to improve the safety of coal mines rather than as a potential resource... Therefore coal mine owners only budget for measures needed to meet national safety criteria for coal mine operation. Coal mines owners have not paid attention to the potential for CMM utilization".*

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 (as demonstrated in the common practice section of the PDD for this project). It is not

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[29] UK Department of Trade & Industry, *Enhancing Coal Mine Methane Usage in China*, December 2005 (p23-4, available at www.berr.gov.uk/files/file29223.pdf) and IEA, *Energy Sector Methane Recovery and Use*, 2009 (p21, available at http://www.iea.org/textbase/Papers/2009/methane_brochure.pdf)

[30] Energy Sector Management Assistance Program (the World Bank Group), *A Strategy for Coal Bed Methane (CBM) and Coal Mine Methane (CMM) Development and Utilization in China*, 2007 (available at http://web.worldbank.org/external/projects/main?pagePK=64256111&piPK=64256112&theSitePK=40941&menuPK=115635&entityID=000020953_20070828093241&siteName=PROJECTS)

[31] Ibid

[32] IEA, *Energy Sector Methane Recovery and Use*, 2009 (p21, available at http://www.iea.org/textbase/Papers/2009/methane_brochure.pdf)

[33] Economics Institute of Shanxi Academy of Social Sciences, *Special report: CMM Drainage and Utilization in Shanxi Province(2010 to 2020)*, October 2010

conceivable that coal mine owners will be able to comply with this Standard without the CDM or additional funding from another source. Indeed, according to a statement published in July 2009, 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"*[34].

No exact figures on the percentage of total methane available that is used by registered CDM projects are available. However, according to the data released by the State and Provincial governments of Shanxi, utilisation of CMM with high methane content can be broken down into CMM used for power, for fuel and or other uses.

According to the common practice section of the PDD, all other CMM fired power projects in Shanxi Province are also applying for CDM finance. It can therefore be assumed that all CMM being used for power in Shanxi Province is being utilised because of the CDM. If these power projects are excluded from the total utilisation figures[35], utilisation of CMM with high methane content *excluding* CDM projects is less than 20%, as shown below.

Table B.3: Breakdown of CMM utilisation in Shanxi Province

	Total drained	**Total utilisation**	**Total utilisation (exc. Power)**	**% utilisation exc. Power**	**Power**	**Fuel**	**Other**
2006	1.611	0.327	0.187	11.61	0.14	0.12	0.067
2007	2.08	0.558	0.358	17.21	0.2	0.27	0.088
2008	2.16	0.767	0.367	16.99	0.4	0.27	0.097
2009	2.25	0.873	0.323	14.36	0.55	0.28	0.043
2010	2.50	1.000	0.35	14.00	0.65	0.3	0.05

(ii) The likely fine for non-compliance with the regulation will not be sufficient to incentivise coal mine owners to comply

Table 1 above shows that, according to the Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution, article 48 *"Whoever…discharges pollutants to the atmosphere in excess of the national or local discharge standards shall make treatment thereof within a time limit, and shall also be imposed upon a fine of not less than 10,000 yuan but not more than 100,000 yuan by the administrative department of environmental protection under the local people's government at or above the county level"*.

If the Standard was fully implemented and enforced, then coal mine operators who drain CMM with a concentration ≥30% would be faced with three choices:

i. Continue to vent CMM with a methane concentration ≥30% and pay the fine (maximum 100,000RMB pa). In this scenario no investment would be needed.
ii. Implement a project to utilise/ destroy the CMM (in the case of the proposed project this would consist of a project to install gas gen sets to utilise high concentration CMM to generate

[34] http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=3719
[35] This is conservative as other registered CDM projects also use some CMM for fuel (e.g. registered project 902) and for other uses, and this volume of CMM is not excluded here.

electricity which is then sold to the grid, waste heat recovery boilers to provide heat to buildings and a flare to destroy CMM when the gen sets are not in use) thereby avoiding paying the fine.

iii. Install equipment to dilute any CMM with a methane concentration ≥30% to a concentration <30% and continue to vent, thereby avoiding paying the fine. The equipment needed to be this would be simply an air inlet valve and a gas detector to regulate the proportions of air and methane. The total cost of this would depend on the exact specifications of the drainage system at a particular mine but would likely be less than 100,000RMB with an annual repair cost of 5% of the initial investment.

The NPV was calculated for each of the three scenarios above and the results presented in table 4 below (see also spreadsheet entitled "BYL enforcement scenarios_1101017").

Table B.4: NPV of possible scenarios

Scenario	**NPV**
Continue to vent high concentration CMM and pay the fine (maximum 100,000RMB pa)	- 621,659
Implement a project to utilise/ destroy the CMM thereby avoiding paying the fine.	- 63,319,600
Install equipment to dilute any CMM with a concentration ≥30% to a concentration <30% and continue to vent, thereby avoiding paying the fine.	- 119,579

This shows that even if penalties for non-compliance are introduced and enforced, implementing utilisation projects such as the proposed project will still be financially unattractive. The most financially attractive option would be to install low cost equipment to dilute CMM with a high methane concentration to a methane concentration lower than 30%, thereby avoiding paying the fine.

As recognised by the World Bank[36]:

> *"A weakness of the policy is that no incentive is provided to encourage mines with poor gas drainage that are extracting methane at low and hazardous concentrations to improve performance".*

This was also recognised in a recent study by the IEA[37]:

> *"the new policy requiring methane use if CMM concentrations equal or exceed 30% appears to be creating uncertainty for CMM utilisation projects. Based on anecdotal reports gained from the interviews, this policy may result in an increase in CMM dilution to avoid the requirement of flaring/use"*

And this situation would certainly have safety implications as diluting drained CMM would likely place it in the explosive range of methane, as described earlier.

3. In common with other environmental legislation in China, the Standard is not systematically enforced by the local authorities

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[36] World Bank, CCII and ESMAP, *Economically, socially and environmentally sustainable coal mining sector in China*, December 2008 (available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/01/15/000333037_20090115224330/Rendered/PDF/471310WP0CHA0E1tor0P09839401PUBLIC1.pdf)

[37] International Energy Agency, *Coal Mine Methane in China: A Budding Asset with the Potential to Bloom*, 2009 (available at http://www.iea.org/papers/2009/china_cmm_report.pdf).

Looking at other environmental legislation in China, it can be seen that levels of compliance have been identified by both the Chinese government and external bodies as an issue. For example, a report for the Organisation for Economic Co-operation and Development stated that[38]:

> *"The Chinese government has identified inadequate enforcement as one of the key factors in China's deteriorating environmental situation. The 9th, 10th and 11th FYPs [five year plans] emphasised the need to strengthen environmental enforcement and compliance assurance...*

There appear to be three main reasons for this:

a. "Environmental policies have often been declarative and unrealistic".[39] Much of this stems from a fundamental cultural difference between law-making in China and other countries. For example,

   "the abstract nature of many environmental provisions makes them seem more like 'policy statements and propositions of ideals' rather than laws. Actions are encouraged but not required, or if they are, little guidance is provided as to procedures and specific goals. For example, the use of the word 'should' instead of stronger terms such as 'shall' or 'must' is frequent" [40]

b. An 'implementation gap' between national law makers and local law implementers. For example, according to the OECD[41]:

   "The general policy framework favouring development over the environment compromises the work of enforcement bodies at the subnational level and results in widespread non-compliance with environmental requirements"

   Local EPBs are generally funded by local government rather than the central Ministry of Environmental Protection which results in pressure placed on EPB officers to ignore environmental legislation in the case of certain enterprises who exert a strong influence on local government.

c. Insufficient resources and technical capacity for local EPB to carry out their duties: "*There are simply too many enterprises to be monitored in China and too few trained personnel to carry out Inspections"*.[42]

The new Standard regarding CMM utilisation can be seen to be following a similar pattern i.e. a statement of a policy ideal, rather than a required state of affairs with strict procedures for compliance and penalties for non-compliance.

4. The timeline of this project shows that the project was conceived independently of the Standard.

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[38] Organization for Economic Co-operation and Development, *Environmental Compliance and Enforcement in China*, 2006 (available at http://www.oecd.org/dataoecd/33/5/37867511.pdf).

[39] ibid

[40] Jennifer Wu, *Public Participation in the Enforcement of China's Anti-Pollution Laws*, 4/1 Law, Environment and Development Journal (2008), p. 35, (available at http://www.lead-journal.org/content/08035.pdf)

[41] Organisation for Economic Co-operation and Development, *Environmental Compliance and Enforcement in China*, 2006 (available at http://www.oecd.org/dataoecd/33/5/37867511.pdf).

[42] Jennifer Wu, *Public Participation in the Enforcement of China's Anti-Pollution Laws*, 4/1 Law, Environment and Development Journal (2008), p. 35, (available at http://www.lead-journal.org/content/08035.pdf)

The project timeline shows that the project owner first started considering the feasibility of the project concept significantly before the Standard was even published. As indicated in table B.5 below, prior to publication of the Standard in April 2008, the project owner had signed a CDM co-operation agreement and commissioned the FSR. Further, the project had received FSR and EIA approvals and the project owner had made the decision to proceed with the project before the Standard was implemented. This shows that the project cannot have been implemented to comply with the Standard; rather that the project was conceived independently by the project owner prior to the Standard being published.

In addition to this, according to the Measures for the Management of Environmental Standards[43], as the project had received the FSR and EIA approvals were before the Standard was implemented, measures to ensure compliance with the CMM Standard were not identified or required in the approved EIA. Therefore, compliance with the Standard is not required over the course of the design, construction, or operation of the project.

Table B.5: Project Schedule

Item	Time	Evidence
First discussions between Camco and the project owner	October 2007	CDM consultation agreement (Final Validation Report doc. 21)
Signing of CADA between Camco and project owner	28 February 2008	CDM consultation agreement (Final Validation Report doc. 21)
FSR completed	April 2008	FSR (Final Validation Report doc. 4)
Board meeting decision to proceed with the project as a CDM project	April 2008	Board Meeting Minutes (Final Validation Report doc. 22)
FSR approval by Shanxi DRC	June 2008	FSR approval (Final Validation Report doc. 4)
EIA completed	June 2008	EIA Final Validation Report doc. 5)
EIA approval by Shanxi EPB	June 2008	EIA Final Validation Report doc. 5)

In summary, in common with much other environmental legislation in China, the Emission Standard of Coalbed Methane/Coal Mine Gas (GB 21522-2008) (on trial) can be seen as a 'policy ideal' and aspirational target. The Chinese government has not yet published comprehensive guidance on how the Standard will be implemented and how enforcement will be monitored. Local EPB have not received implementation guidelines from the MEP detailing how they should enforce the Standard and coal mine owners have also not received any guidance on implementation and enforcement of the Standard. Even if this guidance were to be issued, it has been recognised by the OECD and others that conflicting priorities and insufficient capacity at a local level are likely to impede enforcement by local EPB.

Further, as the EIA was approved prior to the implementation of the Standard, there were no requirements for provisions for automatic monitoring equipment (to monitor the concentration of vented CMM) to be installed as part of the project. This will be the case for all existing coal mines and shows that the Standard cannot be systematically enforced unless the government issues further guidance requiring all existing coal mines to install automatic monitoring equipment, which has not yet happened.

In addition to the approval of the EIA, the FSR was also approved and the project owner had made the decision to implement the project as a CDM project before the Standard was implemented. Even before the Standard was published, the project owner had signed a CDM co-operation agreement and commissioned the FSR thus demonstrating that the project was conceived independently of and prior to the publication of the Standard, rather than in response to it.

[43] State Environmental Protection Administration Decree 3, issued on 1 April 1999, articles 17-18.

Finally, based on gas drainage and gas utilisation data for Shanxi Province for 2006-09, it can be seen that utilisation rates of high concentration CMM were always <40%. The Economics Institute of Shanxi Academy of Social Sciences estimates that in 2010, the utilisation rate will still not surpass 40% and the majority of high concentration CMM will continue to be vented.

This can be attributed to the barriers facing CMM utilisation projects in China as many coal mine operators lack the resources to be able to comply with the Standard without additional, external resources (such as the CDM).

Further, even if penalties for non-compliance were implemented and enforced, the level of the fines is unlikely to be sufficient to incentivise coal mine operators to comply with the Standard i.e. considering the NPV of the three options available to coal mine owners[44], the most financially attractive option for coal mine operators is to install low cost equipment to dilute CMM with a high concentration of methane to a methane concentration lower than 30%. This has implications for the safe operation of the CMM drainage system at these mines and also demonstrates that even if the Standard were enforced; venting would still be the baseline scenario.

For these reasons, the Standard is not considered in the baseline analysis for the SDIC Xiyang Baiyangling CMM to Power Generation Project. However, to ensure that the baseline selected is still valid throughout the crediting period of the project, implementation of the standard will be monitored and, following this, compliance with the standard will be monitored throughout the crediting period of the project. For details, see Annex 4.

Step 2c. Options for energy production

Option 2 (Construction of a fuel-fired power plant with equivalent amount of annual electricity generation) does not satisfy China's regulations. Considering the same annual electricity generation, the alternative baseline scenario for the project should be a fuel-fired power plant with installed capacity of <30MW. However, according to China's regulations, construction of fuel-fired power plants with the installed unit capacity equal to or lower than 135 MW is prohibited in the areas which can be covered by large grids such as a provincial grid[45]. Therefore, Option 2 should be eliminated.

Purely captive power plants are prohibited at Chinese coal mines for the reasons given above. If there is a grid connection as well as onsite captive power generation then this allowed according to the safety regulations.

Options 1, 3 and 4 satisfy China's regulations.

To summarize,

- For CBM/CMM/VAM extraction, Options DI and DII satisfy China's regulations;
- for extracted CBM/CMM/VAM treatment, Options I to VIII all satisfy China's regulations;
- for energy production, Options 1, 3 and 4 satisfy China's regulations

For extracted CMM treatment, since option VIII is the combination of options I-VII, only options I - VII

[44] These scenarios are (i) Continue to vent high concentration CMM and pay the fine; (ii) Implement a project to utilise/ destroy the CMM thereby avoiding paying the fine and (iii) Install equipment to dilute any CMM with a concentration ≥30% to a concentration <30% and continue to vent, thereby avoiding paying the fine.

[45] '*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. Available at http://www.gov.cn/gongbao/content/2002/content_61480.htm

are considered in further discussions on extracted CMM treatment.

Step 3. Formulate baseline scenario alternatives

Based on the previous discussion, the baseline scenario alternatives are the possible combination of CMM extraction options, CMM treatment options, and energy production options. More specifically, the baseline scenario alternatives of the project are summarized as follows:

Scenario	CBM/CMM/VAM extraction	CBM/CMM/VAM treatment	Power production
Scenario 1	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	I. Venting	1.Electricity from grid
Scenario 2	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	II. Utilization or destruction of VAM	1.Electricity from grid
Scenario 3	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	III. Flaring of CMM	1.Electricity from grid
Scenario 4	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	IV. Use for additional grid power generation with flaring of CMM when the gen sets are not in operation, i.e. the project not implemented as a CDM project	1.Electricity from grid, 4. Electricity generated from CMM destroyed in grid-connected power plants
Scenario 5	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	V. Use for additional captive power generation (but with grid connection)	3. Electricity generated from CBM/CMM/VAM destroyed in on-site captive power plants with grid connection
Scenario 6	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	VI. Use for additional heat generation	1. Electricity from grid
Scenario 7	DII. Combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM	VII. Feed into gas pipeline	1. Electricity from grid
Scenario 8	DI. Combination of VAM, pre-mining and post-mining CMM extraction, including CBM	I. Venting	1.Electricity from grid

Step 4. Eliminate baseline scenario alternatives that face prohibitive barriers

Scenario 1 There are no barriers to this scenario - this is continuation of the current situation at Baiyangling mine.

Scenario 2 Technologies that oxidize VAM for electricity or heat generation are available although they face significant barriers:

- Technical barriers: there are very few operating projects globally[46], therefore 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). In Chinese mines, VAM concentrations are often lower than this, typically <0.5% and, by law, cannot increase above 1%[47]. 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[48]. Uncertainty in regulatory regimes make the possibility of attracting additional revenue from carbon credits risky. Projects of this type are therefore likely to have difficulty in attracting debt finance.

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

Scenario 3 China's National Climate Change Programme[49] emphasizes the importance of the 'exploration, development and utilization' of CMM and CBM in China. CMM is destroyed by flaring but is not utilized and therefore projects to flare CMM face a number of barriers:

- Investment barriers: flaring requires investment in a new combustion facility which would not generate any returns and is thus not an attractive investment for the project owner or third party investors. This would make it extremely difficult to attract debt finance for this type of project and mine owners would generally be unwilling or unable to invest themselves.
- Barriers due to prevailing practice: For the reasons above, this option (Flaring of CMM) is not widely adopted in China.

This option is therefore excluded.

Scenario 4 There are a number of prohibitive barriers facing grid-connected CMM fired power projects including:

- Investment barriers: 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[50] (ii) Chinese enterprises have a lack of funds to invest in such projects and many schemes are too small to attract financial institutions[51] (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.

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[46] See for example http://www.unece.org/energy/se/pdfs/cmm/4ahge_cmm/9_Kallstrand.pdf and http://cleantech.com/news/2766/biothermica-to-test-methane-mitigation-in-alabama

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

[48] http://www.asiapacificpartnership.org/pdf/Projects/Coal%20Mining%20Task%20Force%20Action%20Plan%20030507.pdf, page 56 and http://www.unece.org/energy/se/pdfs/cmm/AHGE_Letter_Misconceptions_CMM.pdf (page 2)

[49] 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).

[50] UK Department of Trade & Industry, Enhancing Coal Mine Methane Usage in China, December 2005 (p23-4, available at www.berr.gov.uk/files/file29223.pdf) and IEA, Energy Sector Methane Recovery and Use, 2009 (p21, available at http://www.iea.org/textbase/Papers/2009/methane_brochure.pdf)

[51] Energy Sector Management Assistance Program (the World Bank Group), A Strategy for Coal Bed Methane (CBM) and Coal Mine Methane (CMM) Development and Utilization in China, 2007 (available at http://web.worldbank.org/external/projects/main?pagePK=64256111&piPK=64256112&theSitePK=40941&menuPK=115635&entityID=000020953_20070828093241&siteName=PROJECTS)

- Purity Uncertainty: CMM production is linked to mining production and therefore the purity or flowrates are not under the control of the gas engine operator. This can lead to times when the gas supply is not >30% and therefore below the minimum safety threshold for use by the gas engine[52]. This uncertainty increases investment risks which are not compensated for in the return.
- Technological barriers: Power generation from CMM has a low market share in China and involves certain risks due to equipment performance and management uncertainty. Power generation from CMM is a new area of business for the project owner, and therefore carries higher risks.
- Barriers due to prevailing practice: of the CMM that is used in China, most is distributed via pipelines to mining communities and neighboring cities for industrial and domestic use[53]. There are few CMM power generation schemes in China because local authorities and mining enterprises often only consider residential consumers a priority, due to the social requirements. Although gas drainage is increasingly installed in coal mines in China for safety reasons, CMM utilization is not an essential part of mine construction.

Therefore, scenario 4 also faces prohibitive barriers and is excluded.

Scenario 5. As for grid connected CMM power generation, this option faces barriers:

- Investment barriers: 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[54] (ii) Chinese enterprises have a lack of funds to invest in such projects and many schemes are too small to attract financial institutions[55] (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.
- Purity Uncertainty: CMM production is linked to mining production and therefore the purity or flowrates are not under the control of the gas engine operator. This can lead to times when the gas supply is not >30% and therefore below the minimum safety threshold for use by the gas engine[56]. This uncertainty increases investment risks which are not compensated for in the return.
- Technological barriers: Power generation from CMM has a low market share in China and involves certain risks due to equipment performance and management uncertainty. Power generation from CMM is a new area of business for the project owner, and therefore carries higher risks.
- Barriers due to prevailing practice: of the CMM that is used in China, most is distributed via pipelines to mining communities and neighboring cities for industrial and domestic use[57]. There are few CMM power generation schemes in China because local authorities and mining enterprises often only consider residential consumers a priority, due to the social requirements. Although gas drainage is increasingly installed in coal mines in China for safety reasons, CMM utilization is not an essential part of mine construction.

Finally, there is not enough on-site demand for power to consume all of the electricity that is expected to be generated from the proposed project (97,978MWh pa). Exact onsite demand for power during normal

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[52] Ibid
[53] Ibid

[54] UK Department of Trade & Industry, Enhancing Coal Mine Methane Usage in China, December 2005 (p23-4, available at www.berr.gov.uk/files/file29223.pdf) and IEA, Energy Sector Methane Recovery and Use, 2009 (p21, available at http://www.iea.org/textbase/Papers/2009/methane_brochure.pdf)
[55] Energy Sector Management Assistance Program (the World Bank Group), A Strategy for Coal Bed Methane (CBM) and Coal Mine Methane (CMM) Development and Utilization in China, 2007 (available at http://web.worldbank.org/external/projects/main?pagePK=64256111&piPK=64256112&theSitePK=40941&menuPK=115635&entityID=000020953_20070828093241&siteName=PROJECTS)

[56] Ibid
[57] Ibid

operations is not known at Baiyangling as it is currently undergoing a series of major improvements. In 2008, no power was consumed at the mine for this reason. In 2009, Baiyangling consumed 18,220MWh electricity. This was during a time of improvements to the mine rather than normal operations so it can be expected that this is higher consumption of electricity than would be expected during normal operations. Even so, power consumption was approximately just 20% of the expected output from the project.

Further at another mine owned and operated by the project owner which is of a similar size to Baiyangling mine, annual power consumption in 2008 was 15,595MWh and in 2009 was 26,710MWh, both significantly lower than the planned output from this project.

Scenarios 6 and 7 There is a small seasonal heat demand for buildings at the mine site which is currently met by coal fired boilers and there is no additional heat demand nearby. Given the cheap and plentiful coal supply and the relative lack of greater demand, the project owner would be unlikely to invest in CMM boilers unless required to do so. Furthermore, the price of gas fired boilers is generally more expensive than that of coal fired boilers with a similar capacity[58], and extra investment in the new gas containers and supportive gas transmission pipeline is required. Finally, the supply of CMM will have fluctuations in concentration due to changes in the operation of the coal mine, impacting on the stability of the heat supply. Therefore, use of CMM for additional heat generation faces investment and technology barriers and cannot be considered a plausible baseline scenario. It is therefore excluded.

Local residents living in the vicinity of the mine are very few and very dispersed and it is therefore not practical to supply heat or CMM to these local residents using a pipeline.

The next nearest major centre of demand for heat is Jinzhong city, more than 30km from the mine. Methane gas would need to be compressed and transported to be fed into the gas pipeline for use by industrial and commercial users here. The technology for CMM compression (i.e. where the air is removed from low concentration CMM (20-40%) and it is liquefied) is still at a demonstration stage in China but has not yet been commercialized and these options are therefore excluded[59].

Scenario 8. The introduction of CBM faces significant barriers:

- Technological barriers: these include difficulties of extracting gas from low permeability coal seams, unreliable monitoring equipment and inadequate drilling equipment[60]. In addition, the land which would need to be drilled to access the CBM may not necessarily be owned by the project owner meaning that either the land would have to be purchased or drilling rights would have to be secured from the landowner. This would add to the expense and/ or complexity of the project.
- Barriers due to prevailing practice: coal mining companies are not generally familiar with CBM well drilling procedures and extraction technologies. Introduction of these practices requires extensive training and support.
- Investment barriers are significant. Drilling and completion costs for CBM wells are generally high. Currently, the selling price for CBM is generally the same as that of natural gas and the price of natural gas is set at a low level by the Government. This means that the return on investment for CBM developers is low. Further, Chinese coal mine operators generally lack the capital to invest in CBM development and utilization projects.

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[58].UK Department of Trade and Industry, A. Market Assessment of Industrial Sized Coal Fired Boilers in China http://www.berr.gov.uk/files/file18620.pdf (p30).

[59] Huang S., Liu W, Liu X and Sun Q (China Coal Information Institute), Progress and Project Opportunities of the CDM Development and Utilisation in China, Methane to Markets Partnership Expo 2007 Proceedings.

[60] Energy Sector Management Assistance Program (the World Bank Group), A Strategy for Coal Bed Methane (CBM) and Coal Mine Methane (CMM) Development and Utilization in China, 2007. Available at http://web.worldbank.org/external/projects/main?pagePK=64256111&piPK=64256112&theSitePK=40941&menuPK=115635&entityID=000020953_20070828093241&siteName=PROJECTS

This scenario therefore faces prohibitive barriers and is eliminated.

To summarise, scenario 2~8 are excluded.

Therefore the baseline scenario identified is scenario 1:

- For CMM extraction: Combination of VAM, pre-mining (without CBM) and post-mining CMM extraction (Option DII)
- For CMM treatment: Venting of VAM and CMM (Option I)
- For energy production: Continuation of electricity supply from the NCPG (Option 1)

Step 5. Identify the most economically attractive baseline scenario alternative

This step is omitted as steps 1-4 clearly show that only 1 baseline scenario remains.

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):

The table below shows the timeline for the project and illustrates that the possibility of additional revenue through the sale of CERs was a key factor for deciding to proceed with the project.

Table B.6 Project schedule

Item	Time
Signing of CADA between Camco and project owner	February 2008
FSR completed	April 2008
Board meeting decision to proceed with the project as a CDM project	April 2008
FSR approval by Shanxi DRC	June 2008
EIA completed	June 2008
EIA approval by Shanxi EPB	June 2008
Stakeholder meeting	November 2008
Estimated date for equipment purchase contract to be signed	December 2009
Estimated start date for start of construction of power stations	March 2010
Estimated date for start of power production	September 2010

The additionality of the project is demonstrated and assessed by using the '***Tool for the Demonstration and Assessment of Additionality***' *version 05.2* approved by CDM EB.

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

Based on the analysis carried out in Section B.4, the baseline scenario of the project is scenario 1:

- For CMM extraction: combination of VAM, pre-mining and post-mining CMM extraction, excluding CBM (Option DII);
- For CMM treatment: venting of VAM and CMM (Option I);
- For energy production: continuation of electricity supply from the NCPG (Option 1).

Based on the analysis in Step 2 (eliminate baseline options that do not comply with legal or regulatory requirements) of Section B.4, all the formulated baseline scenario alternatives satisfy current laws and regulations.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

The *Tool for the Demonstration and Assessment of Additionality* suggests three analysis methods which are simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III). Since the Project will earn revenues not only from the CERs sales but also from electricity sales, the simple cost analysis method is not appropriate. Investment comparison analysis method is only applicable to projects whose alternatives are similar investment projects. The alternative to the project is the continuation of current status of Baiyangling Mine rather than a new investment project. Therefore Option II is not appropriate. The project will use benchmark analysis method (Option III) as a benchmark is available.

Sub-step 2b. Benchmark Analysis Method (Option III)

The appropriate financial indicator is the internal hurdle rate of return (IRR), which 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.

An equity IRR is calculated for the project and the benchmark used is taken from "*Interim Rules on Economic Assessment of Electric Engineering Retrofit Projects*"[61]. For the power sector, the benchmark for the equity IRR is 10% (after tax). On the basis of the benchmark, the calculation and comparison of financial indicators are carried out in sub-step 2c.

The power sector benchmark is selected as the project is grid-connected. This is a conservative assumption, since the coal mining industry has little experience in power generation and this adds significant risk to their investment decision. They would therefore expect higher returns than they would normally expect from an investment in their core business. Moreover, CMM projects are entirely reliant upon the amount of coal mined and drainage practices at the mine which are generally out of the control of the gas engine operator.

In short, as CMM projects have additional risk for the project owner, using a benchmark of 10% is conservative. On the basis of the benchmark, the calculation and comparison of financial indicators are carried out in sub-step 2c.

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

The basic parameters for the calculation of financial indicators for the Project are listed in Table B.2.

Table B.7 Basic parameters for calculation of financial indicators of the project

[61] Issued by State Power Corporation of China. Beijing: China Electric Power Press, 2003

Parameter	Value	Unit	Source
installed capacity (rated)	16	MW	FSR
installed capacity (operational)	14.4	MW	FSR
operation hours	7200	hours pa	FSR
auxiliary power consumption	5.5%		FSR
gross power generation	103,680	MWh	Calculated
net delivered power	97,978	MWh	Calculated
construction period	1	year	FSR
operation period	20	years	FSR
electricity tariff (inc. VAT)	275	RMB/MWh	FSR
heat (steam) tariff (inc. VAT)	35.8	RMB/ tonne steam	FSR
heat (steam) produced	79,554	tonnes steam	FSR
construction investment	169,918,400	RMB	FSR
interest during construction	5,630,000	RMB	FSR
fixed asset investment	175,548,400	RMB	FSR
working capital	830,000	RMB	FSR
total investment	176,378,400	RMB	FSR
loan for construction costs	110,446,960	RMB	FSR
construction costs loan interest rate	7.20%		FSR
construction costs loan repayment period	5	years	FSR Design Institute
loan for working capital	580,000	RMB	FSR
working capital loan interest rate	7.20%		FSR
- tangible assets	155,018,400	RMB	FSR
- intangible assets	20,530,000	RMB	FSR
water cost	104,407	RMB	FSR
material fee (engine oil)	311,000	RMB	FSR
employee expenditure (including benefits)	889,200	RMB	FSR
maintenance and repairs	8,495,920	RMB	FSR
Other O&M expenditure	5,184,000	RMB	FSR
Depreciation pa	7,363,374	RMB	Calculated
Deprecitation period	20	years	Calculated
fixed asset residue	5%		Calculated
Amortisation of intangible assets pa	2,053,000	RMB	Calculated
Amortisation of intangible assets period	10	years	FSR
Income tax	25%		FSR
VAT	17%		FSR
construction surcharge	5%		FSR
education surcharge	3%		FSR
CER crediting period	10	years	project owner
CER revenue pa	32,000,000	RMB	project owner

Input values for the IRR calculation in the PDD for the proposed project are taken from the FSR for the proposed project which was completed in April 2008 and approved by Shanxi Development and Reform Commission in June 2008. The decision to proceed with the project was made by the project owner in 2008 based on the FSR data. The input values from the FSR were therefore valid and applicable at the time of the investment decision to proceed with the project and to secure CDM status for it. Further details on the input values for the sensitivity analysis are given below:

Total investment: total investment in the project is from the FSR. The total amount can be divided as follows:

Item	**Cost (RMB)**
Equipment	109,938,500
Engines and generators	*77,100,000*
Fuel supply system	*19,968,000*
Water treatment system	*224,600*
Electrical system	*8,824,900*
Control system	*3,821,000*
Installation fee	17,988,800
Construction engineering fee	8,111,700
Other fees (including engineering preparation fee, project management fees, consultant fees, landscaping, treatment of foundations)	33,879,400
Total construction investment	**169,918,400**
Interest during construction	5,630,000
Working capital	830,000
Total investment	**176,378,400**
Unit equipment costs RMB/MW	6,871,156
Unit total investment RMB/MW	11,023,650

The costs in the FSR are based on using more expensive, imported Caterpillar gen sets as the project owner deems these to be more reliable than the cheaper, domestically produced equivalent. As such, the project investment costs can be compared to investment costs of other CMM to power projects in Shanxi province that also use imported engines. These are listed in table B.8 below.

Considering registered projects only, table B.8 shows that 2 projects (Yangquan and Sihe) have lower investment costs per MW installed but their total installed capacities are both much larger than that of the proposed project (90 and 120MW compared with 16MW) so it is likely that those projects benefit from significant economies of scale and so cannot really be compared with the Baiyangling project. The Duerping project is of a similar scale to the proposed project and has broadly similar unit investment costs (actually slightly higher) than those used here.

Considering all projects (i.e. registered projects, projects under validation, at completeness check and with a review requested), the unit cost range in Shanxi province is between 6,610 and 22,418 RMB/kW. The unit investment costs for the proposed project falls at the lower end of this range and, on this basis, the value used in the IRR calculation is reasonable.

Table B.8: Comparison of unit investment costs for CMM to power projects using international gen sets in Shanxi Province (Unit: RMB/kW)

	CDM Status			
Title	**Under validation**	**Registered**	**Review requested**	**At completeness check**
Duerping Coal Mine Methane Utilization Project		12,309		
Jincheng Chengzhuang 18 MW Coal Mine Methane Power Generation Project				8,322
Jincheng Sihe 120MW Coal Mine Methane Power Generation Project		6,610		
Lanhua Daning Coal Mine Methane Power Generation Project, Shanxi Province				7,309
Malan Coal Mine Methane Utilisation Project			16,943	
SDIC Xiyang Baiyangling CMM to Power Generation Project			*11,024*	
SDIC Xiyang Huangyanhui CMM to Power				11,683

Generation Project				
Shanxi Fengtai Coal Mine Methane (CMM) Utilization Project	12,120			
Shanxi Herui Coal Mine Methane Power Generation Project	7,504			
Shanxi Jincheng Beishidian 36MW Coal Mine Methane Power Generation Project	7,426			
Shaqu Coal mine CMM to power generation Phase 2 Project				7,221
Tunlan Coal Mine Methane Utilization Project, Shanxi Province				22,418
Yangquan Coal Mine Methane (CMM) Utilization for Power Generation Project, Shanxi Province		9,667		
Range of unit investment cost	7,426~12,120	6,610~12,309	11,024~16,943	7,221~22,418

Source: UNFCCC

To date, no actual costs have been incurred: purchasing of the gen sets has been delayed due to internal staff changes and re-organisation at the mine. Due to this delay, actual costs for equipment to be used in this project are likely to be a little higher than those used in the FSR as prices in China are generally rising[62]. On this basis, the value used in the IRR calculation is conservative.

Finally, a recent report by the UN Economic Commission for Europe and the Methane to Markets Partnership[63] states that

> *"Costs per megawatt of electricity capacity (MWe) for a CMM co-generation power plant[64] (all equipment including gas conditioning) is about US \$1.0 million to US \$1.5 million for international standard high efficiency generators (2008)".*

Using 2008 exchange rates[65], this equates to about 6.8 – 10.2 million RMB per MW installed. The equipment costs for this project (6.87 million RMB/MW) are at the bottom of this range and can therefore be considered reasonable and conservative.

Installed capacity: according to the FSR, the actual operating capacity is 90% of the rated installed capacity. This is due to the high altitude of the project site.

Electricity tariff: the tariff for selling power produced by the project to the grid at the time of writing the FSR had not been confirmed. Therefore, a tariff of 275RMB/MWh (inc. VAT) was assumed. This is a reasonable assumption as the standard power tariff for grid connected coal fired power stations in Shanxi Province at the time of writing the FSR was 275RMB/MWh (inc. VAT)[66] and other CMM projects in Shanxi province had received this tariff. For example, in 2007, a feed-in tariff of 0.275

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[62] According to the China Statistical Yearbook, in 2004, 2005, 2006, 2007 and 2008, the national general growth rate of purchasing prices of raw materials, fuels and power was 11.4%, 8.3%, 6%, 4.4% and 10.5% respectively. Also in 2004, 2005, 2006, 2007 and 2008, the national total price indices of investment in fixed assets was 5.6%, 1.6%, 1.5%, 3.9% and 8.9% respectively. See http://www.stats.gov.cn/tjsj/ndsj/2009/indexeh.htm, tables 8-1 and 8-15.

[63] UNECE and M2M Partnership, Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines, 2010 (p39). Available at http://www.unece.org/energy/se/pdfs/cmm/pub/BestPractGuide_MethDrain_es31.pdf.

[64] In this report, co-generation is defined as gas engine generators producing power with waste heat recovery for heating mine buildings, miners' baths, and shaft heating and cooling. This is the situation for the proposed project and these costs are therefore comparable.

[65] 1USD = 6.8 RMB (31 December 2008), http://www.xe.com/ict/?basecur=USD&historical=true&month=12&day=31&year=2008&sort_by=name&image.x=7&image.y=9

[66] Notice [1228] from the National Development and Reform Commission of China, 28 June 2006

RMB/kWh was approved by the Price Bureau of Shanxi province for the "Fengrun CMM to power generation" project[67]. Further, in early 2008, the Price Bureau of Shanxi province approved a feed-in Tariff of 0.275 RMB/kWh for three other CMM to power generation projects (Qishui Xinyuan, Yangcheng Xinyuan and Liulin Jinding CMM company)[68]. So, using a tariff of 275 RMB/kWh (inc. VAT) in the FSR and PDD IRR calculation is reasonable.
Note that in 2007, the National Development and Reform Commission of China published the "Implementing Opinions on Power Generation by Utilising CBM/CMM". This requires that grid companies purchase power produced by CMM/CBM to power projects and that the on-grid tariff of CBM/CMM power shall be determined by reference to the biomass power tariff set out in the Trial Measures on the Administration of Pricing and Allocation of Expenses in relation to Electricity Generated using Renewable Energy, which comprised of the benchmark on-grid tariff of the provincial desulfurized coal-fired generators in the year of 2005 plus a subsidy tariff.

However, in actual fact, there is little evidence to show that, in practice, this was being enforced. According to a study published in 2009, which was conducted by the International Energy Agency[69]:

> *"The subsidies and priority grid access policies that were enacted in April 2007 are not being enforced. For instance, none of the interviewees for this study were aware of a project that has received the subsidy, suggesting that it has not been widely publicized or exercised."*

At present, the project owner is still negotiating the tariff with the local grid company and no PPA has yet been signed. The project owner still therefore expects to receive a tariff that is similar to the standard power tariff for grid connected coal fired power stations in Shanxi Province. This tariff has recently risen to 325RMB (inc. VAT)[70]. Even using this tariff, the IRR of the project is just 7.79%, still below the benchmark for the project (10%).
Operation hours: the operation hours in the FSR for the gen sets are 7200 hours pa. Operating hours of 7200 hours each year is conservative due to fluctuating gas concentrations and volumes and outages in coal mine operation leading to periods when no gas is released (e.g. when changing the seam that is being worked on).

Power generated: this is based on operation hours of 7200 pa for the gen sets and an operating capacity of 14.4MW.

Power generated = 7200 x 14.4 = 103,680MWh

Auxiliary power consumption: in the FSR and IRR calculation, this was estimated to be 5.5% of total power generation. According to the Construction Implementation Plan[71] for the project, based on the actual equipment to be installed, auxiliary consumption will be 6.9% of power generation. On this basis, the value used in the IRR calculation is conservative.

Heat tariff and heat amounts: waste heat produced by the gen sets is captured by the waste heat recovery boilers. These boilers will provide heat (in the form of hot water) to buildings at the project site, thereby displacing steam produced by some of the existing coal fired boilers.

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[67] http://www.sxprice.gov.cn/sy/jgzc/20090205/092544.html

[68] http://www.3jjj.com/coal_new.asp?nid=383452&lid=44

[69] International Energy Agency, Coal Mine Methane in China, A Budding Asset with the Potential to Bloom, 2009 (p29) available at http://www.iea.org/textbase/papers/2009/china_cmm_report.pdf)

[70] http://www.jzwj.gov.cn/the_policy/shijuwenjian/2009-12-17/20091217842343166.htm

[71] Shanxi Taiyuan Coal Mine Design Institute

The proposed project proposes to install eight 1.68 tonne/ hour waste heat recovery boilers, meaning that the maximum amount of steam that could be produced is 13.44 tonnes/ hour and 96,768 tonnes each year (assuming operation hours of 7200 each year as the boilers will operate for the same number of hours as the gen sets).

According to the FSR, the hot water demand at the project site is 6.4MW. Hot water demand is therefore 23.04GJ per hour (where 1kWh = 3600kJ). Using an enthalpy of 2085kJ/kg[72], steam production = 23,040,000kJ/ 2085kJ/kg = 11.05 tonnes of steam each hour.

As explained above, the boilers will operate for 7200 hours each year. Therefore annual steam production = 7200 x 11.05 = 79,560 tonnes steam each year. (Note the slight difference between this figure and the FSR figure is due to rounding and makes no material difference to the calculation or result).

Even if the boilers operated at full capacity and produced 96,768 tonnes of steam each year, the IRR would be raised to just 4.52%, still below the benchmark for the proposed project.

The heat tariff used in the IRR calculation is taken from the FSR for the proposed project and is based on the cost of producing steam from burning coal mined by the coal mine. The calculation of the heat tariff is based on a coal production price of 272 RMB/tonne coal:

According to the China Energy Statistical Yearbook, the NCV of standard coal in China is 20.908 GJ/t coal. Using a coal production price of 272RMB/ tonne, this equates to 13RMB/ GJ coal. The standard enthalpy of saturated steam is 2756 kJ/kg[73], therefore the steam tariff is calculated to be 13 x 0.2756 = 35.8RMB/tonne steam.

As no coal has been produced at the mine for the last few years, the actual coal production price at Baiyangling mine is not known. However, the average coal production price for Shanxi province in 2008 was 198 RMB/tonne[74]. Also, it is likely that the coal production price in Baiyangling mine will be similar to that of other coal mines owned by the project owner. One such mine is Huangyanhui mine. At this mine, the coal production price is 171 RMB/tonne[75]. Further, in the calculation of heat price, it is assumed that the coal fired boiler is 100% efficient. On this basis, the value used in the IRR calculation above is conservative.

Loan – according to the FSR, the project would be funded with 35% equity and 65% loan. This split between debt and equity follows the guidelines laid out in "the Methodology and Parameters for Financial Evaluation of Construction projects (3rd Edition)" published by the Chinese government.

O&M costs: These are sub-divided into the following categories (Note that no fuel cost is used as the CMM was vented in the baseline scenario):

- Water cost – According to the FSR, 61,416 tonnes of water will be used each year at a cost of 1.7 RMB/m^3. Evidence from the local water supply company shows that the actual water price was 3.35RMB/m^3 so on this basis the value used here is conservative[76].

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[72] At 0.6MPa (absolute pressure), the specific enthalpy of steam is 2756 kJ/kg and the specific enthalpy of water is 671 kJ/kg (http://www.spiraxsarco.com/resources/steam-tables/saturated-steam.asp). Therefore to vaporise the water, the enthalpy is 2756-671 = 2085 kJ/kg

[73] ibid

[74] http://www.sxnem.gov.cn/view.asp?ArticleID=8883

[75] Raw coal production cost table of Xiyang Huangyanhui Coal Mine, 2008

[76] Xiyang County Water Supply Company

- Employee expenditure – this assumes a total of 26 employees at the plant with an annual salary of 30,000RMB. Employee benefits add an additional 14% to the total salary amount. According to the project owner, the actual salary will be at least 35,000RMB each year. On this basis, the value used here is conservative[77].
- Material fee (this refers to the engine oil needed to ensure smooth operation of the gen sets)– The value in the FSR is based on an oil price of 10,000 RMB/tonne and annual consumption of 31.1 tonnes pa. This oil price is based on a domestic brand[78]; the foreign brand that is likely to be needed for the imported engines is likely to be more expensive so on this basis, the value used in the IRR calculation is conservative.
- Repairs – according to the FSR, the annual repair fee is 5% of the construction investment. This value is confirmed by the government publication "Financial evaluation and analysis for FSR research and bank loan projects"[79]
- Other overhead expenditure – this is estimated to be 0.05RMB/kWh of gross power generated and totals 5.184 million RMB. This figure covers all expenditure incurred during the operation of the project including material costs (such as air filters, valves, oil filters, switches, bulbs and gaskets) and management costs (including labor union cost, office cost, training costs, travel costs, entertainment costs, cost of vehicle licenses, sewage treatment charge, insurance of assets, cost for legal advice, labour insurance, auditing charge).

Total O&M costs are 14.98 million RMB each year i.e. 8.8% of the total investment. Based on annual net power generation of 97,978MWh, unit O&M costs are 0.153RMB/kWh.

According to the Best Practice Guide on Effective Methane Drainage and Use in Coal Mines, recently published by UNECE and the M2M partnership[80]:

> *"O&M costs (all in) in terms of electricity produced average around US $0.02 to US $0.025/kilowatt hour (kWh) for the entire life cycle of the cogeneration plant (2008)"*

Based on 2008 exchange rates, this equates to 0.136 – 0.17RMB/kWh. The unit O&M costs for this project comfortably fit within this range and can therefore be considered reasonable.

To date, the project is not operational and therefore these estimated O&M costs cannot be compared with actual costs. However, actual O&M costs in this project are likely to be a little higher than those used in the FSR as prices in China are generally rising[81]. On this basis, the value used in the IRR calculation is conservative.

The rates used for income tax, VAT on electricity sales, education surcharge and construction surcharges were all standard rates in China at the time of writing the FSR.

The only relevant government subsidy for CMM to power projects operated by state owned enterprises is the "Notification on speeding up the establishment of a tax policy for CMM/CBM drainage" issued by

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[77] Xiyang Coal mine employer salary table

[78] http://www.52oil.com/article/2008/0327/article_3081.html

[79] China Publishing House, 2007

[80] UNECE and M2M Partnership, Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines, 2010 (p39). Available at http://www.unece.org/energy/se/pdfs/cmm/pub/BestPractGuide_MethDrain_es31.pdf.

[81] According to the China Statistical Yearbook, in 2004, 2005, 2006, 2007 and 2008, the national general growth rate of purchasing prices of raw materials, fuels and power was 11.4%, 8.3%, 6%, 4.4% and 10.5% respectively. Also in 2004, 2005, 2006, 2007 and 2008, the national total price indices of investment in fixed assets was 5.6%, 1.6%, 1.5%, 3.9% and 8.9% respectively. See http://www.stats.gov.cn/tjsj/ndsj/2009/indexeh.htm, tables 8-1 and 8-15

the Ministry of Finance and the State Administration of Taxation in February 2007. This states that a VAT refund should be used for CMM/CBM Utilisation projects.

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Anecdotally, it seems that this regulation is not enforced. Further, even if it were enforced, it is not applicable to the proposed project as, according to this regulation, a VAT refund could only be given when the CMM is sold to a separate company. This is not the case for this project and it is not therefore included in the IRR calculation for the project.

The IRR calculation therefore follows standard Chinese accounting procedures and includes all relevant tax exemptions and refunds.

In accordance with the benchmark analysis (Option III), if the financial indicators (such as the IRR) of the project are lower than the benchmark, the proposed project is not considered financially attractive. Based on the data above, without CERs sales revenues, the after-tax equity IRR of the project is lower than the benchmark (10%). Therefore, the project is not financially attractive.

With the CDM revenue, the IRR will be significantly improved, taking the after-tax equity IRR above the benchmark.

Table B.9. Financial indicators of the project

	After-tax equity IRR
Without CDM	4.03 %
With CDM	78.53%
Benchmark	10%

Sub-step 2d. Sensitivity analysis

For the project, the following financial parameters were considered in the sensitivity analysis:

- Investment in fixed assets
- Annual O&M cost
- Operation hours
- Electricity tariff

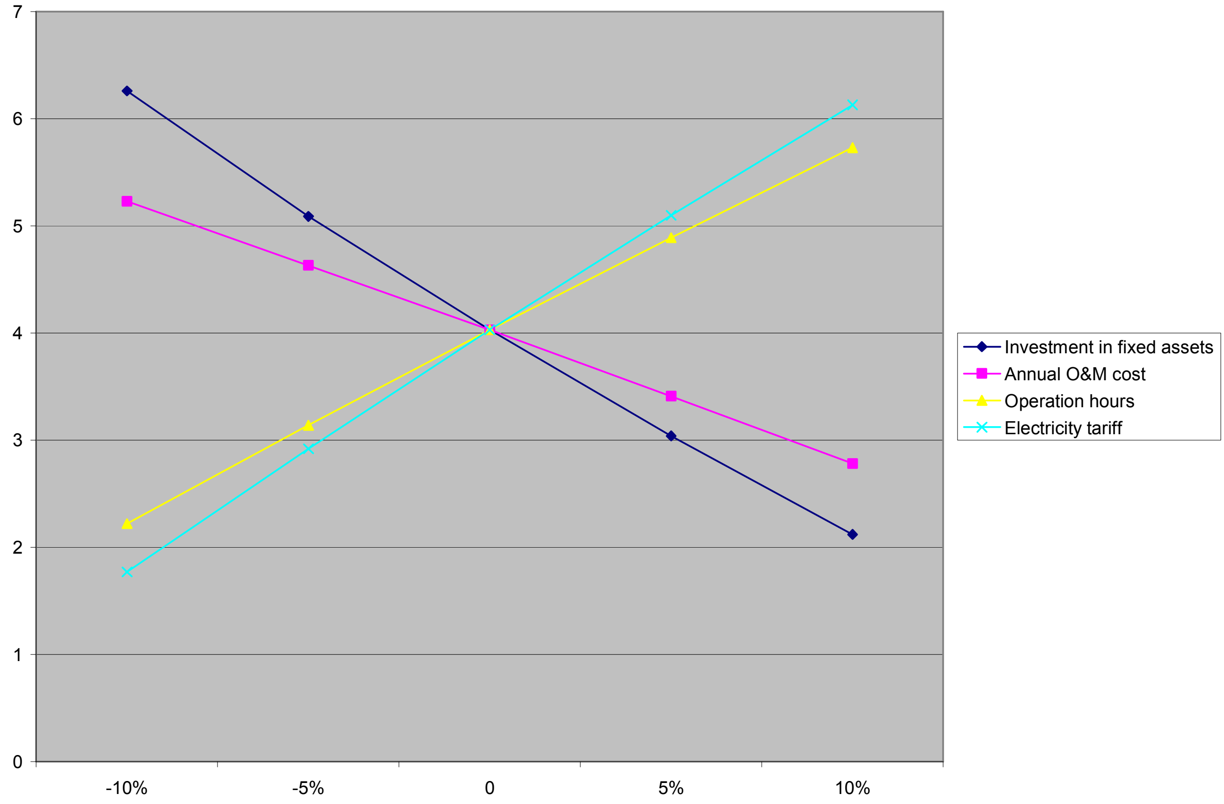
Note: 'heat tariff' is not included in the sensitivity analysis because this revenue from heat sales is <20% of total revenues and so does not need to be included according to EB41, annex 45.

The results of sensitivity analysis of the four indicators above are shown below.

Table B.10. Sensitivity analysis for the equity IRR, without CERs sales revenues

	-10%	-5%	0	5%	10%
Investment in fixed assets	6.26	5.09	4.03	3.04	2.12
Annual O&M cost	5.23	4.63	4.03	3.41	2.78
Operation hours	2.22	3.14	4.03	4.89	5.73
Electricity tariff	1.77	2.92	4.03	5.10	6.13

Figure B.3. Sensitivity analysis for the equity IRR, without CERs sales revenues



The analysis below shows at what point the IRR of the project will rise above the benchmark:

- For the total fixed asset investment, investment in fixed assets would need to decrease by 24% for the project to go over the benchmark. This scenario is extremely unlikely to happen as costs of this type (e.g. materials. equipment) have been increasing in China in recent years[82].

- For O&M costs, O&M costs would need to decrease by 52% for the project to go over the benchmark. Again, a decrease of this amount is not plausible, particularly during a period of price increases. Further, as explained above, a number of the parameters used in the IRR calculation for O&M costs are already conservative (e.g. employee expenditure and water price) so it is more plausible that actual O&M costs will be higher than those used in the IRR calculation, not lower.

- For operation hours, these would need to increase by 37% for the IRR to go over the benchmark. Operation hours used in the IRR calculation are 7200 and increase of 37% would be 9,864, more than the hours available in one year. This is therefore impossible.

- For electricity tariff, this would need to increase by 30% for the IRR to go over the benchmark. This corresponds to a tariff of 358RMB/MWh (inc. VAT) and is implausible for the following reasons:

    - In 2007, the National Development and Reform Commission of China published the “Implementing Opinions on Power Generation by Utilising CBM/CMM. This requires that grid companies purchase power produced by CMM/CBM to power projects and that

[82] According to the China Statistical Yearbook, in 2003, 2004, 2005 and 2006，the national general growth rate of purchasing prices of raw materials, fuels and power ,was 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 was 2.2% and 5.6%, and 1.6%, 1.3% respectively. See http://www.stats.gov.cn/tjsj/ndsj/2007/html/I0901e.htm, http://www.stats.gov.cn/tjsj/ndsj/2007/html/I0915e.htm and http://www.stats.gov.cn/tjsj/ndsj/2005/html/I0914e.htm

the on-grid tariff of CBM/CMM power shall be determined by reference to the biomass power tariff set out in the Trial Measures on the Administration of Pricing and Allocation of Expenses in relation to Electricity Generated using Renewable Energy, which comprised of the benchmark on-grid tariff of the provincial desulfurized coal-fired generators in the year of 2005 plus a subsidy tariff.

- In actual fact, there is little evidence to show that, in practice, this is being enforced. According to a recent study published in 2009, which was conduced by the International Energy Agency:

"The subsidies and priority grid access policies that were enacted in April 2007 are not being enforced. For instance, none of the interviewees for this study were aware of a project that has received the subsidy, suggesting that it has not been widely publicized or exercised."

- The actual tariff received by CMM to power projects in Shanxi province is generally close to the standard power tariff for grid connected coal fired power stations in Shanxi Province. At the time of writing the FSR, this was 275RMB/MWh (inc. VAT) and it is likely therefore that the proposed project will eventually receive a tariff that is similar to this. This value is therefore used in the FSR and IRR calculation above.
- Further, considering the tariff for grid connected coal fired power stations in Shanxi Province over the last few years we can see that the average annual increase is 4.28% (see table below). Therefore an increase of 35% is not plausible.

Year	Tariff (coal fired power plant inc FGD)	Reference	% increase
2004	250 RMB/MWh	http://www.cec.org.cn/news/content.asp?NewsID=28140	
2005	259 RMB/MWh	http://sx.people.com.cn/GB/channel10/200509/13/22041.html	3.6%
2006	275 RMB/MWh	Notice [1228] from the National Development and Reform Commission of China, 28 June 2006	6.2%
2007	275 RMB/MWh	www.ndrc.gov.cn/zcfb/zcfbtz/2008tongzhi/t20080702_222220.htm	0%
2008	295 RMB/MWh	www.ndrc.gov.cn/zcfb/zcfbtz/2008tongzhi/t20080702_222220.htm	7.3%

In conclusion, as shown in the sensitivity analysis, even when key parameters vary within a reasonable range, the IRR of the project will not reach the benchmark. In conclusion, the project is not financially attractive.

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 (available at http://www2.ergweb.com/cmm/index.aspx).
- The UNFCCC website showing details of registered CDM projects and CDM projects under development (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 .
- 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.

According to the Additionality tool, other CDM projects should not be included in the common practice analysis. The table below shows that all other CMM projects in Shanxi province are also applying for CDM finance and are therefore excluded from the analysis.

Table B.11 Information of Similar activity

NO.	Name of project	Installed Capacity	Domestic/ international technology	Notes
1	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
2	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
3	Shanxi Liulin Coal Mine Methane Utilization Project	12.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1183560834.33/view
4	Shanxi Yangcheng Coal Mine Methane Utilization Project, China	15.5	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1185280806.49/view
5	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
6	Shanxi Datuhe Coal Mine Methane Utilization Project	17.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1207732414.72/view
7	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
8	Duerping Coal Mine Methane Utilization Project	12.0	Not specified.	Applying for CDM. http://cdm.unfccc.int/Projects/DB/TUEV-SUED1214838535.8/view
9	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
10	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

11	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
12	Shanxi Fengtai Coal Mine Methane (CMM) Utilization Project	6.3	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/C18W3BCEGCLCIFALUA4JKSW3VYOBZG/view.html
13	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
14	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
15	Lanjin CMM Power Generation Project	33.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/506OKN4Y6CM2HPZT6BG0KI5IFKNK8Y/view.html
16	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
17	Duanwang CMM Power Generation Project	4.0	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/68F6RTI2LQCM9I7EXXSLT5VDGMM3JN/view.html
18	Yangquan CMM Power Generation Project	6.5	Domestic	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/S197RAQV3TLCG2W8PO491IKLT9YX6E/view.html
19	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
20	Malan Coal Mine Methane Utilisation Project	7.5	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/XRJQ3MEI95NHZ46CH4VA25EU0GE2CY/view.html
21	Tunlan Coal Mine Methane Utilization Project, Shanxi Province	34.8	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/B6HFFEUCK1EGVP1IN41O1ZV1RH0VDK/view.html
22	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
23	Shanxi Herui Coal Mine Methane Power Generation Project	45.0	International	Applying for CDM. http://cdm.unfccc.int/Projects/Validation/DB/UKLMN824TUIYJ8PEWAPX96273EQ01L/view.html
24	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
25	Qinxin CMM Power Generation Project	6	Domestic	http://cdm.unfccc.int/Projects/Validation/DB/G3Y1FU8B8VVW5V7WWZ6CSEAZT3RQBH/view.html
26	Qinshui Yong Changlong CMM Power Generation Project	9.8	Domestic	http://cdm.unfccc.int/UserManagement/FileStorage/OMG2R9SLA3ZENP8KBJDX0571TW6HIY

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

As demonstrated in sub-step 4a) above, all other similar projects in Shanxi province are also applying for CDM finance and are therefore excluded from the analysis. There are therefore no projects that are similar to the proposed project that have proceeded without the CDM. This further demonstrates the barriers that the project faces and that the project is additional.

In summary, the investment analysis above shows that the project is not financially attractive without additional revenue from the CDM. The common practice analysis above shows that no similar activities are observed.

The intention to register the project under the CDM was a determining factor in the decision to proceed with the project (see table B1) and it is therefore concluded that the project is not the baseline scenario, and is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The Approved consolidated methodology ACM0008 is applied in the context of the Project in the following four steps:

1. Determine the project emissions;
2. Determine the baseline emissions;
3. Determine the leakage;
4. Calculate the emission reductions.

1. Project Emissions

According to the Approved consolidated methodology ACM0008, the project emissions are defined by the following equation:

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM}$$

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.

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

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_2/MWh)
$CONS_{HEAT,PJ}$	Additional heat consumption for capture and use or destruction of methane, if any (GJ)
CEF_{HEAT}	Carbon emissions factor of heat used by coal mine (tCO_2e/GJ)
$CONS_{FossFuel,PJ}$	Additional fossil fuel consumption for capture and use or destruction of methane, if any (GJ)
$CEF_{FossFuel}$	Carbon emissions factor of fossil fuel used by coal mine (tCO_2/GJ)

No additional heat or fossil fuel will be used by the project, so $CONS_{HEAT,PJ}$ =0, and $CONS_{FossFuel,PJ}$ =0. Electricity consumed by Baiyangling Mine is supplied by the North China Power Grid , therefore the emission factor of electricity used by the coal mine is equal to the emission factor of the North China Power Grid. Additional electricity consumed by the project will be deducted from the power generated and the net power supplied to the NCPG will be monitored meaning that $CONS_{ELEC,PJ}$ =0. Therefore, PE_{ME} =0.

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

According to the Approved consolidated methodology ACM0008, if NMHC account for more than 1% by volume of the extracted coal mine gas, combustion emission from these gases should also be included.

$$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT} + MD_{GAS}) \times (CEF_{CH4} + r \times CEF_{NMHC})$$

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

Where[83]:

PE_{MD}	Project emissions from CMM/CBM destroyed (tCO_2e)
MD_{FL}	Methane destroyed through flaring (tCH_4)
MD_{OX}	Methane destroyed through flameless oxidation (tCH_4)
MD_{ELEC}	Methane destroyed through power generation (tCH_4)
MD_{HEAT}	Methane destroyed through heat generation (tCH_4)
MD_{GAS}	Methane destroyed after being supplied to gas grid or for vehicle use (tCH_4)
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 tCO_2/tCH_4)
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO_2/tNMHC)
r	Relative proportion of NMHC compared to methane
PC_{CH4}	Concentration (in mass) of methane in extracted gas (%), measured on wet basis
PC_{NMHC}	NMHC concentration (in mass) in extracted gas (%)

CMM will be destroyed through power generation. A flare will also be installed to destroy methane in the event that the gen sets are not in use. Since CMM is not destroyed through heat generation or after being supplied to gas grid or for vehicle use, the value of MD_{HEAT} and MD_{GAS} are zero and the formula above is simplified as

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

According to the Approved consolidated methodology ACM0008, methane destroyed through power generation is given as follows:

$$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC}$$

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 (99.5% according to ACM0008)

And methane destroyed through flaring is given as follows:

$MD_{FL} = MM_{FL} – (PE_{FL}/GWP_{CH4})$

Where:

[83] Note that throughout this baseline methodology, it is assumed that measured quantities of coal mine gas are converted to tonnes of methane using the measured methane concentration of the coal mine gas and the density of methane.

MD_{FL} = Methane destroyed through flaring (tCH_4)
MM_{FL} = Methane measured sent to the flare (tCH_4)
PE_{FL} = Project emissions of non-combusted CH_4, expressed in terms of CO_2e, from flaring of the residual gas stream (tCO_2e)
GWP_{CH4} = Global warming potential of methane (21 tCO_2e/tCH_4)

The project emissions of non-combusted CH_4, expressed in terms of CO_2e, from flaring of the residual gas stream (PE_{FL}) are calculated following the procedures described in the "Tool to determine project emissions from flaring gases containing methane", as described below.

For this project, an enclosed flare is used. According to the Tool, there are 2 options for determining the flare efficiency. In this case, option (a) is used i.e. a 90% default value is used. Continuous monitoring of compliance with the manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) will be performed. If in a specific hour any of the parameters are out of the limit of the manufacturer's specifications, a 50% default value for the flare efficiency will be used for the calculations for this specific hour.

STEP 1: Determination of the mass flow rate of the residual gas that is flared

As per the Tool, a simplified approach is adopted whereby, only the volumetric fraction of methane is measured and the difference to 100% is assumed to all be nitrogen (N_2). CMM flow rate and methane concentration in the CMM is measured in step 5.

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

This step is not necessary for the reasons described above.

STEP 3. Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is not applicable because the methane combustion efficiency of the flare is not continuously monitored.

STEP 4. Determination of methane mass flow rate in the exhaust gas on a dry basis

This step is not applicable because the methane combustion efficiency of the flare is not continuously monitored.

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$

Where:

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour h
$FV_{RG,h}$	m3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h
$fv_{CH4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour h (NB: this corresponds to $fv_{i,RG,h}$ where i refers to methane).
$\rho_{CH4,n}$	kg/m^3	Density of methane at normal conditions (0.716)

STEP 6. Determination of the hourly flare efficiency

In case of enclosed flares and use of the default value for the flare efficiency, the flare efficiency in the hour h ($\eta_{flare,h}$) is:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour h .
- 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.

STEP 7. Calculation of annual project emissions from flaring

$PE_{flare,y} = \Sigma^{8760}_{h=1} TM_{RG,h} \text{ x } (1-\eta_{flare,h}) \text{ x } (GWP_{CH4}/1000)$

Where:

Variable	SI Unit	Description
$PE_{flare,y}$	tCO2e	Project emissions from flaring of the residual gas stream in year y
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour h
$\eta_{flare,h}$	-	Flare efficiency in hour h
GWP_{CH4}	t_{CO2e}/t_{CH4}	Global Warming Potential of methane valid for the commitment Period

1.3 Un-combusted methane from project activity (PE_{UM})

Not all of the methane sent to the flare or used to generate power will be combusted, so a small amount will escape to the atmosphere. These emissions are calculated using the following:

$$PE_{UM} = \left[GWP_{CH4} \times \sum_i MM_i \times (1 - Eff_i) \right] + PE_{flare} + PE_{ox} \times GWP_{CH4}$$

Where:

PE_{UM} Project emissions from un-combusted methane (tCO_2e)

GWP_{CH4} Global warming potential of methane (21 tCO_2e/tCH_4)

i Use of methane (power generation, heat generation, supply to gas grid to various combustion end uses)

MM_i Methane measured sent to use *i* (tCH_4)

Eff_i Efficiency of methane destruction in use *i* (%)

PE_{flare} Project emissions of non-combusted CH_4 expressed in terms of CO_{2e} from flaring of the residual gas stream (tCO_2e)

PE_{OX} Project emissions of non oxidized CH_4 from flameless oxidation of the VAM stream (tCH_4)

Since CMM is only used for power generation in the Project, PE_{ox} =0, so the formula above is simplified to the following:

$$PE_{UM} = \left[GWP_{CH4} \times \sum_{i} MM_{i} \times (1 - Eff_{i}) \right] + PE_{flare}$$

2 Baseline Emissions

According to the Approved consolidated methodology ACM0008, baseline emissions are given by the following equation:

$$BE_{y} = BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$$

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 Methane destruction in the baseline ($BE_{MD,y}$ ***)***

Since there is no methane destruction prior to the implementation of the Project in Baiyangling Mine, methane destruction in the baseline is zero, i.e. $BE_{MD,y}$ =0.

2.2 Methane released into the atmosphere ($BE_{MR,y}$ ***)***

Methane emitted to the atmosphere in the baseline scenario is given by the following equation:

$$BE_{MRy} = GWP_{CH4} \times \left[\sum_{i} (CBMe_{i,y} - CBM_{BLi,y}) + \sum_{i} (CMM_{PJi,y} - CMM_{BLi,y}) + \sum_{i} (PMM_{PJi,y} - PMM_{BLi,y}) + \sum_{i} (VAM_{PJi,y} - VAM_{BLi,y}) \right]$$

Where:

BE_{MRy}	Baseline emissions from release of methane into the atmosphere in year *y* that is avoided by the project activity (tCO_2e)
i	Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
$CBMe_{i\,y}$	Eligible CBM captured, sent to and destroyed by use i in the project for year *y*(expressed in tCH_4)
$CBM_{BLi\,y}$	CBM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year *y* (expressed in tCH_4)
$CMM_{PJi\,y}$	Pre-mining CMM captured, sent to and destroyed by use *i* in the project activity in year *y* (expressed in tCH_4)
$CMM_{BLi\,y}$	Pre-mining CMM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in year *y* (expressed in tCH_4)
$PMM_{PJi\,y}$	Post-mining CMM captured, sent to and destroyed by use *i* in the project activity in year *y* (tCH_4)
$PMM_{BLi\,y}$	Post-mining CMM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in year *y* (tCH_4)
$VAM_{PJi\,y}$	VAM sent to and destroyed by use i in the project activity in year y (tCH_4). In the case

of catalytic flameless oxidation, $VAM_{PJ,i,y}$ is equivalent to MD_{OX} defined previously

$VAM_{BLi\,y}$ VAM that would have been captured, sent to and destroyed by use i in the baseline scenario in year *y* (tCH_4)

GWP_{CH4} Global warming potential of methane (21 tCO_2e/tCH_4)

For the project, CMM used in the project includes underground pre-mining CMM extraction, post-mining CMM extraction which would be released to atmosphere in baseline scenario. Since the project does not include utilisation or destruction of CBM and VAM, $CBMe_{i\,y}$,$CBM_{BLi\,y}$,$VAM_{PJi,y}$ and $VAM_{BLi,y}$ are zero.

Since there is no pre-mining or post-mining CMM destruction in the baseline scenario of the Project, $CMM_{BLi\,y}$ and $PMM_{BLi\,y}$ are zero. Finally, for this 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. These are therefore combined and referred to in the PDD as 'CMM'. Therefore, the equation above can be simplified as follows:

$$BE_{MR,y} = GWP_{CH4} \times (CMM_{PJ,y})$$

2.3 Emissions from power/heat generation and vehicle fuel replaced by project ($BE_{Use,y}$)

$$BE_{Use,y} = ED_{CBMw,y} + ED_{CBMz,y} + ED_{CPMM,y}$$

Where:

$BE_{Use,y}$ Total baseline emissions from the production of power or heat replaced by the project activity in year *y* (tCO_2)

$ED_{CBMw,y}$ Emissions from displacement of end uses by use of coal bed methane captured from wells where the mining area intersected the zone of influence in year *y* (tCO2)

$ED_{CBMz,y}$ Emissions from displacement of end uses by use of coal bed methane captured from wells where the mining area intersected the zone of influence prior to year *y* (tCO2)

$ED_{CPMM,y}$ Emissions from displacement of end uses by use of coal mine methane, VAM and post-mining methane (tCO_2)

Since there is no CBM used in the Project, $ED_{CBMw,y}$ =0, $ED_{CBMz,y}$ =0. Therefore, the formula above is simplified to the following:

$$BE_{Use,y} = ED_{CPMM,y}$$

According to Approved consolidated methodology ACM0008

$$ED_{CPMM,y} = \frac{CMM_{PJ,y} + PMM_{PJ,y} + VAM_{PJ,y}}{CBMM_{tot,y}} \times PBE_{Use,y}$$

Where:

$ED_{CMM,y}$ Emissions from displacement of end uses by use of coal mine methane and post-mining methane (tCO_2e)

$CMM_{PJ,\,y}$ Pre-mining CMM captured by the project activity in year *y* (tCH_4)

$PMM_{PJ,\,y}$ Post-mining CMM captured by the project activity in year *y* (tCH_4)

$VAM_{PJ\,,\,y}$ VAM captured by the project activity in year *y* (tCH_4)

$CBMM_{tot,,\,y}$ Total CBM CMM and VAM captured and utilised by the project activity in year *y*

	(tCH_4)
$PBE_{Use,y}$	Potential total baseline emissions from the production of power or heat replaced by the project activity in year *y* (tCO_2e)

The total methane captured during year y can be described as follows:

$$CBMM_{tot,y} = CBM_{w,y} + CBM_{z,y} + CBM_{x,y} + CMM_{PJ,y} + PMM_{PJ,y} + VAM_{PJ,y}$$

Where:

$CBMM_{tot,y}$	Total CBM, CMM and VAM captured and utilised by the project activity (tCH_4)
$CBM_{w,.y}$	CBM captured from wells where the mining area intersected the zone of influence in year *y* (tCH_4)
$CBM_{z,.y}$	CBM captured from wells where the mining area intersected the zone of influence prior to year *y* (tCH_4)
$CBM_{x,.y}$	CBM captured from wells where the mining area has not yet intersected the zone of influence in year *y* (tCH_4)
$CMM_{PJ,i,y}$	Pre-mining CMM captured by the project activity in year *y* (tCH_4)
$PMM_{PJ,y}$	Post-mining CMM captured by the project activity in year *y* (tCH_4)
$VAM_{PJ,y}$	VAM captured by the project activity year *y* (tCH_4)

Since there is no CBM or VAM utilization in the Project, so $CBMw,.y$=0, $CBMz,.y$=0, $CBMx,.y$=0 and $VAM_{PJ,y}$ =0. 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. These are therefore combined and referred to in the PDD as 'CMM'. Thus

$$CBMM_{tot,y} = CMM_{PJ,y}$$

Therefore, the following formula can be obtained

$$BE_{Use,y} = PBE_{use,y}$$

According to the Approved consolidated methodology ACM0008, total baseline emissions from the production of power or heat replaced by the project activity in year y ($PBE_{use,y}$) is given as follows:

$$PBE_{use,y} = GEN_y \times EF_{ELEC} + HEAT_y \times EF_{HEAT} + VFUEL_y \times EF_V$$

Where:

$PBE_{Use,y}$	Potential total baseline emissions from the production of power or heat replaced by the project activity in year *y* (tCO_2e)
GEN_y	Electricity generated by project activity in year *y* (MWh), including through the use of CBM
EF_{ELEC}	Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO_2/MWh)
$HEAT_y$	Heat generation by project activity in year *y* (GJ), including through the use of CBM
EF_{HEAT}	Emissions factor for heat production replaced by project activity (tCO_2/GJ)
$VFUEL_y$	Vehicle fuel provided by the project activity in year *y* (GJ), including through the use of CBM
EF_V	Emissions factor for vehicle operation replaced by project activity (tCO_2/GJ)

Since there is no vehicle fuel and heat displaced by the project activity, the formula above can be simplified to:

$$PBE_{use,y} = GEN_y \times EF_{ELEC}$$

Note: waste heat recovery boilers will be installed through the project to recover the waste heat from the gen sets. This will displace some existing coal fired boilers. However, no CERs will be claimed for this element of the project. Further, no heat will be produced and coal displaced by directly destroying CMM. Therefore, the equation above is valid.

Grid power emission factor (EF_{ELEC} ***)***

Electricity generated by the project will replace that provided by the North China Power Grid. According to the approved consolidated methodology ACM0008, the emission factor of grid electricity is calculated as per the *"Tool for calculation of emission factor for electricity systems"*.

Step 1. Identify the relevant electric power system.

For the purpose of determining the electricity emission factors, a **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

In China, the DNA has published a delineation of the project electricity system so this is used here. For the proposed project, the relevant electric power system is the North China Power Grid (NCPG). This is made up of 6 provinces (Beijing Municipality, Tianjin Municipality, Hebei Province, Shanxi Province, Shandong Province and Inner Mongolia Autonomous Region) according to published information by the China DNA[84]. Data is easily available from the China DNA, the annually published China Electric Power Yearbook and the annually published China Energy Statistical Yearbook.

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.

For this project, the Simple OM was calculated. This was the as only feasible option as:

a) Dispatch data analysis OM (recommended as the first choice option) cannot be calculated as hourly dispatch data for all power plants in the top 10% of the grid system dispatch order is not made publicly available in China;
b) Simple adjusted OM cannot be calculated for the same reason as above (unavailable data);
c) Average OM calculation is not appropriate as the low-cost/must-run resources constitute less than 50% of the total grid generation: of the total electricity generated by the North China Power Grid, low-cost/must run resources account for 0.86%，0.76%，0.75%，1.04% and 0.90% in 2003, 2004,

[84] http://cdm.ccchina.gov.cn/ (18 July 2008)

2005, 2006 and 2007 respectively of total electricity generated from 2003 to 2007 respectively, all less than 50%.

The OM is calculated ex ante i.e. calculated as a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without the requirement to monitor and recalculate the emissions factor during the crediting period.

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

In accordance with the tool, 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:

- Based on data on fuel consumption and net electricity generation of each power plant / unit (Option A), or
- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit (Option B), or
- 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 C)

Considering the data availability, option C was chosen. Option A cannot be used as fuel consumption data is not available for each power plant or unit in the NCPG. Option B cannot be used as the average efficiency of each power plant and the fuel used in each power plant is not known for the NCPG. Further, option C is applicable as nuclear and renewable power generation are considered as low-cost/ must-run power sources and the quantity of electricity supplied to the grid by these sources is known.

Where Option C is used, 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:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{co_2,i,y}}{EG_y}$$

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
y	=	Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

With reference to the Chinese DNA's calculation, the Simple OM emission factor ($EF_{OM,y}$) of the North China Power Grid is 1.0069 tCO_2e/MWh (see Annex 3 for details).

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

Project participants should use the set of power units that comprises the larger annual generation, so for this project, method (b) is chosen.

In terms of the vintage of the data, two options are given in the tool. In this case Option 1 is chosen: For the first crediting period, the build margin emission factor is calculated 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.

Considering data availability, CDM EB accepts the following deviation in the application of the methodology[85]:

1) Use of capacity additions during the last 1~3 years for estimating the build margin emission factor for grid electricity.
2) Use of weights estimated using installed capacity in place of annual electricity generation.

Step 6. Calculate the build margin emission factor

According to the tool, the build margin emission factor is the generation-weighted average emission factor (tCO2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

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

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

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

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

Following guidance issued by the CDM Executive Board in response to a request for guidance from an accredited DOE on the determination of the Build Margin in methodology AM0005 in China, $EF_{BM,y}$ is calculated as the capacity weighted average emissions factor of new installed capacity rather than the generation weighted factor. Furthermore, it is suggested in the same guidance note that the efficiency level of the best technology commercially available in the provincial/regional or national grid of China is used as a conservative proxy for each fuel type in estimating the fuel consumption when calculating the Build Margin. The suggested approach is followed in the determination of the Build Margin for the purposes of this project.

$$EF_{grid,BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m,y}}{\sum_{m} EG_{m,y}}$$

Therefore for the Project: firstly, calculate the share of different power generation technologies 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 commercially available technology in China.

Since installed capacities employing coal based, oil based and gas based power generation technologies cannot be separated in the current statistical data of thermal power installed capacity, BM is calculated with the following steps and formulae:

Sub-Step 6.1. Calculate the power generation emissions for solid, liquid and gas fuels and the share of each fuel in the total emissions based on the Energy Balance Table of the most recent year.

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}$$

where:

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by power plant j in year(s) y,

$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel i (tCO_2/mass or volume unit), taking into account the carbon content of the fuels used by power plant j and the percent oxidation of the fuel in year(s) y, and COAL, OIL and GAS are footnote group for solid fuels, liquid fuels and gas fuels.

Sub-Step 6.2 Calculate emission factor for thermal power of the grid based on the result of Step a and the efficiency level of the best technology commercially available in China.

$$EF_{Termal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y}$$

Where:

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

Sub-Step 6.3. Calculate BM of the grid based on the result of Step b and the share of thermal power in the recent 20% capacity additions.

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

Where

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

With reference to the *Notification on Determining Baseline Emission Factor of China's Grid*, the Build Margin emission factor ($EF_{BM,y}$) of the North China Power Grid is 0.7802 tCO_2e/MWh (see Annex 3 for details).

Step 7. Calculate the combined margin emissions factor

Based on the tool, the combined emission factor ($EF_{electricity,y}$) is calculated as the weighted average of the operating margin emission factor ($EF_{OM,y}$) and the build margin emission factor ($EF_{BM,y}$), as

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times \omega_{OM} + EF_{grid,BM,y} \times \omega_{BM}$$

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)
ω_{OM}	=	Weighting of operating margin emissions factor (%)
ω_{BM}	=	Weighting of build margin emissions factor (%)

According to the tool, the weight ω_{OM} and the weight ω_{BM} are both 0.5 for the Project. Therefore the combined baseline emission factor

$EF_{electricity,y}$ =0.5×1.0069+0.5×0.7802=0.8936 (tCO_2e/MWh).

3. Leakage

According to the Approved consolidated methodology ACM0008, the formula for leakage is given as follows

$$LE_y = LE_{d,y} + LE_{o,y}$$

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).

3.1 Displacement of baseline thermal energy uses

Since CMM were directly released to the atmosphere in the baseline scenario and was not used to satisfy thermal demands in the baseline scenario, $LE_{d,y}$ is zero.

3.2 CBM drainage from outside the de-stressed zone

Since no CBM are extracted through 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

CMM extraction is present in the baseline scenario therefore according to ACM0008, potential leakage from this source can be ignored.

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

Although this possibility exists in theory, reliable scientific information is hard to obtain now to evaluate this kind of risk and to determine whether this phenomenon can be neglected. Therefore, it is temporarily exempted from consideration[86].

Based on analysis described above, the leakage of the project is zero, i.e. LE_y =0.

4. Emission Reductions

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

$$ER_y = BE_y - PE_y - LE_y \tag{35}$$

Where:

ER_y emissions 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).

86 The Meth Panel recommends that the EB further investigate and monitor this issue after approving this methodology and considers to decide after 2~3 years of projects being implemented using this methodology, whether it should be revised to reflect price and market impacts.

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

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}, $EF_{BM,}$ EF_{OM} and constants used in equations in the "Tool to determine project emissions from flaring gases containing methane" (table 1)

Data / Parameter:	$\eta_{flare,h}$
Data unit:	--
Description:	Flare efficiency in hour h based on measurements or default values
Source of data used:	Methodological "Tool to determine project emissions from flaring gases containing methane"
Value applied:	90%
Justification of the choice of data or description of measurement methods and procedures actually applied :	For enclosed flares, use option a) to determine the flare efficiency in the proposed project. (a) To use a 90% default value. Continuous monitoring of compliance with manufactures specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufactures specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.
Any comment:	No further comments

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 year y
Source of data used:	*China Energy Statistical Yearbook*
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*
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*
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*
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:	$CAP_{i,j,y}$
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*
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*
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 available technology of fuel i
Source of data used:	China's DNA
Value applied:	See Annex 3
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:

1. Project emissions

Data type	ID number	Unit	Source	2010 (6 months)	2011	2012
Additional electricity consumption	$CONS_{ELEC,PJ}$	MWh	Calculated	0	0	0
Carbon emissions factor of electricity used by coal mine	CEF_{ELEC}	tCO_2e/ MWh	China DNA	0.8936	0.8936	0.8936
Emissions from energy to capture & destroy methane	**PE_{ME}**	**tCO_2e**	**Calculated (= CON**	0	0	0
Methane measured sent to power plant	MM_{ELEC}	tCH_4	Calculated	9,980	19,960	19,960
Efficiency of methane destruction/ oxidation in power plant	Eff_{ELEC}		ACM0008	99.50%	99.50%	99.50%
Methane destroyed through power generation	MD_{ELEC}	tCH_4	Calculated (= MM_{EL}	9,930	19,860	19,860
Methane sent to flare	MM_{FL}	tCH_4	Calculated	0	0	0
Methane destroyed through flare	MD_{FL}	tCH_4	Calculated (= MM_{FL}	0	0	0
Carbon emission factor for combusted methane	CEF_{CH4}	tCO_2e/ tCH_4	ACM0008	2.75	2.75	2.75
Project emissions from CMM/CBM destroyed	**PE_{MD}**	**tCO_2e**	**Calculated (= MD_{E}**	27,307	54,615	54,615
Project emissions from un-combusted methane sent to flare	PE_{flare}	tCO_2e	Calculated	0	0	0
Uncombusted methane sent to power plant		tCH_4	Calculated	50	100	100
Global warming potential of methane	GWP_{CH4}	tCO_2e/ tCH_4	ACM0008	21	21	21
Total project emissions from un-combusted methane (tCO_2e)	**PE_{UM}**	**tCO_2e**	**Calculated (= GWP**	1,048	2,096	2,096
Total project emissions	**PE**	**tCO_2e**	**Calculated**	**28,355**	**56,711**	**56,711**

2013	2014	2015	2016	2017	2018	2019	2020 (6 months)
0	0	0	0	0	0	0	0
0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936
0	0	0	0	0	0	0	0
19,960	19,960	19,960	19,960	19,960	19,960	19,960	9,980
99.50%	99.50%	99.50%	99.50%	99.50%	99.50%	99.50%	99.50%
19,860	19,860	19,860	19,860	19,860	19,860	19,860	9,930
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
54,615	54,615	54,615	54,615	54,615	54,615	54,615	27,307
0	0	0	0	0	0	0	0
100	100	100	100	100	100	100	50
21	21	21	21	21	21	21	21
2,096	2,096	2,096	2,096	2,096	2,096	2,096	1,048
56,711	**56,711**	**56,711**	**56,711**	**56,711**	**56,711**	**56,711**	**28,355**

2. Baseline emissions

Data type	ID number	Unit	Source	2010 (6 months	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 (6 months)
Baseline thermal demand	$\Sigma TH_{BL,k}$	tCH_4	Calculated	0	0	0	0	0	0	0	0	0	0	0
Carbon emission factor for combusted methane	CEF_{CH4}	tCO_2e/ tCH_4	ACM0008	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Methane destruction in the baseline	$\mathbf{BE_{MD,y}}$	$\mathbf{tCO_2e}$	**Calculated**	0	0	0	0	0	0	0	0	0	0	0
Global warming potential of methane	GWP_{CH4}	tCO_2e/ tCH_4	ACM0008	21	21	21	21	21	21	21	21	21	21	21
CMM captured, sent to and destroyed by the project activity	$CMM_{PJ,i,y}$	tCH_4	Calculated	9,980	19,960	19,960	19,960	19,960	19,960	19,960	19,960	19,960	19,960	9,980
CMM that would have been captured, sent to and destroyed in the baseline scenario	$CMM_{BL,i,y}$	tCH_4	Calculated	0	0	0	0	0	0	0	0	0	0	0
Baseline emissions from release of methane that is avoided by the project activity	$\mathbf{BE_{MR,y}}$	$\mathbf{tCO_2e}$	$\mathbf{_{J,i,y}}$ *** $\mathbf{GWP_{CH4}}$)**	209,578	419,155	419,155	419,155	419,155	419,155	419,155	419,155	419,155	419,155	209,578
Electricity generated by the project activity	GEN_y	MWh	Calculated	48,989	97,978	97,978	97,978	97,978	97,978	97,978	97,978	97,978	97,978	48,989
Emissions factor for Northeast China Grid	EF_{ELEC}	tCO_2/MWh	China DNA	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936	0.8936
Total baseline emissions from the production of power replaced by the project activity	$\mathbf{BE_{Use,y}}$	$\mathbf{tCO_2}$	**Calculated (=**	43,776	87,553	87,553	87,553	87,553	87,553	87,553	87,553	87,553	87,553	43,776
Baseline emissions	$\mathbf{BE_y}$	$\mathbf{tCO_2e}$	**Calculated**	**253,354**	**506,708**	**506,708**	**506,708**	**506,708**	**506,708**	**506,708**	**506,708**	**506,708**	**506,708**	**253,354**

3. Leakage

As discussed in section B6.1, leakage for this Project is zero.

4. Emission reductions

Data type	ID number	Unit	Source	2010 (6 months)	2011	2012
Baseline emissions	BE_y	tCO_2e	Calculated	253,354	506,708	506,708
Total project emissions	PE	tCO_2e	Calculated	28,355	56,711	56,711
Leakage	LE	tCO_2e	Calculated	0	0	0
Emissions reductions	ER	tCO_2e	Calculated	224,999	449,997	449,997

2013	2014	2015	2016	2017	2018	2019	2020 (6 months)
506,708	506,708	506,708	506,708	506,708	506,708	506,708	253,354
56,711	56,711	56,711	56,711	56,711	56,711	56,711	28,355
0	0	0	0	0	0	0	0
449,997	449,997	449,997	449,997	449,997	449,997	449,997	224,999

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

Years	Project Activity Emissions (tonnes of CO_2e)	Baseline Emissions (tonnes of CO_2e)	Leakage Emissions (tonnes of CO_2e)	Emission Reductions (tonnes of CO_2e)
2010 (01/07/2010 – 31/12/2010)	28,355	253,354	0	224,999
2011	56,711	506,708	0	449,997
2012	56,711	506,708	0	449,997
2013	56,711	506,708	0	449,997
2014	56,711	506,708	0	449,997
2015	56,711	506,708	0	449,997
2016	56,711	506,708	0	449,997
2017	56,711	506,708	0	449,997
2018	56,711	506,708	0	449,997
2019	56,711	506,708	0	449,997
2020 (01/01/2020 – 30/06/2020)	28,355	253,354	0	224,999
Total estimated reductions (tonnes of CO_2e)	**567,107**	**5,067,082**	**0**	**4,499,975**

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

B.7.1 Data and parameters monitored:

Note that meters to measure methane mass flow will be situated on the main methane supply to the engines and on the main methane supply to the flares. These meters will give the parameters MM_{ELEC} and MM_{flare} where:

$$MM_{ELEC} + MM_{flare} = CMM_{PJ} + PMM_{PJ}$$

It is not technically possible to measure pre-mining CMM and post-mining CMM separately as these are drawn out of each mine via a common drainage system for safety purposes and so no breakdown can be provided between them. These are therefore combined and referred to in the PDD as 'CMM'.

This approach does not therefore effect the overall CER calculation and, in fact, potentially leads to more accurate monitoring results as the calculations rely on fewer meter readings.

In light of this issue, at the 54th meeting of the EB, the EB instructed the Meth Panel to investigate this issue, in particular:

> *"the need for these parameters to be measured separately, taking into account practical implementation of such a way of measuring them and consider alternative approaches, if available"*

The meth panel recommended that the Board to approve a revision to the consolidated methodology ACM0008 to allow project proponents to measure the pre-mining CMM ($PMM_{PJ,y}$) together with the post-mining CMM ($CMM_{PJ,y}$). The Board accepted this revision and the PP shall submit a revision to the monitoring plan of the proposed project in line with the revised methodology before the first request for issuance.

Data / Parameter:	MM_{ELEC}
Data unit:	tCH_4
Description:	Methane measured 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 temperature, pressure, flow rate and methane concentration measured continuously with in-line flow meters and concentration meters, and recorded electronically. Further back-up using a conservative energy balance calculation based on total power output and manufacturer's maximum engine efficiency.
QA/QC procedures to be applied:	Meters are to be periodically calibrated according to the manufacturer's recommendations, or calibrated at least once each year.
Any comment:	No further comments.

Data / Parameter:	*GEN_y*
Data unit:	MWh
Description:	Net electricity generated by project activity and sent to the grid 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:	Continuously measured with meters and recorded per month.
QA/QC procedures to be applied:	Power meters will be calibrated by a qualified party at least once each year.
Any comment:	No further comments.

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:	Not applicable as NMHCs represent less than 1% by volume of the extracted coal mine gas.. Actual data are to be calculated annually if NMHCs represent more than 1% by volume of the extracted coal mine gas..
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:	No further comments.

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[87]. Actual data are to be measured annually.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	45%
Description of measurement methods and procedures to be applied:	For calculating r (relative proportion of NMHC compared to methane), methane concentration is obtained through annual analysis of bladder or container sample(s)
QA/QC procedures to be applied:	Bladder or container sample(s) to be tested by a qualified party.
Any comment:	No further comments.

[87] Environment and Energy Engineering College of Beijing Technology University, December 2008

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[88]. Actual data are to be measured annually
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0219%
Description of measurement methods and procedures to be applied:	To be obtained through annual analysis of bladder or container sample(s)
QA/QC procedures to be applied:	To be tested by a qualified party.
Any comment:	No further comments.

Data / Parameter:	MM_{flare}
Data unit:	t CH_4
Description:	Methane measured sent to flare.
Source of data to be used:	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 temperature, pressure, flow rate and methane concentration measured continuously with in-line flow meters and concentration meters, and recorded electronically.
QA/QC procedures to be applied:	Meters are to be periodically calibrated according to the manufacturer's recommendations, or calibrated at least once each year.
Any comment:	No further comments.

[88] ibid

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Source of data to be used:	Measurements using a flow meter
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:	The same basis (dry or wet) will be used for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ºC. Continuous monitoring. Values to be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendations, or calibrated at least once each year
Any comment:	This parameter is related to MM_{flare} above.

Data / Parameter:	T_{flare}
Data unit:	^oC
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measurements of exhaust gas temperature
Value of data applied for the purpose of calculating expected emission reductions in section B.5	>500 ^oC
Description of measurement methods and procedures to be applied:	The temperature of the exhaust gas stream in the flare will be continuously measured by a thermocouple. A temperature >500 ^oC indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year.
Any comment:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

B.7.2 Description of the monitoring plan:

This monitoring plan is a guideline for the project owner to monitor the emission reductions of the proposed and shown as below.

1. Management structure of monitoring plan

To monitor the project emission reductions, the project owner will set up a CDM Monitoring Office and designate 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 responsibility are outlined below.

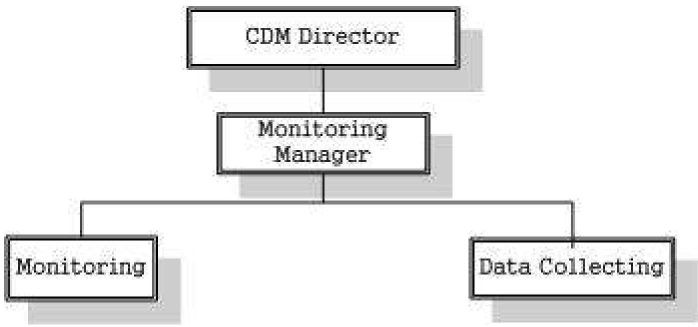


Figure B.3. Management Structure of Monitoring Plan

Table B.12 Responsibility of monitoring

Position	Responsibility
CDM Director	The CDM Director will be in charge of all CDM related matters, in particular communicating with DOEs, the CDM EB and the China DNA.
Monitoring manager	The Monitoring manager will be in charge of the implementation of the 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 Monitoring manager will calculate the emission reductions of the proposed project and develop reports with the support from Camco, as well as training the related monitoring staff.
Monitoring person	These team members will be in charge of the monitoring of meters and calibration, collecting data, as well as maintenance of equipment and preparing daily reports.
Data collection system	This will be used to collate, record and archive all the data related to methane destruction and power generation.

2. CDM Project Management & Calculations

Data to be monitored

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 and recorded on a continuous basis in order to measure methane mass flow. The accuracy of the flow and concentration meters accuracy will be at least 2.5%. The accuracy of the meters measuring pressure and temperature will be at least 1%.

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 using standard electricity meters with readings recorded manually. Electricity generation by the project (GENy) is measured net of plant auxiliary consumption. The accuracy of the power meters will be at least 0.5%.

Methane mass flow to the flare will be measured using a flow meter. The accuracy of the meters will be the same as that for methane mass flow to the gensets. The volumetric fraction of methane in this gas is the same as that sent to the power plants and so is not measured again here. The temperature of the exhaust gas stream in the flare will be continuously measured by a Type N thermocouple. From the temperature of the flare exhaust gas, the efficiency of the flare shall be determined according to the principles outlined in the "Tool to determine project emissions from flaring gases containing methane".

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.

Monitoring meters

Meters will be periodically calibrated according to the manufacturer's recommendations, or be calibrated at least once each year. All records will be kept by the project owner.

A maintenance plan for the project will be implemented according to the manufacture's requirements and relevant industry standards. As part of this, an internal audit will be performed periodically by the CDM team in which the operation of the whole system will be checked to ensure that all equipment is running as planned and that all meters are available and reliable. Details of the maintenance plan and schedule will be communicated to all staff involved in the operation of the project.

Recording of results and data collation

Methane flow, concentration, pressure and temperature will be recorded electronically and recorded on a continuous basis on a computer.

The readings of power meters will be recorded manually, at least once a day. Data will be aggregated in a spreadsheet monthly.

Emission reductions will be calculated periodically for verifications and for interim checks, as required using an Excel sheet and archived with backup to a storage medium.

3. Record Keeping, Error handling and Reporting Procedures

Record Keeping

Records will be paper or computer-based and any paper records transferred to computer files. All the records will be archived for at least 2 years after the end of the relevant crediting period or the last issuance of CERs, whichever occurs later. Hard copy data will be archived in a designated storage area.

Error handling procedure

Any errors found during data audits will be notified to the CDM. Specialists will be appointed to review the implications of the error and provide the necessary correction routines. The DOE will be notified of the error and of the proposed correction procedures.

Reporting Procedures

- Internal reporting - The CDM technical support team is responsible for reporting defects and corrective action to the CDM Director. The CDM Director will provide senior management with monthly progress, annual audit and monitoring reports

- External reporting - The CDM Director will circulate annual audit, monitoring and quarterly progress reports to the developer and buyers as required. The CDM Director will finish the monitoring report two weeks before periodic verification. The report will be in English and signed by the top management before submitting to the DOE.

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 baseline study and monitoring methodology of the Project was completed on 15/05/2009.

Name	Project Participant (Yes / No)
Xu Yong, Rachel Child and Li Na Camco Carbon Limited Floor 14, Lucky Tower A, No. 3 North Road, East 3rd Ring Road, Chaoyang District, Beijing, China 100027 Tel: (86 10) 8448 1623 Fax: (86 10) 8448 2432 Email:Lawrence.xu@camcoglobal.com Maggie.Li@camcoglobal.com Rachel Child@camcoglobal.com Website: www.camcoglobal.com	**Yes**

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

31/12/2009[89]

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

20yrs

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:

01/07/2010

C.2.2.2. Length:

10yrs

[89] Project start date is defined as the signature date of the engine purchase agreement, which is the earliest time in the project time schedule. This is estimated to be 31 December 2009.

SECTION D. Environmental impacts

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

The EIA was completed by Shangxi Nongchang Blue Sky Environment Science and Technology Co., Ltd., and approved by the Shanxi Environmental Protection Bureau in June 2008 (Document No. Jihuanhan[2008]463).

Based on the Environmental Impact Statement Form, the environmental impacts arising from the Project are summarised below.

Noise

Noise during the construction period is mainly from the vehicles and construction machines. Machines with high noise levels will be arranged to operate during day time only. Because of the distance of the site to the nearest residents and the mitigation measures adopted, the noise impacts will not be significant.

Noise during the operation period mainly comes from the gas engine generator sets. The noise value could be decreased by 20-25dB (A) with the adoption of sound insulation for the workshop and other noise damping measures. The noise value can meet standard II of the *Standard of Noise at the Boundary of Industrial Enterprises* (GB12348-90). There will not be significant impacts on the environment around the project from noise after the mitigation measures mentioned above have been adopted.

Air pollution and dust

Fugitive dust during the construction period will mainly be caused by digging earth at the project site. To avoid fugitive dust in the construction site, the project owner will sprinkle the site periodically with water and strengthen the sprinkling volume if the wind becomes heavier. Vehicles at the project site will move at a lower speed to reduce the dust. All the raw materials which could cause fugitive dust will be covered by canvas or transported by sealed vehicles during the transportation process. In addition, materials will not be piled up in the open air. Through these measures, fugitive dust will be reduced to a minimum.

The NOx emissions from the gas engines during the operation period are expected to be 75.3t/a with the emission performance standard value of 1.45g/kWh. This is lower than the requirement in GB17961-2005. The project activity will utilize clean CMM which was previously vented as a fuel to generate electricity. This will both reduce GHG emissions and improve the local air quality.

Waste water

Waste water during the construction period is mainly from the water used to sprinkle roads or ground. Due to the small amount of waste water generated, any negative impacts can be neglected.

Circulating cooling water and boiler drainage water used in the operation period will be drained into the water treatment station inside mining area, and then used as fire water without being discharged outside. Domestic waste water generated by workers in the coal mine will be drained into the domestic waste water treatment station inside of the mining area and then used to irrigate plants after reaching the required standard. In this way, there will be no negative impacts on the environment caused by the project in the operation period.

Solid waste

Since the quantity of earth excavated during the construction is equal to that backfilled, no solid waste will be generated by the construction of the project. Residential garbage generated during construction will be uniformly treated by the environmental sanitation agencies and thus will not have harmful impacts on the surrounding environment.

Residential garbage is expected to be 4.29t/a during the operation period and will be collected and then uniformly disposed of by the environmental sanitation agencies. So no harmful impacts on the environment will be caused by the operation of the project.

In summary, the project will not have significant impacts on the environment.

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 can help effectively reduce the emissions of air pollutants, and basically has no negative impact on the environment. Thus, it can be classified as an environment-friendly project.

SECTION E. Stakeholders' comments

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

To seek comments from stakeholders about the project, the project owner organised a stakeholder meeting on 17th November, 2008 at Baiyangling coal mine. 27 people participated the meeting, including official representatives, local residents, and workers from Baiyangling coal mine. During the meeting, the project owner introduced the CMM power generation project, including the technology that will be used and the process for applying for CDM. Local stakeholders were invited to complete questionnaires to collect their comments on the project.

E.2. Summary of the comments received:

In total, 25 out of 27 questionnaires were returned, giving a response rate of 92.5%. The basic details of the respondents are illustrated in Table E.1.

Table E.1 Structure of the respondents

Basic information	Classification	Number of respondents
Sex	Male	13
	Female	12
Age	younger than 18 years old	0
	between 18 to 35 years old	15
	between 36 to 55 years old	10
	older than 55 years old	0
Occupation	Workers	1
	Engineer	1
	Teacher and students	0
	Rural people	18
	Others	5
Education	under middle school	4
	middle school	14
	Diploma and above	7

The respondents are representative in terms of age, occupation and education, so their attitude towards the impacts of the project can therefore be seen as a comprehensive reflection of the attitudes of the residents possibly affected by the project. A summary of the 25 completed questionnaires is given in table E.2 below.

Table E.2 Outcome of the questionnaires

Question	Opinion	Person in number
Have you heard about "SDIC Xiyang Baiyangling CMM to Power Generation Project"?	Yes	25
	No	0
What pollution do you think may be caused by the construction of the project that	Air pollution	15

will seriously impact on the local environment?	Waste water	9
	Noise	11
	Solid waste	1
Are there any ecologically sensitive areas around the project?	Yes	0
	No	25
	Uncertain	0
Are there any socially sensitive areas around the project site?	Yes	0
	No	25
	Uncertain	0
Do you think the construction of the project will have a positive impact on the development of the local economy?	Yes	25
	No	0
	Uncertain	0
Do you think the construction of the project will improve the CMM utilization of other mines in local area?	Yes	25
	No	0
	Uncertain	0
Are you satisfied with the planned environmental protection measures for the project?	Yes	25
	No	0
	Uncertain	0
Do you agree with the construction of the project?	Accept	25
	Basically accept	0
	No	0

The outcome of the stakeholder consultation process shows that the construction of the project will benefit the local environment, the development of the local economy and create local employment. By participating in the meeting, all the participants had a better understanding of the project and its impact on the environment, economy and local community, and expressed their full support for the development of the project.

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

There were some concerns from stakeholders that the construction of the project would cause air and water pollution as well as noise and waste water. However, according to the EIA of the project, there will not be soot or SO_2 in the fumes from gas engines since all the combustion air will be filtrated before going into the gas engine and no H_2S or dust had been detected from CMM according to the CMM detection report.

The waste water from power generation will be sent into the water treatment station located inside of the Baiyangling coal mine and then used for spraying well. Sewage from daily living will be discharged into the sewage treatment to meet water quality standards and will be used for watering plant etc. There are no sensitive areas near the site of the project, therefore the operation of the project will not impact on the environment[90].

[90] EIA of Baiyangling CMM power generation project, page 19.

The construction of the project will meet all the relevant safety regulations and the related safety training will be carried out in both the construction period and operation period of the project. So this negative impact can be neglected.

Considering the full support from local stakeholders and the benefits brought by the project to the local economy, environment and society, there is no need to make adjustments to the design and implementation of the project. Meanwhile, the project owner expressed that they would take full advantage of the CDM opportunity to facilitate the development of the project and invited the local stakeholders to monitor the course of the construction and implementation of the project.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	SDIC Xiyang Energy Co., Ltd.
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E-Mail:	
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Represented by:	(Primary Signatory)
Title:	Mrs
Salutation:	Qualification Director
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Represented by:	(Secondary Signatory)
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Last name:	Urgel Esteban
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Personal e-mail:	Project.participant.cn@camcoglobal.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There are no public funds used in the proposed project.

Annex 3

BASELINE INFORMATION

According to the approved methodology ACM0002, the "tool to calculate the emission factor for an electricity system" and the document "*Chinese DNA's Notice on Baseline Emission Factor of Regional Power Grid 2009*", released at http://cdm.ccchina.gov.cn/ on 2nd July 2009, the $EF_{grid,CM,y}$, $EF_{grid,OM,y}$, and $EF_{grid,BM,y}$ of North China Power Grid (NCPG) could be calculated as following:

Step 3. Select an operating margin (OM) method

As shown in table 1, NCG is a coal-fired dominated power grid, where the installed capacity of low cost and must run plants account for 0.86%, 0.76%, 0.75%, 1.04% and 0.90% in 2003, 2004, 2005, 2006 and 2007 respectively, much lower than 50%. So method (a): Simple OM was chosen to calculate operating margin (OM).

Table 1 Electricity Generation of NCG (2003-2007)

Year	Electricity Generation (MWh)				Split of low-cost/must-run resources
	Hydro	Thermal	Others	Total	
2003	3,798,000	457,675,000	171,000	461,654,000	0.86%
2004	3,758,000	526,772,000	274,000	530,804,000	0.76%
2005	4,093,000	603,231,000	458,000	607,782,000	0.75%
2006	5,620,000	721,282,000	1,951,000	728,853,000	1.04%
2007	5,210,000	838,100,000	2,430,000	845,740,000	0.90%

Sources: China Electric Power Yearbook 2004-2008
China Energy Statistic Yearbook 2008

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

As said previously, Option (C) was chosen to calculate the Operating Margin Emission Factor ($EF_{grid,OM,y}$) as shown below:

Table 2 Electricity Generation of North China Grid in 2005

1. *Province name*	2. *Electricity generation of fuel-fired power plants（MWh）*	3. *Auxiliary power ratio（%）*	4. *Total Electricity Supplied to the Grid（MWh）*
5. *Beijing*	6. *20,880,000*	7. *7.73*	8. *19,265,976*
9. *Tianjin*	10. *36,993,000*	11. *6.63*	12. *34,540,364*
13. *Hebei*	14. *134,348,000*	15. *6.57*	16. *125,521,336*
17. *Shanxi*	18. *128,785,000*	19. *7.42*	20. *119,229,153*
21. *Inner Mongolia*	22. *92,345,000*	23. *7.01*	24. *85,871,616*
25. *Shandong*	26. *189,880,000*	27. *7.14*	28. *176,322,568*
29. ***Total***	30.	31.	32. *560,751,013*

Sources: China Electric Power Yearbook 2006

Table 3 Electricity Generation of North China Grid in 2006

33. *Province name*	34. *Electricity generation of fuel-fired power plants（MWh）*	35. *Auxiliary power ratio（%）*	36. *Total Electricity Supplied to the Grid（MWh）*
37. *Beijing*	38. *20,705,000*	39. *7.51*	40. *19,150,055*
41. *Tianjin*	42. *35,924,000*	43. *6.86*	44. *33,459,614*
45. *Hebei*	46. *143,888,000*	47. *6.63*	48. *134,348,226*
49. *Shanxi*	50. *150,250,000*	51. *7.45*	52. *139,056,375*
53. *Inner Mongolia*	54. *139,593,000*	55. *7.58*	56. *129,011,851*
57. *Shandong*	58. *230,922,000*	59. *7.12*	60. *214,480,354*
61. ***Total***	62.	63.	64. *669,506,473*

Sources: China Electric Power Yearbook 2007

Table 4 Electricity Generation of North China Grid in 2007

Province name	Electricity generation of fuel-fired power plants（MWh）	Auxiliary power ratio（%）	Total Electricity Supplied to the Grid（MWh）
Beijing	22,300,000	7.51	20,625,270
Tianjin	39,900,000	6.53	37,294,530
Hebei	163,300,000	6.67	152,407,890
Shanxi	173,400,000	7.99	159,545,340
Inner Mongolia	180,100,000	7.77	166,106,230
Shandong	259,100,000	7.23	240,367,070
Total			776,346,330

Sources: China Electric Power Yearbook 2008

Table 5 Calculating CO_2 Emission of North China Grid in 2005

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	CO_2 Emission（tCO_2e）
		A	**B**	**C**	**D**	**E**	**F**	**G=A+B+…+F**	**H=G*I*J*K/100000(mass) H=G*I*J*K/10000(volume)**
Raw Coal	10^4t	897.75	1,675.20	6,726.50	6,176.50	6,277.20	10,405.40	32,158.53	586,979,486
Cleaned coal	10^4t	0.00	0.00	0.00	0.00	0.00	42.18	42.18	970,069
Other Washed Coal	10^4t	6.57	0	167.45	373.65	0.00	108.69	656.36	4,792,018
Coke	10^4t	0.00	0.00	0.00	0.00	0.21	0.11	0.32	8,708
Coke Oven Gas	10^8m^3	0.64	0.75	0.62	21.08	0.39	0.00	23.48	1,464,870
Other Gas	10^8m^3	16.09	7.86	38.83	9.88	18.37	0.00	91.03	1,774,786
Crude Oil	10^4t	0.00	0.00	0.00	0.00	0.73	0.00	0.73	21,704
Gasoline	10^4t	0.00	0.00	0.01	0.00	0.00	0.00	0.01	291
Diesel Oil	10^4t	0.48	0.00	3.54	0.00	0.12	0.00	4.14	128,197
Fuel Oil	10^4t	12.25	0.00	0.23	0.00	0.06	0.00	12.54	395,901
LPG	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Refinery Gas	10^4t	0.00	0.00	9.02	0.00	0.00	0.00	9.02	200,231
Natural Gas	10^8m^3	0.28	0.08	0.00	2.76	0.00	0.00	3.12	659,553
Other Petroleum Products	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Other Coking Products	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Other Energy	10^4tce	8.58	0.00	32.35	69.31	7.27	118.90	236.41	0
Total									597,395,812

Sources: China Energy Statistical Yearbook 2006

Table 6 Calculating CO_2 Emission of North China Grid in 2006

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	CO2 Emission（tCO2e）
		A	B	C	D	E	F	G=A+B +…+F	H=G*I*J*K/100000(mass) H=G*I*J*K/10000(volume)
Raw Coal	104t	796.63	1639.2	6867.99	6968.88	8404.05	10930.66	35607.41	649,930,803
Cleaned coal	104t	0.00	0.00	0.00	0.00	0.00	39.77	39.77	914,643
Other Washed Coal	104t	6.36	0.00	214.13	371.14	61.77	544.6	1198	8,746,477
Briquettes	104t	7.97	0.00	0.00	0.00	0.00	27.77	35.74	652,351
Coke	104t	0.00	0.00	0.00	0.00	0.00	3.23	3.23	87,896
Coke Oven Gas	108m3	0.38	0.63	5.8	22.32	0.64	5.79	35.56	2,218,517
Other Gas	108m3	20.66	6.58	69.72	13.79	22.76	7.22	140.73	2,743,772
Crude Oil	104t	0.00	0.00	0.00	0.00	0.74	0.00	0.74	22,001
Gasoline	104t	0.00	0.00	0.01	0.00	0.00	0.00	0.01	291
Diesel Oil	104t	0.21	0.00	3.01	0.00	0.07	6.32	9.61	297,577
Fuel Oil	104t	6.38	0.00	0.08	0.00	0.00	4.1	10.56	333,391
LPG	104t	0.00	0.00	0.00	0.00	0.00	0.01	0.01	309
Refinery Gas	104t	0.00	0.00	2.43	0.00	0.00	2.32	4.75	105,443
Natural Gas	108m3	3.41	0.73	0.00	0.53	0.00	0.00	4.67	987,216

Other Petroleum Products	104t	0.00	0.00	0.00	0.00	0.00	0.28	0.28	8,840
Other Coking Products	104t	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Other Energy	104tce	6.83	0.00	47.11	230.76	12.51	132.29	429.5	0
Total									667,049,525

Sources: China Energy Statistical Yearbook 2007

Table 7 Calculating CO_2 Emission of North China Grid in 2007

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	CO2 Emission （tCO2e）
		A	B	C	D	E	F	G=A+B+…+F	H=G*I*J*K/100000(mass) H=G*I*J*K/10000(volume)
Raw Coal	104t	816.17	1,753.99	7,716.13	7,510.06	10,434.25	11,884.83	40,115.43	732,214,267
Cleaned coal	104t	0.00	0.00	0.00	0.00	0.00	18.43	18.43	423,859
Other Washed Coal	104t	5.76	0.00	156.89	478.81	48.57	756.84	1,446.87	10,563,452
Briquettes	104t	7.93	0.00	0.00	0.00	0.00	42.86	50.79	927,054
Coke	104t	0.00	0.00	0.02	0.00	0.00	4.09	4.11	111,843
Coke Oven Gas	108m3	0.07	0.72	3.13	25.46	2.58	13.61	45.57	2,843,020
Other Gas	108m3	11.80	7.60	88.38	72.80	28.17	29.64	238.39	4,647,821
Crude Oil	104t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Gasoline	104t	0.00	0.00	0.01	0.00	0.00	0.00	0.01	291
Diesel Oil	104t	0.33	0.00	2.35	0.00	0.62	5.08	8.38	259,490
Fuel Oil	104t	4.74	0.00	0.18	0.00	0.00	2.35	7.27	229,522

LPG	104t		0.00	0.00	0.00	0.00	0.00	0.00	0
Refinery Gas	104t	0.06	0.00	2.85	0.00	0.00	1.65	4.56	101,225
Natural Gas	108m3	5.03	0.73	0.00	0.54	4.22	0.01	10.53	2,225,993
Other Petroleum Products	104t	1.72	0.00	0.00	0.00	0.00	0.00	1.72	54,302
Other Coking Products	104t	4.74	0.00	0.00	0.00	0.00	0.00	4.74	128,986
Other Energy	104tce	11.94	0.00	77.25	360.26	30.75	163.48	643.68	0
Total									754.731,124

Sources: China Energy Statistical Yearbook 2008

Therefore, $EF_{grid,OM,simple}$ **= 1.0069 tCO2e/MWh**

Step 6. Calculate the build margin emission factor

The Emission Factor, Oxidation, Average Low Caloric Value applied in the calculation of the Operating Margin and Build Margin emission factor are listed in table 8.

Table 8 Related Parameters

Fuel	Oxidation I[1]	Average Low Caloric Value J[2]	Emission Factor(kgCO_2/TJ)[3]
Raw Coal	100	20,908 KJ/kg	87,300
Cleaned Coal	100	26,344 KJ/kg	87,300
Briquettes	100	20,908 KJ/kg	87,300
Other Washed Coal	100	8,363 KJ/kg	87,300
Coke	100	28,435 KJ/kg	95,700
Crude Oil	100	41,816 KJ/kg	71,100
Gasoline	100	43,070 KJ/kg	67,500
Diesel Oil	100	42,652 KJ/kg	72,600
Fuel Oil	100	41,816 KJ/kg	75,500
Other Petroleum	100	41,816 KJ/kg	75,500

LPG	100	50,179 KJ/kg	61,600
Refinery Gas	100	46,055 KJ/kg	48,200
Natural Gas	100	38,931 MJ/km^3	54,300
Other Petroleum Products	100	41,816 KJ/kg	75,500
Other Coking Products	100	28,435 KJ/kg	95,700

Source: 1,2,3 China Energy Statistical Yearbook 2008，Page 283

Sub-step 1. Calculating the percentages of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total fuel-fired CO_2 emissions.

Table 9 The percentages of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total fuel-fired CO_2 emissions

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Subtotal	CO_2 Emission （tCO_2e）
		A	**B**	**C**	**D**	**E**	**F**	**G=A+…+F**	**L=G*H*I*J/100000**
Raw Coal	10^4 t	816.17	1,753.9 9	7,716.1 3	7,510.06	11,884.83	10,434.2 5	40115.43	732,214,267
Cleaned Coal	10^4 t	0.00	0.00	0.00	0.00	18.43	0.00	18.43	423,859
Other Washed Coal	10^4 t	5.76	0.00	156.89	478.81	756.84	48.57	1446.87	1,056,3452
Briquettes	10^4 t	7.93	0.00	0.00	0.00	42.86	0.00	50.79	927,054
Coke	10^4 t	0.00	0.00	0.02	0.00	4.09	0.00	4.11	111,843
Other Coking Products	10^4 t	4.74	0.00	0.00	0.00	0.00	0.00	4.74	128,986
Subtotal									**744,369,461**
Crude Oil	10^4 t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Gasoline	10^4 t	0.00	0.00	0.01	0.00	0.00	0.00	0.01	291
Diesel Oil	10^4 t	0.33	0.00	2.35	0.00	5.08	0.62	8.38	259,490
Fuel Oil	10^4 t	4.74	0.00	0.18	0.00	2.35	0.00	7.27	229,522
Other Petroleum Products	10^4 t	1.72	0.00	0.00	0.00	0.00	0.00	1.72	54,302

Subtotal									**543,604**
Natural Gas	10^7m^3	50.3	7.3	0	5.4	0.1	42.2	105.3	2,225,993
Coke Oven Gas	10^7m^3	0.7	7.2	31.3	254.6	136.1	25.8	455.7	2,843,020
Other Gas	10^7m^3	118	76	883.8	728	296.4	281.7	2383.9	4,647,821
LPG	10^4 t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Refinery Gas	10^4 t	0.06	0.00	2.85	0.00	1.65	0.00	4.56	101,225
Subtotal									**9,818,059**
Total									**754,731,124**

Sources: China Energy Statistical Yearbook 2008

The result from the above table: $\lambda_{Coal,y}$ **= 98.63%**, $\lambda_{Oil,y}$ **= 0.07%**, $\lambda_{Gas,y}$ **= 1.30%**

Sub-step 2. Calculating the fuel-fired emission factor

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

Where:
$EF_{Thermal}$ is the fuel-fired emission factor;
$EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ are corresponding to the emission factors of coal, oil and gas fired power plants which are applied by the most advanced commercialized technologies.

According to the announcement "China's Regional Grid Baseline Emission Factors Renewed", the weighted average of coal consumption per kWh supplied of 30 new built 600 MW sub critical units in 2007 is adopted to determine the emission factor of the best advanced coal fired generation technology, which is 322.5 gce/kWh. In other word, the efficiency of best advanced coal fired generation technology is 38.10%.

The maximum electricity supplied efficiency of oil and gas fired generation plants are regarded as approximate estimation of commercially optimal efficiency technology. Similarly, the fuel consumption per kWh supplied of best advanced oil and gas fired generation technology is determined to be 246 gce/kWh, which means a generation efficiency of 49.99% .these data were show as below:

Table 10 Emission factors of Coal, Oil and Gas with the most advanced commercialized technologies applied by the fuel-fired power plants

	Parameters	Fuel consumption rate	Fuel Emission Factor(kgCO_2/TJ)	Oxidation	Emission Factor（tCO_2/MWh）
		A	B	C	D=3.6/A/1000000*B*C
Coal-fired plant	$EF_{Coal,Adv}$	38.10%	87300	1	0.8249
Gas-fired plant	$EF_{Oil,Adv}$	49.99%	75500	1	0.5437
Oil-fired plant	$EF_{Gas,Adv}$	49.99%	54300	1	0.3910

Sources: The Baseline Emission Factors of Chinese Power Grids, NDRC.

Then, calculating
$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y}$ = 0.8191tCO_2/MWh

Sub-step 3. Calculating the Build Margin Emission Factor.

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

Where:
$EF_{BM,y}$ = the Build Margin emission factor with advanced commercialized technologies for year y;
CAP_{Total} = the new capacity additions;
$CAP_{Thermal}$ = the new fuel-fired capacity additions.

Table 11 Installed Capacities of the North China Grid 2007

Installed Capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Fuel-fired	MW	3,900	6,920	29,020	30,950	39,870	54,140	164,800
Hydro	MW	1,050	10	780	790	830	1,050	4,510
Nuclear	MW	0	0	0	0	0	0	0
Wind&Others	MW	3	0	410	0	1,097	210	1,719
Total	MW	4,953	6,930	30,210	31,740	41,797	55,400	171,029

Sources：China Electric Power Yearbook 2008

Table 12 Installed Capacities of the North China Grid 2006

Installed Capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Fuel-fired	MW	3,984	6,512	26,087	26,661	28,899	49,395	141,538
Hydro	MW	1,053	5	785	790	818	553	4,004
Nuclear	MW	0	0	0	0	0	0	0

Wind & Others	MW	24	24	218	0	565	106	937
Total	MW	5,061	6,541	27,090	27,451	30,282	50,054	146,479

Sources：China Electric Power Yearbook 2007

Table 13 Installed Capacities of the North China Grid 2005

Installed Capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Fuel-fired	MW	3,834	6,150	22,333	22,247	19,173	37,332	111,069
Hydro	MW	1,025	5	785	783	568	51	3,216
Nuclear	MW	0	0	0	0	0	0	0
Wind & Others	MW	24	24	48	0	209	31	336
Total	MW	4,883	6,179	23,166	23,030	19,950	37,413	114,620

Sources：China Electric Power Yearbook 2006

Table 14 Change Installed Capacity from 2005-2007

	Year 2005	Year 2006	Year 2007	2005-2007 New Capacity	Percentage of New Capacity Additions
	A			D=C-A	
Fuel-fired (MW)	111,069	141,538	164,800	53,731	95.25%
Hydro (MW)	3,216	4,004	4,510	1,294	2.29%
Nuclear (MW)	0	0	0	0	0.00%
Wind(MW)	336	937	1,719	1,384	2.45%

Total	114,620	146,479	171,029	56,409	100.00%
Percentage of Year 2007	67.02%	85.65%	100.00%		

Then, the result is $EF_{BM,y} = EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal}$

= 0.8190 × 95.25% **= 0.7802 tCO_2/MWh**

Step 7. calculate the combined margin Emission Factor (EF_y)

$EF_{grid,CM,y}$= 0.5×$EF_{grid,OM,y}$+ 0.5×$EF_{grid,BM,y}$= 0.5 × 1.0069 + 0.5 × 0.7802 = **0.8936tCO_2/MWh**

Annex 4

MONITORING INFORMATION

Monitoring compliance with the Emission Standard of CBM/CMM (on trial) GB21522-2008

According to the above Standard, from 1 January 2010, it will be forbidden to vent CMM with a concentration of >30% in China.

First of all, this standard is the national policy for CMM emissions of China, which can give comparative advantages to less emissions-intensive technologies, such as CMM utilization technologies. Therefore, according to items 10-12 of Draft decision -/CMP.5 Further guidance relating to the clean development mechanism, the latest EB guidance will be applied for this project during the crediting period.

If there is no guidance from EB, when the project is on verification, this regulation will be monitored.

According to ACM008, if “based on an examination of current practice in the country or region in which the laws or regulation applies, those applicable legal or regulatory requirement are systematically not enforced and that non-compliance with those requirements is widespread in the country”, then it need not be considered in the baseline selection analysis.

As the regulation for existing coal mines has not yet come into force, no evidence exists as to the level of enforcement and compliance amongst mine owners. However, to ensure that the baseline selected is still valid throughout the crediting period of the project, implementation of the standard will be monitored and, following this, compliance with the standard will be monitored throughout the crediting period of the project.

An annual report will be compiled showing the level of compliance with the Standard in Shanxi Province. If (excluding registered CDM projects) the level of compliance is <50%, it shall be considered that the Standard is not systematically enforced and that non-compliance is widespread. This would mean therefore that the baseline scenario selected in the PDD remains the correct baseline scenario for the project.

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