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:

>>

Wujia coalmine power generation project

Version 01	19/07/2010	Original version
Version 02	16/03/2011	Revised according to CARs and CLs
Version 03	27/05/2011	Revised according to the CLs
Version 04	26/04/2012	Revised according TR
Version 05	9/09/2012	Revised according to UN incompleteness notification
Version 06	21/12/2012	Revisions following requesting for review

A.2. Description of the project activity:

>>

The Wujia coalmine power generation project will capture and utilize coalmine methane (CMM) from the Wujia coal mine for electricity generation (hereafter referred to as "the project"). The project is located in Jincheng City, Shanxi Province, China. Jincheng Runhong New Energy Power Co., Ltd (the "project owner") will construct the power stations required for power generation from CMM drained at the Wujia coal mine. Jincheng Runhong New Energy Power Co., Ltd is a private company (independent from the coal mine) established for the implementation of the CMM utilization project. The designed capacity of Wujia Coal Mine is 0.9 million tons per year. Wujia Coal Mine is a gassy coalmine with total gas emissions of 10.36m^3 of methane per tonne of coal mined. The average concentration of CMM drained from Wujia drainage station is 35%. It is estimated that the CMM (35% concentration) drained in one year will reach 99.864 million m^3. According to the drainage capability of Wujia CMM drainage station, twenty 500KW generator units will be installed with a total capacity of 10MW[1]. This capacity is estimated to use approximately 54.86 million m^3 CMM (35% concentration) per year[2]. Since both Wujia Coalmine and the proposed project are still under construction, the original design of 15 MW power generation capacity on the draft FSR[3] was revised to 10MW in order to avoid possible shortfall between the estimated amount and the actual amount of CMM from Wujia Coalmine.

In the absence of the project, all CMM would be directly released into the atmosphere causing not only a waste of resources but also serious air pollution. The project will utilize this otherwise wasted CMM to produce electricity to be exported to the power grid. The project only includes CMM. It does not include coal bed methane (CBM). The electricity generated from the proposed project will be supplied to the Shanxi Provincial Power Grid; which constitutes a part of the North China Power Grid.

The project activity comprises of a number of stages, including; the installation of equipments allowing the gas collection, pre-treatment, installing the generator set system and linking to the grid connection system.

---

[1] Wujia FSR approved version (10MW) made by Jincheng City Engineering Consulting Centre in April 2009 and Wujia (10MW) FSR Approval issued by by ShanXi Province NDRC (file number (2009) 1368) on 9th Sep 2009

[2] As detailed on p.8 of the FSR the exact estimated amount of CMM usage is 54,857,142 m^3 CMM per year. As this is only an estimate and for simplicity, the drainage figure maybe be given as 54.86 million m^3 elsewhere the PDD.

[3] Wujia FSR draft (15MW) made by Jincheng City Engineering Consulting Centre in April 2009

The project mitigates greenhouse gas emissions via the combustion of CMM, preventing its release directly into the atmosphere. Furthermore, its combustion enables electricity generation, which will partially displace electricity generated by the fossil-fuelled power plants supplying the North China Power Grid. It is estimated the annual power generated will reach 57,600MWh. When operating at full capacity the project will reduce emissions by 278,718 t CO_2e each year. However, due to a period of trial operation in the first year, the project's average annual emissions reductions over the crediting period are estimated to be 273,144 t CO_2e.

The project will contribute to sustainable development in a number of ways:
- Significantly reducing the emissions of CH_4 from mining activates and avoids the CO_2 emissions created from coal fired electricity purchased from the Grid;
- Reducing NO_x and SO_2 emissions, which are often accompanied with coal-fired power generation. As a result, the local air quality will be improved
- Energy can be used more economically, which will promote the development of mine resource utilization technologies
- Contribute to the safety of coal mine operation;
- Provide working opportunities to local residents.

A.3. Project participants:

>>

Name of Party Involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (host)	Jincheng Runhong New Energy Power Co., Ltd. (The PP title for public webhosting: Jincheng Runhong coal mine methane power Co., Ltd.)	No
United Kingdom of Great Britain and Northern Ireland	Originate Carbon Ltd	No

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:

>>

Qinchi Town, Yangcheng County, Jincheng 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 in Qinchizhen Town, Yangcheng County, Jincheng City of Shanxi Province. Its geographic coordinates are: 35°38’57’’ North and 112°17’33’’ East. The location of the project is in the Wujia Coal Mine. The project site is close to Wujia CMM drainage station. The specific location of the project is defined in the following figure.

Figure A.4-1 Map showing the location of the project activity

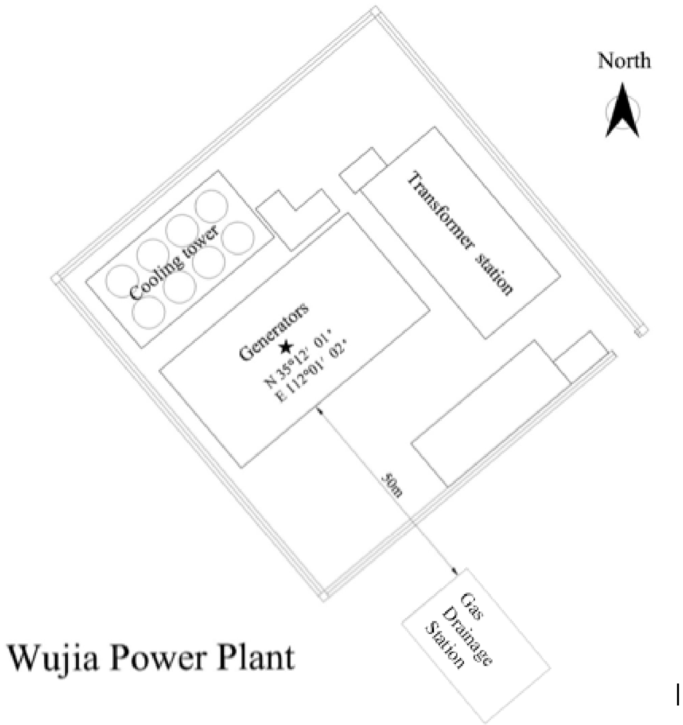


Figure A.4-2 Figure showing the location of the gas drainage station

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

>>
Sectoral Category 8: Mining and mineral production
Sectoral Category 10: Fugitive emissions from fuels (solid, oil and gas)

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

>>
This project involves gas pre-treatment equipment, generation station, power distribution system as well as relevant monitoring meters. Detailed information is as follow. Gas pre-treatment equipment involves dust filters and a gas/water separator that does not demand electric power.

Generator sets:
The model of the machine is scheduled to be 500GF-WK2 from Jichai. The capacity for a single machine is 500KW. The equipment, technology adopt are advanced, mature and reliable, and have been successfully applied in other power generation CDM projects.

Technical parameters of the generator sets are shown in Table A.4-1.

Table A.4-1. Technology specifications of the generator sets

Items	Parameter
Generator sets model	500GF-WK2
A. Gas engine	
Model	G12V190ZLW d2-2
Rated power	500KW
Rotate speed	1000r/min
B. Generators	
Model	1FC6 455-6LA42
Type	Brushless excitation
Rated power	500KW
Output voltage	400V
Rated frequency	50Hz
Power factor	0.8(lagging)
Rated rotational speed	1000rpm
Renewal period (main equipment lifetime[4])	10 years

All equipments are made in China; hence no technology transfer occurs in the project.

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

>>
Fixed crediting period (10yrs) is selected for the project activity. The estimated emission reductions of the project activity will be 2,731,436 tCO_2e in the 10-year crediting period.

Years	**Estimation of annual emission reductions in tonnes of CO_2e**
1/12/2012 - 31/12/2012	18,581
2013	227,620
2014	278,718
2015	278,718
2016	278,718
2017	278,718
2018	278,718
2019	278,718
2020	278,718
2021	278,718
1/1/2022 - 30/11/2022	255,492
Total estimated reductions (tonnes of CO_2e)	**2,731,436***
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**273,144**

*As decimals are not provided for in tables in the PDD template, the entries in each row have been rounded to the nearest whole. The summation figures for the total estimated reductions in the table above is correct as per the ER calculation spreadsheet. Refer to the ER calculation sheet for detailed calculation.

A.4.5. Public funding of the project activity:

[4] "Generator lifetime statement" issued by the manufacturer

>>
No public funding from Annex I party has been used by this project activity.

SECTION B. Application of a baseline and monitoring methodology

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

>>
This project will make use of Version 7 of the ACM0008, "Consolidated baseline 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".
The monitoring plan is established based on monitoring methodology ACM0008 (Ver. 7), "Consolidated baseline 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".

This project will additionally refer to the" Tool for calculation of emission factor for electricity systems" (Ver. 2.2.1); "Tool for the Demonstration and Assessment of Additionality" (ver. 06.0).

For more information regarding the methodologies, please refer to:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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

>>
The project activity fulfills the applicability criteria for the use of this methodology, the reasons are as follows:

Table B.2-1 Comparison between CMM drainage activities and the applicability of ACM0008

ACM0008 Applicability	This project
Surface drainage wells to capture CBM associated with mining activities	Not included
Operate in open cast mines	Not included
Underground boreholes in the mine to capture pre-mining activities	Included
Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM.	Underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM.
Ventilation air methane that would normally be vented.	Not included

Table B.2-2 Comparison of this project with ACM0008 regarding CMM utilization activities

Applicability of ACM0008	This project
Baseline is the partial or total atmosphere release of the methane	The baseline for the project is the total release of methane to the atmosphere
The captured gas being destroyed through flaring	No flaring of methane is involved
The methane is captured and destroyed through	The captured methane is used to generate

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.	electricity, which will displace the power from the North China Power Grid. The emission reductions will be claimed. The Wujia Coalmine is a new mine and has not yet been commissioned. Therefore there is no existing usage record of the CMM and external heating demand is logically met through other means. Of the 99.864 million m^3 drained from the mine, the proposed project will utilise 54.86 million m^3, or 55%. Additionally, the '*Wujia gas purchase agreement*' signed by the PP and the coalmine owner on 15th November 2008 stipulates that the failure of the coalmine to supply the required amount of CMM to the project activity will result in significant financial penalty. Therefore, the project will not displace or avoid the use of energy from other sources
The remaining share of the methane, to be diluted for safety reason, may still be vented.	The remaining share of the methane, to be diluted for safety reasons, may still be vented.
All CBM and CMM captured in this project must be utilized or flared, and cannot be vented.	CMM captured in the project will be utilized for power generation

ACM0008 does not apply to project activities with the following features. The project activity does not involve any of these features.

Table B.2-3 Comparison between the project activity and the inapplicability of ACM0008

Inapplicability of ACM0008	The project activity
Capture methane from abandoned/decommissioned coalmine,	Gas capture activity is progressing simultaneously with mining activity.
Capture/use of virgin coal-bed methane	CBM is not involved in this project.
Use CO_2 or any other fluid/gas to enhance CBM drainage before mining takes place.	CBM is not involved in this project

As stated above, this project activity meets all of the applicable conditions of ACM0008. Therefore, ACM0008 can be used for the project activity.

Since electricity generated from the project will displace electricity from the North China Power Grid (NCPG), according to ACM0008 (version 7), 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 the sources and gases included in the project boundary

>>

As per ACM008, the spatial extent of the project boundary comprises:

- All equipment installed and used as part of the project activity for the extraction, compression, and storage of CMM and CBM at the project site, and transport to an off-site user[5];
- Flaring, flameless oxidation, captive power and heat generation facilities installed and used as part of the project activity;
- Power plants connected to the electricity grid, where the project activity exports power to the grid, as per the definition of project electricity system and connected electricity system given in "Tool to calculate the emission factor for an electricity system".

Therefore, the boundary of this project includes all of the equipment and constructions required to extract CMM from the coalmine through to the power output of the power station, as well as all of the power plants that are connecting to the North China Power Grid. The area covered by the North China Power Grid includes Beijing, Tianjin, Hebei, Shanxi, Shandong and Inner Mongolia. Figure B.3-1 shows the boundary of this project.

All equipment installed as a result of the project activity is shaded in blue in the diagram of the project boundary on the following page. While the mine is not yet operational and is being constructed in tandem with the proposed project, Wujia coalmine is required to install CMM extraction equipment for safety reasons as per item 136 the "*National coalmine safety regulation (version 2010)*". Therefore, while the proposed project will utilise this CMM extraction equipment, it is not included in the financial analysis. This is conservative, as the construction of extraction equipment would increase project investment.

Existing extraction equipment includes:

- Underground boreholes, gas drainage galleries and goaf gas capture techniques used to capture and extract CMM utilising:
  - Water drainage equipment (to separate water during drilling)
  - Extraction pump and flow meter
  - Explosion-proofing
  - Transmission pipe to vent
  - Fire-proof equipment

Equipment installed for the project activity includes:

- Linkage pipeline from transmission pipe to gas pre-treatment equipment
- Pre-treatment equipment (dust and water filters for extracted gas) and compression equipment for gas
- Gas Generators
- Exhaust system
- Transformer and Grid substation

The diagram of the project boundary is given on the following page in Figure B.3-1.

[5] If these equipment existed in the baseline the project participant shall include them and explain the effect of this inclusion in the investment analysis of the project activity and in the baseline calculations.

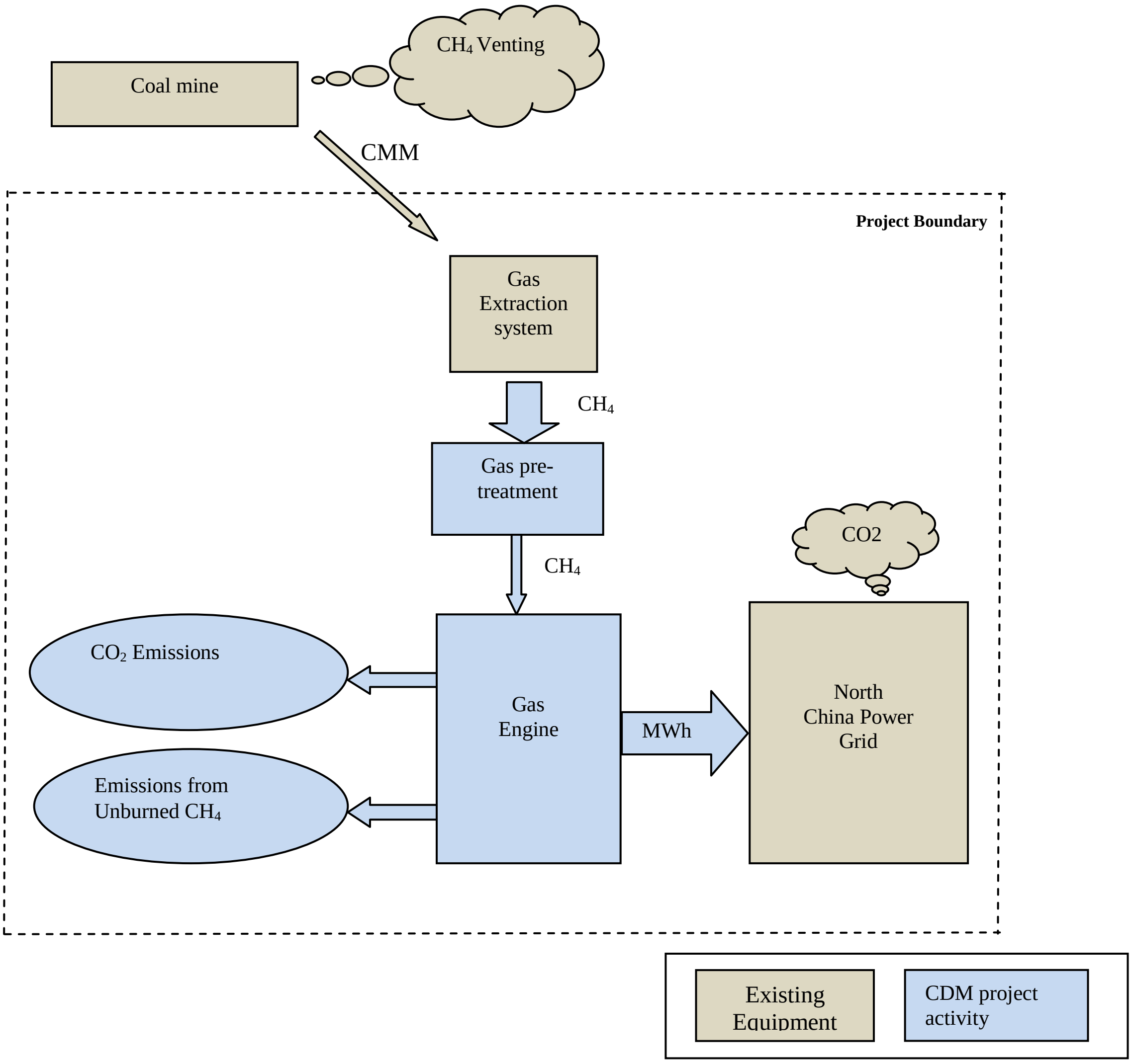


Figure B.3-1 Diagram of project boundary

Types of GHG that is included within the project boundary are shown in following table:

Baseline	**Emission Source**	**Gas**	**Included or not?**	**Justification / Explanation**
	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	There is no methane destruction in the baseline
		CH_4	Excluded	There is no methane destruction in the baseline
		N_2O	Excluded	There is no methane destruction in the baseline
	Grid electricity generation (electricity provided to the grid)	CO_2	Included	Main emission source

		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 released will be taken into account, by monitoring the methane used or destroyed by the project activity.
	On-site fuel consumption due to the project activity, including transport of the gas	CO_2	Included	The project activity does not use any additional energy for CMM drainage as the pumping station is part of the baseline scenario. But the power station will cause some auxiliary power consumption.
		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, if it accounts for more than 1% by volume of extracted coal mine gas. NMHC are less than 1%, therefore in practice these emissions are excluded – to be confirmed annually
	Fugitive emissions of unburned methane	CH_4	Included	Small amounts of methane will remain unburned in heat/power generation. Default emission factors are applied as per ACM0008.
	Fugitive methane emissions from on-site equipment	CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	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	CH_4	Excluded	Excluded for simplification. This

	release			emission source is assumed to be very small.

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

>>

Step 1: Identify technically feasible options for capturing and/or using CMM

Step 1a: Options for CMM extraction

As per ACM0008 the technically feasible options for CMM extraction at Wujia coal mine include:

Option A. Pre mining CMM extraction;
Option B. Post mining CMM extraction;
Option C. Possible combinations of A, and B, This option is the project activity not implemented as a CDM project.

There will be no CBM extraction adopted at the Wujia coalmine. While utilizing VAM is a technically feasible option, the methane concentration of the VAM is very low, thus there is no plan to utilize VAM. Therefore, CBM and VAM options need not be dealt with in the project activities, as only CMM will be utilised for electricity generation. The Wujia coalmine will use same extraction system, according to the methodology ACM0008 (version 07 EB55 CMM) allowing pre-mining and post-mining CMM to be measured together, meaning the relative measurement of each gas in the baseline is not necessary.

Step 1b: Options for extracted CMM treatment

The possible options that are technically feasible to use CMM at Wujia coal mine include:

i. Venting;
ii. Using/destroying ventilation air methane rather than venting it;
iii. Flaring of CMM;
iv. Use for additional grid power generation; This option is the CDM project activity not implemented as a CDM project;
v. Use for additional captive power generation;
vi. Use for additional heat generation;
vii. Feeding into gas pipelines (to be used as fuel for vehicles or heat/power generation);
viii. Possible combinations of options i to vii with the relative shares of gas treated under each option specified.

Option i.

This is the proposed scenario for the mine and therefore faces no barriers;

Option ii.

Although projects utilizing VAM have been registered, the technology is still not considered as mature, and is undertaken as pilot or demonstration projects[6]. So far no experience in continuous operation at Chinese coal mines could be collected. Existing projects in China – solely conducted under the CDM – are still at demonstration stage[7]. In addition the considerable investment would not be covered by any

[6] http://www.chinanews.com/ny/2010/07-02/2377307.shtml; http://content.caixun.com/NE/01/83/NE0183ht.shtm

[7] By now only one registered VAM utilization CDM project in China is known to the project participants. So far there has been no issuance of carbon credits generated by this technology.

income from operation. At present, the investors of the proposed project will not face the risk of unstable operation or insufficient financial return. Hence this option - Utilization of VAM – faces technological and barriers and is not a prevailing practice.

Using VAM rather than venting it is not a technically feasible option, thus option ii should be eliminated;

Option iii.
Flaring of CMM is technically feasible option;

Option iv.
Use of CMM for additional grid power generation without CDM assistance is a technically feasible option and will be discussed later;

Option v.
Use for additional captive power generation is technically feasible option and will be discussed later;

Option vi.
The project activity and the coalmine are under construction, so any heat demand is estimated through ex ante forecasts. In the baseline scenario for the proposed project, heat demand is already met through other means. Furthermore, there are no further heat consumers in the Wujia coalmine area.

As a result, it is impossible to consume all drained CMM via heat generation. Therefore *Option vi* - use for additional heat generation is not technically feasible and should be eliminated.

Option vii.
Feeding into gas pipelines (to be used as fuel for vehicles or heat/power generation) is technically feasible option and will discussed later;

Option viii.
Possible combinations of options i to vii with the relative shares of gas treated under each option specified is technically feasible option and will be discussed later.

Both the proposed project and the coalmine are new projects that are currently under construction. As such, the relative shares of each gas treatment process in the baseline will be monitored after the construction of coalmine is completed.

Step 1c: Options for energy production

Technically feasible options for power generation at Wujia coal mine include:
P1. No power generation capacity is installed and an equivalent quantity of electricity is purchased from the North China Power Grid;
P2. Construction of a coal-fired captive power plant with equivalent installed capacity (10MW);
P3. CMM power generation, this is the project activity not implemented as a CDM project.

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

The "*National coalmine safety regulation (version 2010)*" issued by the State Administration of Work Safety, sets the conditions and requirements on coal mine safety in articles 101, 136, 145, 146 and 190. Furthermore, the Standing Committee of the National People's Congress, State Council and State

Administration of Work Safety has issued a series of regulations regarding coalmine safety which can be found on the website (http://www.chinasafety.gov.cn).

At present, methane control requirements in these laws and regulations are only for health and safety purpose. Each coalmine is obliged to extract a certain amount of CMM prior to their coal mining activities but there exists no mandatory requirements on the utilization of the extracted gas. The CMM extraction, treatment and energy generation scenarios that do not comply with legal and regulatory requirements will be eliminated one by one below.

Step 2a. Options for CMM extraction

Item 136 the "*National coalmine safety regulation (version 2010)*" in particular, specifies that methane concentrations in the mine air should be below 1% in order to negate the risk of explosion. However, a concentration of this level would be unachievable at the Wujia Coalmine solely through the use of ventilation. Furthermore, Item 145 specifies that an above ground gas drainage station must be constructed above ground when the CMM emission rate of a mine exceeds 40m^3/min. While the Wujia Coalmine is not yet operational and thus the actual rate of CMM emission cannot be observed, the CMM gas emission rate can be calculated using the expected average annual volume of CMM extracted from the Wujia Coalmine (as evidenced in the FSR as follows[8]):

$$99{,}864{,}000m^3 / 365\ days / 24\ hours / 60\ minutes = 190m^3/min$$

It can be seen that this CMM emission rate far exceeds the threshold of 40m^3/min specified in Item 145 of the "*National coalmine safety regulation (version 2010)*". Therefore the project activity requires gas to be extracted through the use of underground boreholes. As a result, the relative shares of pre-mining and post mining CMM are difficult to quantify, as they will both be bought to the surface through the same extraction system.

With consideration given to these legal and regulatory requirements, Options A and B in *Step 1a: Options for CMM extraction* can be eliminated. Option C, a combination of pre and post mining CMM extraction will be used.

Step 2b. Options for extracted CMM treatment

For CMM utilization, it is regulated that if methane concentration is lower than 30%[9], gas utilization and transportation must be in accordance with the relevant standards and the related safety technology measures need to be considered. At the Wujia Coalmine, the average methane content of extracted CMM is estimated to be 35%[10]. As it is expected that the CMM to be extracted from Wujia coalmine will exceed the range for which legal and regulatory requirements are imposed, the transport and utilization of extracted CMM in the project activity is compliant with all applicable safety laws.

While the Chinese government promotes the utilization of CMM, in June 2005 the NDRC announced the Coalmine Methane Treatment and Utilization Macro Plan to encourage CMM drainage and utilization and calling for the incentives from CDM to overcome barriers in the country to implement CMM drainage and utilization activities.

The treatment of extracted CMM is generally subject to the "Emission Standard of Coal Bed

---

[8] FSR, "Section 1.1.2 - General information of Wujia coalmine" (p.1-2), issued by Jincheng City Engineering Consulting Centre in April 2009.

[9] *National Coalmine Safety Regulation 2010* - Item 148, issued by the State Administration of Work Safety,

[10] FSR (p.8), issued by Jincheng City Engineering Consulting Centre in April 2009.

Methane/Coal Mine Methane (GB 21522-2008)" that was issued by the Chinese Ministry of Environment Protection on 2nd April 2008. This provision, effective as of 1st July 2008, states that for existing coal mines, direct CMM venting is prohibited from 1st July 2010 in cases where the methane concentration of CMM is above 30%.

According to ACM008 version 7, 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[11]	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

[11] *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

	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. 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[12]	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

[12] SEPA order no. 28, *Measures for the Administration of Automatic Monitoring of Pollution Sources*, published by National Environmental Protection Bureau on 1st Nov 2005 and available at http://www.nnhb.gov.cn/uploadfile/2008314153359411.pdf (Chinese) and http://faolex.fao.org/docs/texts/chn61891.doc (English)

	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[13]	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.

In addition to this, the provincial Environmental Protection Bureau in Shanxi Province (where the proposed project is located) issued further guidance[14] 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 Bureaus (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, Wujia coalmine has obtained the "EIA approval" from the Shanxi Province Environmental protection Bureau[15].

  As identified by the Economics Institute of Shanxi Academy of Social Sciences[16]:

---

[13] SEPA order no. 39, *Measures for the Administration of Environmental Surveillance*, published by National environmental protection bureau on 25th July 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)

[14] 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

[15] "EIA approval" issued by Shanxi Province Environmental Protection Bureau on 26th Aug 2010

[16] 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

"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 1053 coal mines[17], 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[18].

- 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 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)[19]. 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.

- 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

---

[17] http://energy.nmgnews.com.cn/system/2010/06/02/010445188.shtml

[18] 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

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

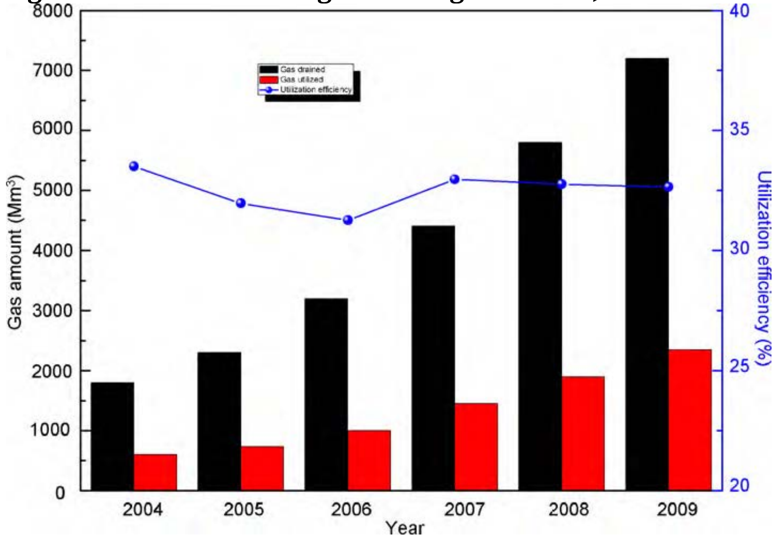
Response to Misconceptions about Coal Mine Methane Projects (Para. 9) (available at http://www.unece.org/energy/se/pdfs/cmm/AHGE_Letter_Misconceptions_CMM.pdf).

Targets for CMM drainage and utilisation were set in the Twelfth Five Year plan (2011-2015)[20]:

- The drainage amount of CMM will reach 14 billion cubic meters by 2015
- The utilisation amount of CMM will reach 8.4 billion cubic meters by 2015 (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[21]. 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[22]



The latest data shows that:

In 2010, the total drainage volume of CMM gas is 7.35 billion cubic meters and the total used amount is 2.5 billion cubic[23];

in 2011, the total drainage volume of CMM gas is 9.2 billion cubic meters and the total used amount is 3.2 billion cubic meters[24].

---

[20] State Council of the P.R. of China, *12th Five-Year Plan for Development and Utilization of Coalbed Methane and Coal Mine Methane (2011-2015) published China NDRC on 26 Nov 2011* (available at http://www.sdpc.gov.cn/zcfb/zcfbtz/2011tz/t20111231_454225.htm).

[21] 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)

[22] 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).

[23] News "CMM gas extraction volum" published by China Energy Paper on 10th Jan 2011, available at http://paper.people.com.cn/zgnyb/html/2011-01/10/content_719599.htm

[24] News "CMM gas extraction in 2011" published by China Economy Net on 17th Jan 2012, available at: http://www.ce.cn/cysc/ny/meitan/201201/17/t20120117_21102500.shtml

There are 1053 coal mines in Shanxi Province[25], where the proposed project is located, and CMM drained in this province makes up over 1/3 of the total CMM drained in China[26]. Determination of the number of coal mines abiding by the regulation is not possible due to::

(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	2011
Drainage	Billion m^3	1.611	2.080	2.160	2.250	2.513	2.674
Utilization	Billion m^3	0.327	0.558	0.767	0.873	1.01	1.135
% Utilisation	%	20.30	26.83	35.51	38.8	40.2	42.45

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 CMM with a high concentration of methane, in 2010 and 2011, there was slight increase in the utilization, however, the majority of the drained CMM gas (over 50%) was still not used.

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

---

[25] News “Merging time of coalmines in Shanxi “published by China Wealth Net on 02[nd] Oct 2011, available at: http://energy.nmgnews.com.cn/system/2010/06/02/010445188.shtml

[26] Information “Shanxi CMM resource” published by National Energy Administration on 30[th] Oct 2012, available at: http://www.nea.gov.cn/2012-10/30/c_131940177.htm

[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 and “high concentration CMM gas drainage and usage in Shanxi province” by Shanxi government Coal Industry Department 28[th] Nov 2012

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-user. 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[31],

> *"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[32]:

> *"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".*

Also please note: According to the common practice of CMM power generation in Shanxi provinces, among the 54 CMM power generation projects[33] (approved before 2012) in Shanxi provinces, there are 44 projects which are registered as CDM projects or under the CDM validation process which represents 951.1 MW among the total installation capacity of 988.9 MW. The projects with CDM support holds 96.18% of the total installation capacity of CMM power generation projects in Shanxi province. Therefore, majority of such utilization is based on the CDM support. It is not conceivable that coal mine owners will be able to comply with this Standard without the CDM or additional funding from another source. 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*

---

[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)

[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] IEA, *Energy Sector Methane Recovery and Use*, 2009 (p21)

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

[33] CPA of CMM power generation projects in Shanxi Province

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].

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. In the power generation, projects with CDM support holds about 96.18% of total installation capacity of all approved CMM power generation projects.

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 similar installation power generation 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 15%, 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	2.513	1.01	0.36	14.33	0.65	0.3	0.06
2011	2.674	1.135	0.365	13.65	0.77	0.3	0.065

(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 $\geq$30% would be faced with three choices:

i. Continue to vent CMM with a methane concentration $\geq$30% and pay the fine (maximum 100,000RMB pa). In this scenario no investment would be needed.

[34] Article "CDM evolution" published by China CDM governmental website on 16 July 2009 , available at: 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.

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 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 "Wujia IRR scenarios_analysis").

Table B.4: NPV of possible scenarios

Scenario	NPV
Continue to vent high concentration CMM and pay the fine (maximum 100,000RMB pa)	- 676,935
Implement a project to utilise/ destroy the CMM thereby avoiding paying the fine.	- 10,334,074
Install equipment to dilute any CMM with a concentration ≥30% to a concentration <30% and continue to vent, thereby avoiding paying the fine.	- 132,008

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"*

---

[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

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

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". 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" [39]

b. An 'implementation gap' between national law makers and local law implementers. For example, according to the OECD[40]:

   "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"*.[41]

---

[38] Organization for Economic Co-operation and Development, *Environmental Compliance and Enforcement in China*

[39] Jennifer Wu, *Public Participation in the Enforcement of China's Anti-Pollution Laws*, 4/1 Law, Environment and Development Journal (2008), p. 35

[40] Organisation for Economic Co-operation and Development, *Environmental Compliance and Enforcement in China* 2008

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.

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.

Finally, based on gas drainage and gas utilisation data for Shanxi Province for 2006-2011 it can be seen that utilisation rates of high concentration CMM were around 40%. The increase of the utilization is because more and more CMM power generation projects put into operation based on the CDM support. Even though, majority of high concentration CMM gas is still being 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[42], 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 Wujia CMM power Generation Project.

Step 2c. Options for Energy production

The project activity includes the construction of a 10MW CMM power generation plant for which the electricity generation is roughly equivalent to a coal-fired power plant with a capacity of approximately

[41] Jennifer Wu, *Public Participation in the Enforcement of China’s Anti-Pollution Laws*, 4/1 Law, Environment and Development Journal (2008), p. 35

[42] 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 $\geq$30% to a concentration <30% and continue to vent, thereby avoiding paying the fine.

10MWh[43]. According to Chinese power regulation, it is strictly prohibited to build coal-fired power plants with capacities of 135MW and below[44]. Therefore option P2 given in *Step 1c. Options for Energy Generation* does not comply with the legal and regulatory requirements and will be eliminated.

Options P1 and P3 presented in *Step 1c. Options for Energy Generation* are both in compliance with all relevant legal and regulatory requirements.

Step 3: Formulate baseline scenario alternatives
The technically feasible baseline scenario alternatives that comply with all legal and regulatory requirements are identified below:

3a. Baseline scenario alternatives for CMM extraction

Scenario C
The combination of A and B, with pre mining CMM/post mining CMM.

3b. Baseline scenario alternatives for extracted CMM treatment

Scenario i: venting;
Scenario iii: Destroyed via flaring;
Scenario iv: Use for additional grid power generation;
Scenario v: Use for captive power generation;
Scenario vii: Feed into pipeline (used by vehicles or used for power or heat generation);
Scenario viii: The combination of scenarios i and vii.

3c. Baseline scenario alternatives for energy production

Scenario P1
This is the scenario for the mine in the absence of the project. No electricity generation capacity would be installed and electricity would be purchased from the North China Power Grid;

Scenario P3
Use CMM for power production, this is the project activity not implemented as a CDM project.

Step 4: Eliminate baseline scenario alternatives that face prohibitive barriers
Barriers exist that would prevent identified baseline scenario alternatives to occur in the absence of the CDM. The baseline scenario alternatives formulated above in Step 3 will be assessed here with consideration to those barriers.

4a. Barriers analysis made on baseline alternatives for CMM extraction

Scenario C
This is the project situation and faces no barriers.

4b. Barriers analysis made on baseline alternatives for extracted CMM treatment

[43] According to China Electric Power Yearbook (2009) p.698, the annual utilization hours of fossil fuel power plant is 5,069 hours. Thus the electricity generation of the project equals to that of a coal-fired power plant with capacity of 51840MWh/5069h ≈ 10.23MW
[44] "Decision on strictly forbidding the illegal construction of fuel-fired power plant with the capacity 135MW and below", General Office of the State Council, http://www.gov.cn/gongbao/content/2002/content_61480.htm

Scenario i
Venting is the scenario for the mine in the absence of the project and faces no barriers.

Scenario iii
Destroying methane by flaring does not utilize the energy potential of CMM, but requires great investment without any revenues. Thus scenario iii faces investment barriers and will be eliminated.

Scenario iv
This is the proposed project activity not implemented as a CDM project. This scenario is technically feasible because of many CMM power generation project has been carried out in China. However, as described in B.5, the scenario has investment barriers. This scenario could be eliminated.

Scenario v - Use for captive power generation
The electricity purchased price was published by Shanxi province on 20 Sep 2009 as 0.4521 RMB/Kwh (VAT included)[45]. Purchase invoices also provided for crosscheck.

Self-captive power generation financial analysis result shows the IRR (before tax) is: 11.52%[46] lower than 13%, the benchmark of mining industry. Therefore, scenario v is eliminated.

Scenario vi: Use for additional heat generation
Both the coal fired boilers and gas fired boilers belong to the Wujia coalmine. And both the coal and CMM gas produced by the coalmine themselves as well. Therefore, there is no cost to the Wujia coalmine of using either coal or CMM gas. With no saving in the fuel cost, fuel switching does not have any revenue for the coalmine. However, whether purchasing new gas-fired boilers or making the retrofitting on the existing coal-fired boilers requires investment from the Wujia coalmine. It is not possible for the coalmine to invest into a project without any revenue. This scenario is eliminated.

Scenario vii - Feed into pipeline (used by vehicles or used for power or heat generation)
There is no existing pipeline. A financial analysis of building pipeline and selling CMM gas to the nearest town (over 30 km away from the Wujia coalmine) shows that the IRR before tax is -8.86% and after tax is -5.31% and both the before tax and after tax NPV are negative[47], therefore this scenario is eliminated.

Scenario viii
As analyzed above, scenario ii，iii，iv，v，vi，vii are not feasible scenarios therefore scenario viii is eliminated from baseline scenario.

As a result of above consideration, **Scenario I** (business as usual scenario) is the only scenario that does not face prohibitive barriers. Therefore, it is considered to be the baseline scenario.

4c. Barrier analysis made on baseline alternatives for energy production

Scenario P1
Purchasing electricity from the North China Power Grid is would be the situation in the absence of the project and faces no barriers.

---

[45] http://www.shanxigov.cn/n16/n37141/n37756/n37951/n39226/15724891.html

[46] Wujia project scenario v financial analysis

[47] Wujia project scenario vii financial analysis

Scenario P3
According to analysis made in B.5, the project is not financially attractive. Therefore, Scenario P3 faces an investment barrier and should be eliminated.

Step 5. Identify the most economically attractive baseline scenario alternative

It can be concluded from the above analysis that the baseline scenario of this project is the combination of Option C, *Scenario i* and P1, namely, the continuation of current situation at Wujia Coal Mine: venting pre-mining CMM/post mining CMM; purchasing power from the North China Power Grid.

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):

>>

CDM consideration
CDM was seriously considered during the development of the Project, the timeline of the Project implementation is shown in the following table.

Table B.5-1 Timeline of the Project Implementation

Time	Milestones
20/10/2008	EIA completion
20/12/2008	Approval of EIA
04/2009	FSR completion (including CDM consideration)
16/04/2009	Decision of the board meeting on CDM development
9/09/2009	Approval of FSR
03/12/2009	CDM consultant contract
02/03/2010	Chinese NDRC confirmed receipt the PO’s request for prior consideration of seeking the help of CDM
05/03/2010	Construction contract (the starting date of the project)
31/03/2010	UNFCCC confirmed receipt of the project’s request for prior consideration for seeking the help of CDM
01/04/2010	Equipment contract signed
30/04/2010	ERPA signed
01/06/2012	Project commission

The additionality of the project activity will be demonstrated and assessed by using the “Tools for the demonstration and assessment of additionality” (version 06.0). Step 1 of the tool can be ignored in accordance with ACM0008.

Step 2. Investment analysis
The additionality of the project is established using **Step 2: Investment analysis.**
It is to determine whether the proposed project activity is economically or financially less attractive than

other alternatives without the revenues from the sale of certified emission reductions (CERs). To conduct the investment analysis, the following sub-steps will be followed:

Sub-step 2a. Determination of the appropriate analysis method
The "Tools for the demonstration and assessment of additionality (version 06.0)" recommends three analysis methods, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

The proposed project activity generates both CDM related income and electricity related income, then 'Option I - Simple cost analysis' cannot be used. 'Option II – Investment Analysis', is only applicable to projects where alternatives are similar investment projects, as the identified alternative to the project activity is the baseline scenario where CMM is vented, no investment is required and this Option cannot be used. Therefore, 'Option III - Benchmark analysis' will be used for the investment analysis of this project.

Sub-step 2b. Benchmark analysis (Option III)
The indicator to be used for financial analysis of the project activity is selected to be the Project Internal Rate of Return (IRR) in accordance with the "Tool for the demonstration and assessment of additionality (version 06.0)".

The benchmarks considered for this project were; coal mining, 13% (before tax); electricity generation, 8% (before tax) and gas drainage on the land, 12% (before tax). These figures are all in accordance with the "Economic Evaluation Method and Parameters for Construction Projects (Version 03)[48]". The following shows the process used to determine the most applicable benchmark.

As the coalmine is not owned by the project participant and the project participant does not sell gas, the benchmark of coal mining and gas industries cannot reflect the project financial situation. The project participant is only engaged in their core business of electricity generation. Furthermore, the vast majority of electricity finally supplied to the NCPG (North China Power Grid) is generated using fossil fuel, so the benchmark of this project is chosen as the benchmark of the fossil fuel electricity generation industry.
Therefore, the benchmark value of the project IRR for electricity generation (total investment, before income tax) is chosen to be 8%.

Sub-step 2c. Calculation and comparison of financial indicators
The basic data used for the IRR calculation are listed in Table B.5-2.

Table B.5-2 Basic data used for the IRR calculation

Parameters	**Value**	**Sources**
Installed capacity	10MW	FSR
Annual Operating Hours	7200 hours	FSR
Annual net electricity supply	51,840MWh	FSR
Total Static investment	42.87 million RMB Yuan	FSR, "Wujia 35 KV step-up equipment purchase and construction contracts" and "Wujia 35KV step-up substation design contract"
Operating Cost	12.70million RMB Yuan	FSR
Operating Cost Including:		

[48] "Economic Evaluation Method and Parameters for Construction Projects/Version 03", China Plan Press, 2006.

➢ Raw Material	9.3257 million RMB Yuan	FSR
➢ Fuel Expense	0.3641 million RMB Yuan	FSR
➢ Salary and Welfare	0.3283 million RMB Yuan	FSR
➢ Repair Fee	1.2863 million RMB Yuan	FSR
➢ Other operation and management fee	1.40 million RMB Yuan	FSR

Electricity tariff	0.38 RMB Yuan/kWh (with tax)[49]	FSR
Project lifetime	11 years	FSR
CMM Gas Price	0.17 RMB/m^3	Gas Purchase Agreement
Revenue Tax	25%	FSR
Value added tax rate	17%	FSR
City Maintenance and construction tax rate	5%	FSR
Education Surcharge rate	3%	FSR
Crediting period	10 years	
CERs price	8€/tCO2e	
Exchange rate	8.5Yuan RMB/€	

Total static investment
According to the Grid Connection Agreement, the voltage level of electricity generated by the Wujia power plant should be increased to 35KV. However, as the voltage level of the installed generators under the project activity is only 400V, the PP is required by the Grid Connection Agreement to build a substation that will increase the voltage level of electricity generated by the Wujia power plant.

The FSR did not include the necessary investment in infrastructure that would enable grid connection and the export of electricity generated. When the PP applied for the "Grid connection approval"[50] from the Electric Power Company of Shanxi Province, State Grid, the PP was notified that: the substation infrastructure is necessary for the PP to export electricity generated from the proposed project the Grid. The "Grid connection approval" was issued by the Electric Power Company of Shanxi Province, State Grid on 4th January 2010. Hence, the proposed project cannot be put into commercial operation without the additional investment in the substation.

The Grid connection agreement states this requirement clearly and the construction contract can be used to validate the additional investment amount. Total additional investment of substation construction is: 10,039,076 RMB. The project static investment (including equipment purchase) amount on FSR is: 32.84 million RMB. Therefore the total static investment in the project is: 42.87 million RMB.

The additional investment required to construct substation and purchase related equipments were taken into account during the financial analysis (investment & sensitivity analysis) in the PDD.

Operating Costs:
The operating costs given in the FSR and used in the financial analysis of this project are further detailed below. A justification of their suitability has also been provided to demonstrate the conservative nature of their estimation. Each of the primary operating costs given in Table B.5.2 is examined below:

---

[49] http://www.sxprice.gov.cn/sy/tzgg/20091209/084629.html
[50] Grid connection approval was made by the Electric Power Company of Shanxi Province, State Grid on 30th December, 2009 and issued on 4th January, 2010.

Raw Material (9.3257 million RMB Yuan):
The raw material cost given here constitutes the cost of purchasing the CMM consumed by the project activity. The relevant constituents of this cost are the CMM gas consumption and the CMM Price, each of which is specified in the FSR as follows:

$$54,857,142m^3 * 0.17RMB/m^3 = 9,325,714 \text{ RMB/year}$$

The estimate of CMM gas consumed by the project is calculated from the expected consumption of the installed equipment given on p.8 of the FSR. As the project has not yet commenced operation, no actual gas consumption data is available.

The estimate of CMM Price is explained and considered in its wider context in the section below and also above, under the analysis of *Scenario v* at Step 4b of the Baseline analysis.

Fuel Expense (0.3641 million RMB Yuan):
The Fuel Expense considered in the financial analysis of the proposed project is the combination of engine oil and cooling water costs. It has been calculated using the respective values for their price and volume as given in the FSR (p.46). This is represented below:

30,000L * 12 RMB/L + 2,064t * 2RMB/t = 364,100 RMB/year

Regarding the consumption of engine oil, the equipment purchase contract between PP and the equipment supplier states: the engine oil consumption is less than or equal to 1.6 gram/Kwh[51]. Therefore, given the gross electricity generation of the proposed project is 57,600,000kWh, 92,160kg of oil is used each year, which equates to over 100,000 litres. Therefore, this estimation in the FSR can be considered extremely conservative. The price of engine oil to be purchased is given as 12 RMB/L in the FSR. Given the extremely conservative nature of the engine oil quantity estimate, it is most likely that the overall cost of engine oil will be conservative.

With regard to the cost of water, the Jingcheng City price database gives a price for water used in industrial uses of 6.96 RMB/t[52]. Therefore, the estimated cost of 2 RMB/t for water in the FSR can be considered conservative. As the actual water consumption of the project can vary for a range of technical reasons, and is not easily compared, this conservative estimate for price will ensure that the stated costs are conservative overall.

Salary and Welfare (0.3283 million RMB Yuan):
Given the project employed 20 persons, at 1,200 RMB/month and a welfare rate of 14%, the Salary and Welfare costs of the project as calculated as follows

1,200 RMB * 12 * 20 * 1.14 = 328,320 RMB/year

Therefore, the total salary package paid to each employee is 16,416 RMB/year (1,200 * 12 * 1.14). In comparison, the average salary for workers in the Shanxi Province in 2010 was 33,544 RMB/year (a 17.8% increase on the 2009 salary)[53]. Furthermore, the same source shows that the average salary in the power generation industry in 2010 was 48,323 RMB/year (a 13.3% increase on the 2009 salary). As both these

[51] *"Engine oil consumption evidence"* issued by Shandong Jichai Green Power Driving Equipment Co., Ltd. on April 2010.

[52] The price for water used for industrial purposes issued by the Jingcheng City price database, available at http://jcwj.jconline.cn/Contents/Channel_5808/2009/0826/252230/content_252230.htm and dated 18/5/2011.

[53] The average salary of different industries, National Bureau of Statistics of China, available at; http://www.stats.gov.cn/tjfx/jdfx/t20110503_402722855.htm

rates far exceed the FSR estimations, salary used in the financial analysis of this project can be considered conservative.

Repair Fee (1.2863 million RMB Yuan):
The repair fee for the project is calculated using the total static investment and a percentage rate for annual ongoing maintenance. In the proposed project this rate is nominated to be 3%, therefore the total repair cost can be calculated as:

42,875,776 RMB * 0.03 = 1,286,273 RMB/year

The adoption of a 3% repair rate is in line with other recently registered projects also using ACM0008. The table below demonstrates this:

Project Number	Project Name	Repair Rate
3219	SDIC Xiyang Baiyangling CMM to power generation project	5%
5227	Jilin Hunchun Coal Mine Methane (CMM) Power Generation Project	3%
3661	Shaanxi Tongchuan Huachen 7MW CMM Power Generation Project	2%
3542	Sichuan Guang'an Caishandong Coal Mine CMM Power Generation Project	3%
n/a	Proposed Project	3%

Other operating and management fees (1.40 million RMB Yuan):
This cost is composed of two parts, the management costs totaling 1,000,000 RMB/year and 400,000 RMB/year for other operation costs. While the FSR does not specify exactly what will constitute the other operating costs, it is common for such developments to allocate a small amount of money to cover unexpected emergencies, cleaning, training and public relation costs etc. The other management costs consist of project consulting (technical, management and financial) and training expenses (occupational safety, management and technical)[54]. The table below compares the other operation and management costs per MWh with a number of other similar registered projects.

Project Number	**Project Name**	**Net Generation (MWh)**	**Other management costs**	**Cost per MWh**
3219	SDIC Xiyang Baiyangling CMM to power generation project	97,978	5,184,000	52.9
5227	Jilin Hunchun Coal Mine Methane (CMM) Power Generation Project	20,520	525,000	25.6
3661	Shaanxi Tongchuan Huachen 7MW CMM Power Generation Project	34,927	1,058,400	30
3200	Qinxin CMM Power Generation Project	30,744	938,000	30.5
n/a	Proposed Project	51,840	1,400,000	27

As seen the above, the other operating and management costs assumed by the project are very reasonable.

The value of all O&M parameters given in the FSR was the best possible estimate available to the PO at the time of the investment decision.

[54] *'Other management fees statement'* issued by Jingcheng City Engineering Consulting Centre, 22nd July 2012

CMM Gas Price
As stated on the CMM purchase agreement between the project owner and the coalmine owner, the CMM price is stipulated as 0.17RMB/m^3, which is for the CMM gas with the concentration of 35% methane. This is also the price used in the project FSR.

Although the CMM will be vented by the coalmine, the wasted CMM does have commercial value simply due to its high calorific value. The CMM price was negotiated by the coalmine owner and the project proponent based on the local policy and referred to the market value of CMM. In item 2 of the Notice Regarding CMM Pricing, Jincheng City Pricing Bureau (No. 301 of 2003) states that "pricing for the CMM from the mine (gas source) to the gas storage tank. The CMM price is determined based on the cost and benefit of CMM utilization and ultimate market consumer price. The unit price of CMM gas with 40% methane concentration is 0.15 RMB/m^3. For every 5% increase of concentration, the price is to be added with 0.01 RMB/m^3". However, it was recognized by the project proponent that it is not entirely transparent how the CMM price was determined by the Jincheng government. Therefore, it is not clear which aspects of the CMM extraction and supply are included in the fixed CMM price. It can be a credible reference for pricing procedure. The concentration of methane in the CMM sold to this project activity is 35%, considering the inflation from year 2003 to year 2009, the price of 0.17 RMB/m^3 is conservative.

Evidences can be found that the CMM gas also has a local market value. Nine coalmines in Jincheng City sold CMM to Jincheng City Fengrun CMM Utilization Co., Ltd. for power generation with the price of 0.15 RMB/m^3 (with 40% of methane). Chengzhuang Coal Mine in Jincheng City sells CMM gas to the Shanxi Jinju Meidianhua (Joint Stock) Co., Ltd. at the price of 0.4RMB/m^3 (100% methane). Daning coal mine in Yangcheng County sold CMM to Shanxi Lanhua Daning Power Generation Co. Ltd. for power generation with the price of 0.37 RMB/m^3 (100% of methane).

In order to supply the CMM gas, the Wujia coalmine needs to invest into gas supply facilities[55] and construction[56] and also pays for the O & M costs including staff[57], electricity cost, management cost and equipment insurance[58] etc. The Wujia Coalmine and the proposed project PP are independent entity without any overlapping in the ownership; therefore the Wujia coalmine needs to charge the PP for supplying the CMM gas.

To demonstrate the CMM gas cost's impact on the proposed project in a quantitative way, we have made the financial analysis of the proposed project PP covering the costs of supplying the CMM gas by themselves. In this analysis, the CMM gas price was set as 0. The financial analysis results show that the IRR before tax is 6.99%, still lower than the benchmark of 8%, and the NPV before tax is negative.

Also, as tax policy [2007] No. 16 (started from 1st Jan 2007) published by China Ministry of Finance & China National Taxation office on 07 Feb 2007: "For the companies extracting and selling the CMM gas, the VAT should be pre-paid and then refunded." Therefore, the proposed project's PP is not qualified for this VAT preferential policy.
We also make a financial analysis of Wujia Coalmine selling the CMM gas. The result shows that the

---

[55] Gas supply equipment contract

[56] Gas supply facilities construction contract

[57] Staff payroll sheet

[58] Insurance policy

IRR of the Wujia coalmine's selling CMM gas to the proposed project is 10.69% (Before tax) and 14.24% (after tax) due to the VAT preferential policy. The financial analysis result shows that the 0.17 RMB CMM gas price is a reasonable market price.

Therefore, it can be seen that the CMM price of 0.17 RMB/m^3 for this project is reasonable.

Considerations on government subsidies

The FSR of this project was completed in April 2009 and was approved by local authority in September 2009. Before the investment decision was made, the available government subsidies on CMM are:

i. "Notification on Speeding Up the Implementation of the Tax Policy on the Coal Mine Methane Extraction", issued by the State Administration of Taxation and the Ministry of Finance in February 2007[59]. This Notification indicates that, for enterprises specialized in CMM extraction, the VAT from selling the CMM gas can be refunded. The project owner is not an "enterprises specialized in CMM extraction" but a power generation company and thus this subsidy cannot be applied to this project.

ii. "Implementation Suggestions on Accelerating the Comprehensive Treatment and Utilization of CMM", issued by Government of Shanxi Province published in October 2007[60]. This is a detailed local implementation guideline of the above "Notification on Speeding Up the Implementation of the Tax Policy on the Coal Mine Methane Extraction". The project owner is not an "enterprises specialized in CMM extraction", therefore such subsidy cannot be applied to this project.

iii. "Executing Opinion on Subsidizing CBM/CMM Development and Utilization Enterprises", issued by the Ministry of Finance published in April 2007[61]. According to the Executing Opinions, the CMM utilization enterprise could be qualified for an incentive of 0.2RMB/m3 pure methane from central government. However, this regulation clearly states it is not applied to the CMM used for power generation.

iv. "Implementing Opinions on Power Generation by Utilizing CBM/CMM", issued by National Development and Reform Commission published in April 2007[62]. As per the regulation, grid companies are not allowed to refuse to purchase power produced by CMM/CBM and the on-grid tariff of CBM/CMM power shall be determined by reference to the tariff for biomass-fired power plants set out in the Tentative Management Measures for Pricing and Expense-sharing for Electricity Generated from Renewable Energy, which is the sum of the benchmark on-grid tariff of the provincial desulfurized coal-fired generators in the year of 2005 and a subsidy tariff of 0.25RMB/kWh.

However, this policy was not being enforced. According to a study conducted by the International Energy Agency and published in 2009[63]. "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."

Table B.5-3 shows the calculated project IRR with and without CDM revenues. It could be noted that the project IRR without CDM revenues is -1.14%, which is lower than the benchmark value (8%). It means that the project is not financial attractive. After tacking CDM revenues into consideration, the project IRR

---

[59] http://www.chinatax.gov.cn/n480462/n480498/n575817/5137990.html

[60] http://www.chinalawedu.com/news/1200/22016/22027/22344/22361/2007/11/li62072341251621170022180l-0.htm

[61] http://www.hnmcq.com/Article_Show.asp?ArticleID=409

[62] http://www.gov.cn/zwgk/2007-04/16/content_583702.htm

[63] International Energy Agency, Coal Mine Methane in China, A Budding Asset with the Potential to Bloom, 2009 (p.29) available at http://www.iea.org/textbase/papers/2009/china_cmm_report.pdf

amounts to 47.54 % that is higher than the benchmark value. Therefore the CDM revenues could enable the project to overcome the investment barrier and make it become feasible.

Table B.5-3 Comparison of the project IRR with and without CDM revenues

	IRR (total investment, before income tax)
Without CDM revenues	-1.14%
With CDM revenues	47.54%
Benchmark value	8%

Sub-step 2d: Sensitivity analysis

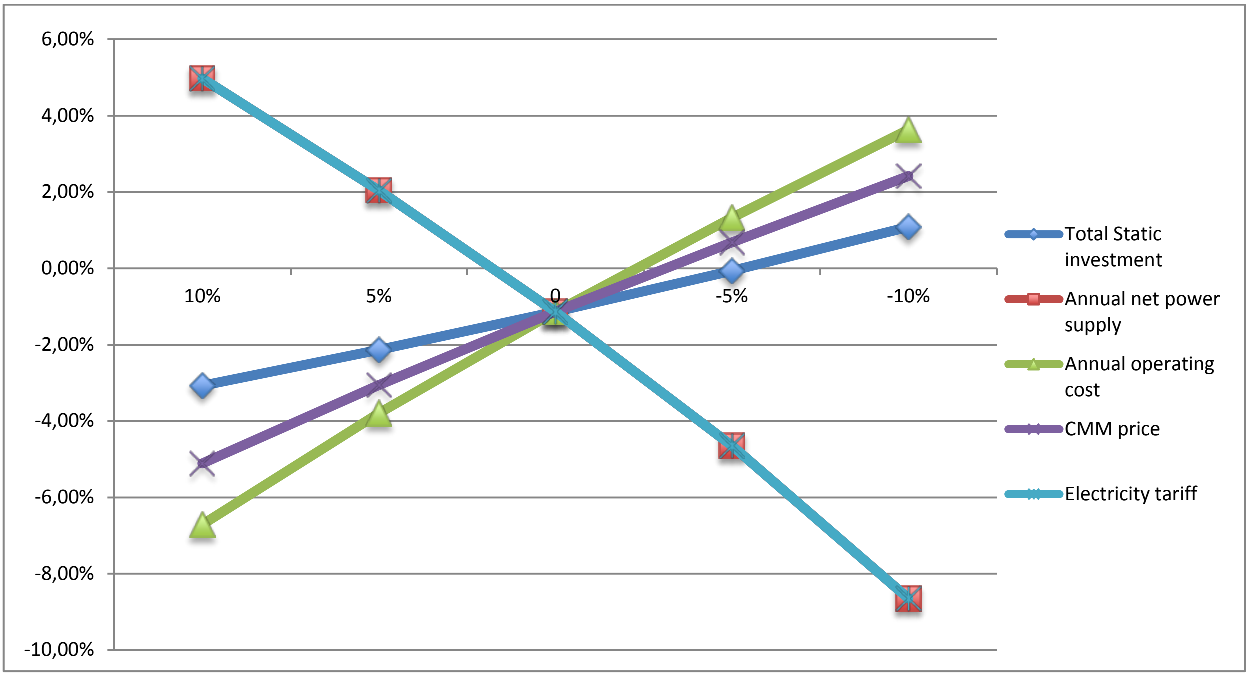
The sensitivity analysis shall show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. For such purpose, following parameters were selected as sensitive factors to check out their effects on project IRR.

1. Total static investment
2. CMM price
3. Annual operating cost
4. Annual power supply
5. Electricity tariff

The project IRR will fluctuate with the variations (-10% to 10%) of the above five factors. The result is demonstrated in Table B.5-4.

Table B.5-4 Sensitivity analysis

Parameter	**10%**	**5%**	**0**	**-5%**	**-10%**	**Critical Point**
Total static investment	-3.07%	-2.14%	-1.14%	-0.07%	1.08%	-33.50%
Annual power supply	4.97%	2.04%	-1.14%	-4.65%	-8.65%	15.55%
Annual operating cost	-6.71%	-3.79%	-1.14%	1.33%	3.64%	-20.25%
CMM price	-5.11%	-3.06%	-1.14%	0.68%	2.41%	-27.67%
Electricity tariff	4.97%	2.04%	-1.14%	-4.65%	-8.65%	15.55%
Benchmark	*8.00%*	*8.00%*	*8%*	*8.00%*	*8.00%*	



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

Total investment would need to decrease by 33.50% 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[64].

For annual power supply, annual power supply would need to increase by 15.55% for the project to go over the benchmark. Increase of this amount is not plausible, because of the volume of CMM, so the IRR won't rise above the benchmark. Additionally, the maximum operation time and electrical output of the generators will not exceed the levels used in the IRR calculation meaning that and increase in these factors (and hence the IRR) is impossible[65].

For annual operating cost, annual operating cost would need to decrease by 20.25% for the project to go over the benchmark. Again, a decrease of this amount is not plausible, particularly during a period of price increases.

For CMM price, CMM price would need to decrease by 27.67% for the project to go over the benchmark. According to Gas purchase and supply agreement between the project owner and Wujia coal mine and FSR, CMM used for project activity is purchased at the stated fixed price in project implementation. The price is regulated and determined according to the average cost and market supply.

For electricity tariff, electricity tariff would need to increase by 15.55% for the project to go over the benchmark. The Chinese Government will only order an adjustment in the electricity tariff after internal negotiations between several government departments. It is difficult to forecast these adjustments. In

[64] According to the China Statistical Yearbook, in 2005, 2006 , 2007, 2008 and 2009， the national general growth rate of purchasing prices of raw materials, fuels and power ; the national total price indices of total investment was increased respectively. See http://www.stats.gov.cn/tjsj/ndsj/2009/indexch.htm

[65] '*Wujia Generator annual hours and electrical output'* issued by Shandong Jichai Green Power Driving Equipment Co. Ltd. on the 23rd February 2012.

China electricity is a necessary input for people's daily life and industrial operation; therefore the electricity tariff has a significant impact on social stability and the national economy[66]. In order to maintain social stability and economic growth, the electricity tariff is strictly regulated by the Chinese Government and is not expected to fluctuate significantly.

It is very unlikely that the electricity tariff will appreciate by more than 15.55%. Before the FSR was completed and the investment decision was made on 2009, the Pricing Bureau of Shanxi Province published the power tariff for CMM power generation in July 2009. The tariff was stipulated as 0.38 RMB/kWh (Inc. VAT). The proposed project was still in the construction stage at this point and the Tariff was not yet approved by local government. Furthermore, it can be seen that even with the tariff increased by 15.55%, if only a 5% rate of annual increase is applied to the cost of raw materials (extremely conservative considering the observed rate over the years 2000-2009 was 12.27%[67]) the project IRR becomes negative.

It could be seen from Table B.5-4 that whatever the five key parameters changes, the project IRR will be always lower than the benchmark value of IRR. The sensitivity analysis shows that it will not be possible to get the project IRR above the benchmark value without the CDM revenues. It is always true that the project activity is not financially attractive without the CDM revenues.

Step 3: Barrier analysis
According to the "Tool for the demonstration and assessment of additionality" the adoption of this step is not required because step 2 – investment analysis – is carried out.

Step 4: Common Practice Analysis

Within Shanxi Province, 59 projects were identified for consideration in the Common Practice Analysis using the following sources:

- Shanxi NDRC, Shanxi Provincial government website. Register of all approved electricity generating projects with approval to export electricity to the power grid.. Available at http://www.sxdrc.gov.cn/xxlm/lxsp/
- Clean Development Mechanism in China government website (CMM power generation projects with China LoA). Available at http://cdm.ccchina.gov.cn
- UNFCCC website (Registered or in the process of validation of CMM power generation project)

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

According to the *Tool for the demonstration and assessment of additionally (Version 6.0)*, projects are considered similar in case they are "located in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc."

The scope of similar projects used for common practice analysis is defined as follows:

i. Shanxi province is selected as the region for the common practice analysis, for reasons as follows:

---

[66] Rate of purchasing prices of raw materials, fuels and power; the national total price indices of total investment was increased respectively. See http://www.stats.gov.cn/tjsj/ndsj/2009/indexch.htm

[67] '*Raw Materials Prices Statistical Data'* issued by the National Bureau of Statistics China on the 9th September 2011 and available at http://www.stats.gov.cn/tjsj/ndsj/2010/indexch.htm

- NCPG encompasses 6 provinces, cities and autonomous regions (Shandong, Beijing, Tianjin, Hebei, Shanxi and Inner Mongolia), this areas is a large geographical region with a population of 230 million residents.
- A number of key economic factors vary from province to province including: tariff rates on 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 loans that can be obtained; all of which alter the investment climate between provinces.
- Shanxi is the province with the largest coalmine reserves in China, 27.02% of the total reserve in China[68]" and is a good representative area to conduct a common practice analysis.

Therefore, only projects within the same province can be truly comparable.

ii. Projects with installed capacities within a range between -50% and +50% of the proposed project and employing the same technology are defined as comparable projects. This is because different project scales may lead to variations in the ratio of investment risk and ongoing cost and operation cost etc. Based on this principle, projects with installed capacities between 5 MW and 15 MW are included in the range of similar projects.

iii. Projects employing both domestic and foreign technologies using CMM to generate electricity are included in the range of comparable projects.

In total, 59 CMM utilisation projects were identified in Shanxi Province and examined for the common practice analysis. Firstly, a +/-50% range was applied to the proposed project's output to determine the comparable capacity range to be used in the analysis. Within the comparable range (5MW - 15MW), 20 other projects were identified and are given in the table below

	Project Name	**Installation capacity**	**Applied for CDM**
1	Shanxi Majunyu CMM Power Generation Project	5MW	Yes Webhosted (UNFCCC)
2	Shaqu 14MW CMM Power Generation Project in Shanxi Province (Phase I)	14 MW	Yes (3190)
3	Shanxi Yaoyuan Coal Mine Methance Developing Co., Ltd, Coal Mine Methance (Coal Mine Gas) Unilization (Nanyu) Project	10MW	Yes Webhosted (UNFCCC)
4	Coal Mine Methane (CMM) and Ventilation Air Methane (VAM) Comprehensive Utilization Project of Taiyuan, Shanxi Province	10MW	Yes Webhosted (UNFCCC)
5	Yanguan Nanmei (Group) Co. Ltd. Coalmine Methance Utilization Project (Project set up two separate 5 MW power plants at Nanzhuang and Dayangquan Coalmine.	10 MW	Yes (3016)
6	Hengtai Huanghou Coal Mine 5 MW CMM Power Project This project is part of the registered project: Shanxi Coal Transport Market Co., Ltd. Yangquan Branch CMM	5MW	Yes (1319)

[68] '*Shanxi Coal reserve evidence*' issued by Shanxi Province NDRC on 12th October 2008 and available at http://www.shanxigov.cn/n16/n8319541/n8319612/n8321708/n8321873/8394807.html

	Utilization Project (1319)		
7	Xingyu Coal Mine CMM to Power Generation Project	10 MW	Yes Webhosted (UNFCCC)
8	Shanxi Wangpo Low Concentration Coal Mine Methane Utilization Project	7MW	Yes (4534)
9	Tunlan Coal Mine Methane Utilization Project, Shanxi Province, People's Republic of China	7.5MW	Yes (3067)
10	SDIC Xiyang Huangyanhui CMM to Power Generation Project	10 MW	Yes (2929)
11	Yangquan Yinying Coal Mine Methane (CMM) Power Generation Project of Yangquan City, Shanxi Province, P.R.China	5 MW	Yes (3266)
12	Qinxin CMM Power Generation Project	6MW	Yes (3200)
13	Shanxi Liulin Coal Mine Methane Utilization Project	12 MW	Yes (1230)
14	Shanxi Jincheng Daning Coalmine CMM power generation project (PP is Jincheng City Fengrun CMM Utilization Co. Ltd. project was set up at Daning and Nanaosi Coalmine)	15 MW	Yes Webhosted (UNFCCC)
15	Shanxi Xiyang Fenghui Coal Industry Co. Ltd. Mahui Coal Mine Utilization for Power Generation Project	10 MW	Yes Webhosted (UNFCCC)
16	Duerping Coal Mine Methane Utilization Project	12 MW	Yes (1929)
17	Yangquan Coal Mine Methane (CMM) Utilization for Power Generation Project, Shanxi Province, China (Chengzhuang Coalmine CMM power generation project is part of the registered project: Shanxi Coal Transport Market Co., Ltd. Yangquan Branch CMM Utilization Project (1319))	8 MW (Chengzhuang Coalmine)	Yes (1319)
18	Huineng Coal Industry 12MW CMM Power Project http://www.sxdrc.gov.cn/xxlm/xny/zhdt/201203/t20120322_64189.htm	12MW	Yes, project approved by Shanxi Provincial NDRC recently (22nd Mar 2012) and listed on UNFCCC as undergoing Validation.
19	Xiyang Fengyuan Anping CMM Power Project http://www.sxdrc.gov.cn/xxlm/xny/zhdt/201206/t20120612_64893.htm	12MW	No
20	Qinshui Longxin CMM Power Project http://www.sxdrc.gov.cn/xxlm/nyfz/zhdt/201108/t20110808_24785.htm	8MW	No

Projects 19 and 20 in the table above are within the comparable capacity range of the proposed project and have not registered for CDM but can be ruled out as similar projects for the following reasons:

- The Xiyang Fengyuan Anping CMM Power Project (12MW) was approved by local government very recently during the month of June 2012[69] and has not yet applied for CDM. However, this project can be excluded from the analysis since it is not yet in operation.
- The Qinshui Longxin CMM Power Project (8MW) does not apply for CDM, however, involves an investment of only 17.41 million RMB[70]. Little information is available on the technologies used in this project however, applying the same operating conditions as the proposed project, this project would generate 46,080MWh annually (7,200hrs * 8MW * 80%). Therefore, as per paragraph 9.(e) of the '*Tool for the demonstration and assessment of additionality (ver 6.0)*' this project is considered a different technology as it's unit cost of output differs from the proposed project by more than 20% (i.e. 377.8RMB/MWh compared to 744.4RMB/MWh).

Based on the analysis of the 20 projects within the comparable capacity range and given in the table above:

- 11 projects are registered as CDM projects
- 7 projects have been webhosted on the UNFCCC website and have commenced the CDM process
- 2 projects have been excluded due in-operation and technological differences respectively

Therefore, all projects can be excluded based on the paragraph 44 of the '*Tool for the demonstration and assessment of additionality (ver 6.0)*' and it is determined that there are no similar projects to the proposed project. Therefore, proposed project is not common practice in Shanxi Province.

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 projects that have proceeded without the CDM. This further demonstrates the barriers that the project faces and that the project is additional.

To summarize, without CERs sales revenues, the project IRR of the project activity is lower than the benchmark value and the project is therefore not financially feasible. Under such circumstances, it is difficult to implement and operate the project activity. Being registered as a CDM project, CERs sales revenues can improve the project IRR above the benchmark value thus help the project activity to overcome investment barrier.

Therefore the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>
The emission reductions by the project during a given year y is the difference between baseline emissions and project emissions, as follows:

$$ER_y=BE_y-PE_y-LE_y \quad (1)$$

[69] '*Xiyang County Fengyuan construction approval*' issued by Shanxi Provincial NDRC on 12/6/2012. Available at http://www.sxdrc.gov.cn/xxlm/xny/zhdt/201206/t20120612_64893.htm

[70] '*Longxin CMM power generation project approval*' issued by Shanxi Provincial NDRC on 1th December 2008. Available at http://www.shanxigov.cn/n16/n1398/n2108/n5685/n29607/779271.html

Where:
ER_y: emission reductions of the project activity during the year y (tCO_2e);
BE_y: baseline emissions during the year y (tCO_2e);
PE_y: project emissions during the year y (tCO_2e);
LE_y: leakage emissions in year y (tCO_2e).

The baseline emissions, project emissions and leakage emissions have to be determined in order to calculate the emission reductions.

1. Baseline emissions:
Baseline emissions are given by the following equation:

$$BE_y=BE_{MD,y}+BE_{MR,y}+BE_{Use,y} \quad (2)$$

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).

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

All of the CMM captured in baseline scenario will be vented without any utilization, therefore, $BE_{MD,y}$=0.

1.2 Methane released into the atmosphere ($BE_{MR,y}$)
All the extracted coalmine gas will release into the atmosphere. But only the portion of CMM sent to the project activity is accounted for in this calculation. The methane that is still vented in the project activity is excluded from both baseline emissions and project emissions since it is vented in both situations.

In practice, the pre-mining and post-mining methane are indistinguishable, being extracted through the same pumping system in proportions that vary depending on mining activities, atmospheric pressure changes and day to day management of the ventilation systems.

$$BE_{MR,y}=GWP_{CH4}x\left(\sum_i(CMMPJi,y-CMMBLi,y)+\sum_i(PMMPJi,y-PMMBLi,y)\right)$$

$$= GWP_{CH4}\ x(CMM_{ELEC,y}+PMM_{ELEC,y})=GWP_{CH4}\ x\ MM_{ELEC,y} \quad (3)$$

Where:

$BE_{MR,y}$	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 users)

$CMM_{PJi,y}$	Pre-mining CMM captured, sent to and destroyed by use i in the project activity in year y（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（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）
GWP_{CH4}	Global warming potential of CMM，21tCO_2e/tCH_4
$MM_{ELE,yC}$	The amount of methane sent to power generation equipment in year y（tCH_4）,which is measured by the monitoring device that is installed on distribution pipe line

1.3 Emissions from power/heat generation replaced by project ($BE_{Use,y}$)

The electricity generated by this project will displace the equivalent electricity purchased from China Northern Power Grid. There is no heat supply in the project.

$BE_{Use,y}$ is calculated by the use of following formula:

$$BE_{Use,y} = GEN_y \times EF_{ELEC} + HEAT_y \times EF_{HEAT}$$

$$= GEN_y \times EF_{ELEC} \qquad (4)$$

Where:

$BE_{Use,y}$	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 the project activity in year y（MWh）
EF_{ELEC}	emission factor of the North China Power Grid（tCO_2e/MWh）
$HEAT_y$	heat generation by the project activity in year y（GJ）
EF_{HEAT}	emission factor for heat production replaced by project activity（tCO_2/GJ）

1.3.1 Emission factor of power grid (EF_{ELEC})

Sub step 1. Identify the relevant electricity systems

In accordance with the *Tool to Calculate the Emission Factor for an Electricity System*, the project electricity system of the Project is identified according to the delineation of the project electricity system and connected electricity systems published by China's DNA.

According to the *2010 Baseline Emission Factors for Regional Power Grids in China* issued by China's DNA which provides the delineation of relevant electric power systems, Northwest Power Grid is the relevant electric power system of the Project. Northwest Power Grid is composed of Shandong, Shanxi, Beijing, Tianjin, Hebei, Inner Mongolia provincial grids.

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

In accordance with the *Tool to Calculate the Emission Factor for an Electricity System*, project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

The project participants choose Option I: Only grid power plants are included in the calculation as the way to calculate the operating margin and build margin emission factors.

Sub step 3. Select a method to determine the operating margin (OM)

The Operating Margin emission factor ($EF_{OM,y}$) is calculated based on one of the four following methods:

- Simple OM;
- Simple adjusted OM;
- Dispatch data analysis OM;
- Average OM.

'Simple OM' (1) method is applicable to this project activity as in the last five years the low cost/must run resources had constituted less than 50% of generation in the project power grid, the North China Power Grid. The data in the table below illustrates this point.

Table B6-1 Power generation mix of North China Power Grid for most recent five years

Energy Source	**2004**	**2005**	**2006**	**2007**	**2008**
Total Power Generation (GWh)	530,804	607,782	609,971	847,500	716,694
Total Low-cost/must run resources (GWh)	4032	4551	4804	7640	9110
Percentage of Low cost/must run resources % of the total grid generation (GWh)	0.8	0.7	0.8	0.9	1.3
Data Source	2005/P474	2006/P568	2007/P638	2008/P733	2009/P716

Data Sources: *China Electric Power Yearbook (2005-2009)*

Note: Only nuclear/renewables are considered low-cost/must-run. The emission factors were determined ex ante (A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation) and will not be updated during the first crediting period.

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

Three options are provided in the *Tool to Calculate the Emission Factor for an Electricity System* for the determination of the simple OM emission factor ($EF_{grid,OMsimple,y}$). Since 1) the data on net electricity

generation and a CO_2 emission factor of each power unit in Northwest Power Grid are not available; 2) only 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; and 3) Off-grid power plants are not included in the calculation, Option B (based on data on the total net electricity generation of all power plants / units serving the system and the fuel types and total fuel consumption of the project electricity system) is adopted to calculate the simple OM emission factor ($EF_{grid,OMsimple,y}$). The formula of $EF_{grid,OMsimple,y}$ calculation is

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \quad (5)$$

Where:

$EF_{grid,OMsimple,y}$	is the simple operating margin CO2 emission factor in year *y* in tCO2/MWh;
$FC_{i,y}$	is the amount of fossil fuel type *i* consumed in the project electricity system in year *y* in mass or volume unit;
$NCV_{i,y}$	is the net calorific value (energy content) of fossil fuel type *i* in year *y* in GJ/mass or volume unit;
$EF_{CO2,i,y}$	is the CO_2 emission factor of fossil fuel type *i* in year *y* in tCO2/GJ;
EG_y	is the 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* in MWh;
i	are all fossil fuel types combusted in power sources in the project electricity system in year *y*;
y	is the relevant year as per the data vintage chosen in Step 3.

With reference to the *2010 Baseline Emission Factors for Regional Power Grids in China*, the simple OM emission factor ($EF_{grid,OM,y}$) of North China Power Grid is 0.9914 tCO_2e/MWh (see Annex 3 for details).

Sub step 5. Identify the group of power units to be included in the build margin

The sample group of power units 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.

Due to data availability, the latest clarification from CDM EB is applied. And option (b) is used to calculate build margin.

In terms of vintage of data, there are also two options:

Option 1. For the first crediting period, calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group *m* at the time of 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.

Option 2. For the first crediting period, the build margin emission factor shall be updated annually, *ex-post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex-ante*, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

And option 1 is used for the proposed project.

Sub step 6. Calculate the build margin emission factor

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (6)$$

Where:

$EF_{grid,BM,y}$ is the build margin CO2 emission factor in year *y* in tCO2/MWh;

$EG_{m,y}$ is the net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* in MWh;

$EF_{EL,m,y}$ is the CO2 emission factor of power unit m in year y in tCO2/MWh;

m is the power units included in the build margin;

y is the most recent historical year for which power generation data are available.

Since there is no way to separate the different generation technology capacities as fuel coal, fuel oil, fuel gas etc from thermal power based on the present statistical data, the following calculating measures will be taken: First, according to the energy statistical data of most recent one year, determine the ratio of CO_2 emissions produced by solid, liquid, and gas fuel consumption for power generation; then multiply this ratio by the respective emission factors based on commercially available best practice technology in terms of efficiency. Finally, this emission factor for thermal power is multiplied with the ratio of thermal power identified within the approximation for the latest 20% installed capacity addition to the grid. The result is the BM emission factor of the grid.

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

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (7)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (8)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (9)$$

Where:

$FC_{i,j,y}$	is the amount of fuel i consumed by power plant /unit j in year(s) y in mass or volume unit;
$NCV_{i,y}$	is the net calorific value (energy content) of fossil fuel type i in year y in GJ/mass or volume unit;
$EF_{CO2,i,y}$	is the CO_2 emission factor of fossil fuel type i in year y in tCO_2/GJ.

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

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

$$EF_{Thermal} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Coal,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (10)$$

Where:

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

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

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (11)$$

Where:

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

With reference to the *Notification on Determining Baseline Emission Factor of China's Grid in 2010*[71], which uses data from 2007, 2008 and 2009, the Build Margin emission factor ($EF_{BM,y}$) of the NCPG is 0.7495t CO_2e/MWh.

As mentioned above, the build margin emission factor of the baseline is calculated ex-ante and will not be renewed in the first crediting period.

[71] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2552.pdf

Sub step 7. **Calculate the combined margin emissions factor (EF_y)**

The baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$), where the weights $\omega_{OM,y}$ and $\omega_{BM,y}$ by default, are 50% (i.e., $\omega_{OM,y}$ = $\omega_{BM,y}$ = 0.5) in the first crediting period, and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described above and are expressed in tCO_2/MWh.

$$EF_y = \omega_{OM} \times EF_{grid,OM,y} + \omega_{BM} \times EF_{grid,BM,y} \quad (12)$$

1.3.2 Emission factor for heat generation (*EF_{HEAT}*)

The baseline scenario includes existing heat generation that is replaced by the project activity. The emission factor for displaced heat generation is calculated as follows:

$$EF_{heat,y} = \frac{EF_{CO2,i}}{Eff_{heat}} \times \frac{44}{12} \times \frac{1TJ}{1000GJ} \quad (13)$$

Where:

$EF_{heat,y}$:	Emissions factor for heat generation in year y(tCO_2/GJ);
$EF_{CO2,i}$:	CO_2 emissions factor of fuel i used in heat generation (tC/TJ);
Eff_{heat} :	Boiler efficiency of the heat generation (%);
44/12 :	Carbon to Carbon Dioxide conversion factor;
1/1000 :	TJ to GJ conversion factor

Boiler efficiency is taken as 100% as defined in Option B of the relevant section of ACM0008.

2. Project emissions（*PE_y*）

Project emissions are defined by the following equation

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (14)$$

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) (14)

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

The methane used by this project was vented in baseline scenario. No additional energy is used in capturing methane. But some electricity is consumed in the course of power generation. Therefore,

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC} \quad (15)$$

Where:

PE_{ME}: Project emissions from energy use to capture and use methane(tCO_2e）；

$CONS_{ELEC,PJ}$: Additional electricity consumption for power generation by using of methane（MWh）

CEF_{ELEC}: CO_2 emission factor of the North China Power Grid（tCO_2e/MWh）.

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

The captured methane is used for power generation in this project. When the captured methane is burned in the engine, combustion emissions are released. In addition, if NMHC accounts for more than 1% by volume of the extracted coal mine gas, combustion emissions from these gases should also be included.

$$PE_{MD} = MD_{ELEC} \times (CEF_{CH4} + r \times CEF_{NMHC}) \quad (16)$$

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

Where:

PE_{MD}: Project emission from CMM/CBM destroyed（tCO_2e）;

MD_{ELEC}: Methane destroyed through power generation（tCH_4）;

CEF_{CH4}: Carbon emission factor for combusted methane (2.75tCO_2e/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) ($tCO_2e/tNMHC$）;

r : Relative proportion of NMHC compared to methane;

Pc_{CH4} : Concentration (in mass)of methane in extracted gas (%), measured in wet basis;

Pc_{NMHC} : NMHC concentration (in mass) in extracted gas (%).

$$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC} \quad (17)$$

Where:

MD_{ELEC}: Methane destroyed through power generation（tCH_4）;

MM_{ELEC}: Methane measured sent to power plant（tCH_4）;

Eff_{ELEC}: Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC).

2.3 Un-combusted methane from end uses (*PE_{UM}*)

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

$$PE_{UM} = GWP_{CH4} \times (MM_{ELEC} \times (1 - Eff_{ELEC})) \quad (18)$$

Where:

PE_{UM} : Project emission from un-combusted methane（tCO_2e）;

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

MM_{ELEC}: Methane measured sent to power plant（tCH_4）;

Eff_{ELEC}: Efficiency of methane destruction/oxidation in power plant（taken as 99.5% from IPCC）.

3. Leakage

The formula for leakage is given as follows:

$$LE_y = LE_{d,y} + LE_{o,y} \quad (19)$$

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).

There is no baseline thermal energy use of CMM therefore $LE_{d,y}$ is zero. As to other uncertainties, the project will not have any direct impact upon coal production (the newly coal mine) therefore it is not expected to have any impact upon coal prices and market dynamics, $LE_{o,y}$ is zero too. So that:

$LE_y = 0$

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

Many parameters listed in the methodology are related only to thermal or mechanical processes not involved in the project activity, or the utilization of CBM or VAM, neither of which is related to the project activity. To avoid confusion, parameters not used in the calculation of the emissions reductions of the proposed project have not been included in the table below.

Data / Parameter:	CEF_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Carbon emission factor for combusted methane
Source of data used:	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2Energy, Table 1.3 and 1.4, page 1.21-1.24, chapter 1. No country specific data is available.
Value applied:	2.75
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC default value
Any comment:	Low uncertainty

Data / Parameter:	GWP_{CH4}

Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of methane
Source of data used:	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2Energy, Table 1.3 and 1.4, page 1.21-1.24, chapter 1. No country specific data is available.
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC default value
Any comment:	Low uncertainty

Data / Parameter:	Installed capacity
Data unit:	kW
Description:	Installed capacity of provincial sub-girds in the North China Power Grid
Source of data used:	China Electric Power Yearbook 2007-2009
Value applied:	As per Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	The China Electric Power Yearbook 2007-2009 is an authoritative national publication.
Any comment:	Low uncertainty

Data / Parameter:	$EF_{Coal,Adv,y}$
Data unit:	%
Description:	Electricity supply efficiency of the best commercially available technology for coal-fired power generation in China.
Source of data used:	Chinese DNA: Bulletin on China's Regional Grid Baseline Emission Factor 2010
Value applied:	39.08%
Justification of the choice of data or description of measurement methods and procedures actually applied:	Bulletin on China's Regional Grid Baseline Emission Factor 2010
Any comment:	Low uncertainty

Data / Parameter:	$EF_{Gas,Adv,y}$
Data unit:	%
Description:	Electricity supply efficiency of the best commercially available technology for gas-fired power generation in China.
Source of data used:	Chinese DNA: Bulletin on China's Regional Grid Baseline Emission Factor 2010
Value applied:	51.46%

Justification of the choice of data or description of measurement methods and procedures actually applied:	Bulletin on China's Regional Grid Baseline Emission Factor 2010
Any comment:	Low uncertainty

Data / Parameter:	$EF_{Oil,Adv,y}$
Data unit:	%
Description:	Electricity supply efficiency of the best commercially available technology for oil-fired power generation in China.
Source of data used:	Chinese DNA: Bulletin on China's Regional Grid Baseline Emission Factor 2010
Value applied:	51.46%
Justification of the choice of data or description of measurement methods and procedures actually applied:	Bulletin on China's Regional Grid Baseline Emission Factor 2010
Any comment:	Low uncertainty

Data / Parameter:	$CAP_{Thermal,y}$
Data unit:	MW
Description:	The newly added thermal power capacity in the project electricity system, NCPG, in year *y*
Source of data used:	China Electric Power Yearbook 2007-2009
Value applied:	See annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	Official publication. Publicly accessible and reliable data source.
Any comment:	Low uncertainty

Data / Parameter:	$CAP_{Total,y}$
Data unit:	MW
Description:	The total newly added capacity in the project electricity system, NCPG, in year *y*
Source of data used:	China Electric Power Yearbook 2007-2009
Value applied:	See annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Official publication. Publicly accessible and reliable data source.

Any comment:	Low uncertainty

Data / Parameter:	NCV_i
Data unit:	GJ/tce or m^3
Description:	Net calorific value of fuel *i*
Source of data used:	China Energy Statistical Yearbook 2007-2009
Value applied:	As per Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	China Energy Statistical Yearbook 2007-2009,
Any comment:	Low uncertainty

Data / Parameter:	$F_{i,j,y}$
Data unit:	t or m^3
Description:	The amount of fuel i (in a mass or volume unit) consumed by relevant provincial sub-grid j in year y.
Source of data used:	China Energy Statistical Yearbook 2007-2009
Value applied:	As per Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	The China Energy Statistical Yearbook 2007-2009 is published by the NDRC and can be considered an authoritative national publication.
Any comment:	Low uncertainty

Data / Parameter:	EF_i
Data unit:	tC/TJ
Description:	The carbon emission factor per unit of energy of the fuel i
Source of data used:	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2Energy, Table 1.3 and 1.4, page 1.21-1.24, chapter 1. No country specific data is available.
Value applied:	As per Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC default value
Any comment:	Low uncertainty

Data / Parameter:	Eff_{ELEC}
Data unit:	%
Description:	Efficiency of methane destruction / oxidation in power plant
Source of data used:	ACM0008 (Version 7)
Value applied:	99.5%

Justification of the choice of data or description of measurement methods and procedures actually applied:	ACM0008 (Version 7) specifies this value to be applied.
Any comment:	Low uncertainty

Data / Parameter:	$EF_{CM,grid,y}$
Data unit:	tCO_2e/MWh
Description:	CO_2 emission factor of the NCPG
Source of data used:	Calculated
Value applied:	0.87045
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated as per "Tool to calculate the emission factor for an electricity system" in Section B.6.3.
Any comment:	Low uncertainty

Data / Parameter:	$EF_{OM,grid,y}$
Data unit:	tCO_2e/MWh
Description:	CO_2 operating margin emission factor of the NCPG
Source of data used:	Published information from the Chinese DNA Available at: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2552.pdf
Value applied:	0.9914
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated as per "Tool to calculate the emission factor for an electricity system". See annex 3 for details.
Any comment:	Low uncertainty

Data / Parameter:	$EF_{BM,grid,y}$
Data unit:	tCO_2e/MWh
Description:	CO_2 build margin emission factor of the NCPG
Source of data used:	Published information from the Chinese DNA Available at: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2552.pdf
Value applied:	0.7495
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated as per "Tool to calculate the emission factor for an electricity system". See annex 3 for details.
Any comment:	Low uncertainty

Data / Parameter:	D_{CH4}
Data unit:	tCH_4/m^3CH_4
Description:	Density of methane
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.00067
Justification of the choice of data or description of measurement methods and procedures actually applied:	Actual density will be measured onsite.
Any comment:	Low uncertainty

B.6.3 Ex-ante calculation of emission reductions:

>>

Some basic data used in calculating baseline and project emission is listed in table B.6-1

Table B.6-2 Basic data for the estimation of emission reductions

Data	**Value**	**Remarks**
Annual methane consumption by power generation plant (m^3)	54,857,142	Based on the Feasibility Study
Methane concentration (%)	35	Based on the Feasibility Study
The proportion of electricity consumed by project activity (%)	10	Based on the Feasibility Study
Methane density under normal conditions （tCH_4/m^3CH_4）	0.00067	2006 IPCC Guidelines for National Greenhouse Gas Inventories
The amount of methane consumed by the power station in one year (tCH_4)	12,864	Based on the Feasibility Study 54,857,142 m^3 CH_4 x 35%x 0.00067 tCH_4/m^3CH_4 =12,864 tCH_4
Power generated by the project (net of auxiliary consumption) in year y (MWh)	51,840	Based on the Feasibility Study

1. Estimated baseline emissions

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

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

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

$$BE_{MR,y} = GWP_{CH4} \times MM_{ELEC} = 21tCO_2e/tCH_4 \times 12{,}864tCH_4/year$$

=270,144 tCO_2e/year

1.3 Emissions from power/heat generation replaced by project ($BE_{Use,y}$)
GEN_y = 51,840 MWh
GEN_y is the power generated by the project (net of auxiliary consumption) in year y (MWh)

Due to the altitude and the temperature of the project site a deduction of 20% of the possible power output is adopted, which is caused by a reduction of the turbo charger capacity that appears at higher altitudes with less air density.

Calculation of the Grid emissions factor

Step 1. Calculate the operating margin emission factor $EF_{OM,grid,y}$

The value of $EF_{OM,grid,y}$ used in this document is 0.9914 tCO_2e/MWh from the data and calculation results published by the Chinese DNA[72].

Step 2. Calculate the build margin emission factor $EF_{BM,grid,y}$

The value of $EF_{BM,grid,y}$ used in this document is 0.7495 tCO_2e/MWh from the data and calculation results published by the Chinese DNA[73].

Step 3. Calculate the combined margin emission factor $EF_{CM,grid,y}$

$$EF_{CM,grid,y} = 0.5 \times EF_{OM,grid,y} + 0.5 \times EF_{BM,grid,y}$$
$$= 0.5 \times 0.9914 + 0.5 \times 0.7495 = 0.87045 \ tCO_2e/MWh$$

Therefore, the Emissions from power generation replaced by project ($BE_{Use,y}$) is calculated as follows

$$BE_{Use,y} = GEN_y \times EF_{CM,grid,y} = 51{,}840 MWh/year \times 0.87045 tCO_2e/MWh = 45{,}124 tCO_2e/year$$

Therefore, baseline emissions are;

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$$
$$= 0 + 270{,}144 + 45{,}124 = 315{,}268 tCO_2e/year$$

1.4 calculation of Baseline Emission
Note that in the figures for Baseline Emissions in the Table below, operation for the first year of the project (1/12/2012 – 30/11/2013) is only 80% of capacity, leading to an adjustment in the figures for years 2012 and 2013.

Year	BE_{MD} (tCO_2e)	BE_{MR} (tCO_2e)	BE_{use} (tCO_2e)	BEy (tCO_2e)
1/12/2012-31/12/2012	0	18,010	3,008	21,018

[72] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2552.pdf

[73] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2552.pdf

2013	0	220,618	36,851	257,469
2014	0	270,144	45,124	315,268
2015	0	270,144	45,124	315,268
2016	0	270,144	45,124	315,268
2017	0	270,144	45,124	315,268
2018	0	270,144	45,124	315,268
2019	0	270,144	45,124	315,268
2020	0	270,144	45,124	315,268
2021	0	270,144	45,124	315,268
1/1/2022 - 30/11/2022	0	247,632	41,364	288,996
Total	**0**	**2,647,411***	**442,215**	**3,089,626***

* As decimals are not provided for in tables in the PDD template, the entries in each row have been rounded to the nearest whole. The summation figures in the bottom row are correct as per the ER calculation spreadsheet. Refer to the ER calculation sheet for detailed calculation.

2.Project emissions（PE_y）

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

$PE_{ME} = 0tCO_2$

Since GEN_y was calculated based on the net output which has deducted the 10% auxiliary self-usage electricity, therefore the PE_{ME} equals to 0.

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

$PE_{MD} = MM_{ELEC}\ x\ Eff_{ELEC}\ x\ CEF_{CH4} = 12{,}864tCH_4/year\ x\ 99.5\%\ x\ 2.75tCO_2e/tCH_4$

$= 35{,}199tCO_2/year$

2.3 Un-combusted methane from end uses (PE_{UM})

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

$= 21tCO_2e/tCH_4\ x\ 12{,}864tCH_4/year\ x\ (1-99.5\%) = 1{,}351tCO_2e/year$

Therefore, project emission $PE_y = 0 + 35{,}199 + 1{,}351 = 36{,}550CO_2e/year$

2.4 Project Emissions Calculation

In the first year 1/12/2012 – 30/11/2013 of the project activity, all the equipments are in trial operation. Therefore, engines are run at 80% of normal operation level, thus more un-combusted methane will be released into the atmosphere. From 1/12/2013, the project will operate under normal conditions.

Year	PE_{ME} (tCO_2e)	PE_{MD} (tCO_2e)	PE_{UM} (tCO_2e)	PE_y (tCO_2e)
1/12/2012-31/12/2012	0	2,347	90	2,437
2013	0	28,746	1,104	29,849
2014	0	35,199	1,351	36,550
2015	0	35,199	1,351	36,550

2016	0	35,199	1,351	36,550
2017	0	35,199	1,351	36,550
2018	0	35,199	1,351	36,550
2019	0	35,199	1,351	36,550
2020	0	35,199	1,351	36,550
2021	0	35,199	1,351	36,550
1/1/2022 - 30/11/2022	0	32,266	1,238	33,504
Total	**0**	**344,950***	**13,240**	**358,190**

***** As decimals are not provided for in tables in the PDD template, the entries in each row have been rounded to the nearest whole. The summation figures in the bottom row are correct as per the ER calculation spreadsheet. Refer to the ER calculation sheet for detailed calculation.

3. Leakage

As stated in section B.6.1, no leakage is considered for the project activity, so that LE_y = 0.

4. Emission reductions

$ER_y = BE_y - PE_y - LE_y$

$= 315,268 – 36,550 - 0$

$= 278,718 tCO_2e/year$

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

>>

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
1/12/2012-31/12/2012	2,437	21,018	0	18,581
2013	29,849	257,469	0	227,620
2014	36,550	315,268	0	278,718
2015	36,550	315,268	0	278,718
2016	36,550	315,268	0	278,718
2017	36,550	315,268	0	278,718
2018	36,550	315,268	0	278,718
2019	36,550	315,268	0	278,718
2020	36,550	315,268	0	278,718
2021	36,550	315,268	0	278,718
1/1/2022 - 30/11/2022	33,504	288,996	0	255,492
Total (tCO_2e)	**358,190**	**3,089,626***	**0**	**2,731,436***

* As decimals are not provided for in tables in the PDD template, the entries in each row have been rounded to the nearest whole. The summation figures in the bottom row are correct as per the ER calculation spreadsheet. Refer to the ER calculation sheet for detailed calculation.

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

B.7.1 Data and parameters monitored:

Many parameters listed in the methodology are related only to thermal or mechanical processes not involved in the project activity, or the utilization of CBM or VAM, neither of which is related to the project activity. To avoid confusion, parameters not used in the calculation of the emissions reductions of the proposed project have not been included in the table below.

Data / Parameter:	MM_{ELEC}
Data unit:	tCH_4
Description:	Methane sent to power generators
Source of data to be used:	Measured by a flow meter on the inlet to each generator and summed. Temperature and pressure will be recorded for flow adjustment
Value of data applied for the purpose of calculating expected emission reductions in section B.5	12,864.67 tCH_4
Description of measurement methods and procedures to be applied:	Continuous monitoring and monthly recording, A flow meter with differential pressure measurement function will be used to determine the flow to all generator sets.
QA/QC procedures to be applied:	Data will be backed up and archived in two different locations, where it will be stored for a period of two years after the crediting period or two years after the last issuance of CERs. Flow meters will be calibrated according to the manufacturer's specifications. Mine drainage data will be available to crosscheck measured data if required.
Any comment:	-

Data / Parameter:	PC_{CH4}
Data unit:	%
Description:	Concentration (in mass) of methane (wet basis) in drained gas
Source of data to be used:	Methane meter at the inlet to power generation plant (post CMM treatment)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	35%
Description of measurement methods and procedures to be applied:	Daily monitoring and monthly recording. Methane concentration will be measured by infra red instrumentation mounted in the gas pipework between the gas treatment package and the generator sets
QA/QC procedures to be applied:	Data will be backed up and archived in two different locations, where it will be stored for a period of two years after the crediting period or two years after the last issuance of CERs. Methane meters will be calibrated according to the manufacturer's specifications. Methane concentration of CMM fed to the generators will be checked against coalmine methane drainage data.
Any comment:	Measured on a wet basis

Data / Parameter:	PC_{NMHC}

Data unit:	%
Description:	NMHC concentration (by mass) in coal mine methane
Source of data to be used:	Will be determined from annual tests of samples of coal mine gas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable at this stage because the sum of all non-methane hydrocarbons in gas samples is less than 1% and therefore can be ignored.
Description of measurement methods and procedures to be applied:	Annually monitoring and recording, samples of gas will be extracted into gas sampling bottles using the appropriate procedures and analyzed by an accredited laboratory, for example, TES Bretby in the UK or an equivalent in China.
QA/QC procedures to be applied:	A minimum of 3 samples will be collected in secure gas bottles, suitable for storage and transport to the selected laboratory. The bottles will be filled by following the manufacturer's procedures. If one or more samples are found to be faulty (i.e. leaked) replacement samples will be taken. Scanned copies of the analyses will be backed up and archived in two different locations, where they will be stored for a period of two years after the crediting period or two years after the last issuance of CER's.
Any comment:	-

Data / Parameter:	GEN_y
Data unit:	MWh
Description:	Net Electricity generated by the project activity in year *y*
Source of data to be used:	Monitored data from installed ammeters.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	51,840 according to FSR
Description of measurement methods and procedures to be applied:	The readings of electricity meter will be continuously measured and monthly recorded. Automatic measurement and automatic recording will be made by computers. Double checking by the receipt of electricity sales.
QA/QC procedures to be applied:	The uncertainty level of this data is low. The meters will be installed following manufacturers' instructions. The measurement/ monitoring equipment should adopt the colligated automation system complying with national standard and technology. These equipment and systems should be calibrated and checked every year.
Any comment:	Monitoring point will be at the transformer station where the project connects to the grid as per Figure B.7-2.

Data / Parameter:	$CONS_{ELEC}$
Data unit:	MWh
Description:	Additional electricity consumption for capture and use or destruction of methane, if any
Source of data to be	Readings from installed Ammeters

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to the FSR, $CONS_{ELEC}$ is estimated to be 10% of the power generated by the CMM power plant. With annual power generation of 57,600MWh, the project own consumption is estimated with 5,760MWh.
Description of measurement methods and procedures to be applied:	Continuously measured and recorded monthly.
QA/QC procedures to be applied:	The electricity meter will be subject to regular (according to manufacturer specifications) maintenance and testing to ensure ongoing accuracy.
Any comment:	-

Data / Parameter:	CEF_{NMHC}
Data unit:	tCO_2/tNMHC
Description:	Carbon emission factor for combusted non methane hydrocarbons
Source of data to be used:	Annual laboratory testing results
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	To be obtained through annual analysis of the fractional composition of captured gas. If NMHC concentration is less than 1%, its emissions can be ignored.
QA/QC procedures to be applied:	Testing to be undertaken by an independent and appropriately certified laboratory.
Any comment:	-

B.7.2 Description of the monitoring plan:

>>

A monitoring plan will be implemented to ensure that the approved monitoring methodology ACM0008 (Version 07) is correctly implemented in order to enable the accurate and transparent determination of avoided emissions. The plan will incorporate the QA/QC procedures described in 7.1 above.

1. Parameters to be monitored

The following four parameters will be monitored:

- Volume of methane sent to power generators (MM_{ELEC});
- Percentage of pure methane (wet basis) in drained gas (by volume)(PC_{CH4});
- Electricity generated by the project activity in year *y* (GEN_y)
- Additional electricity consumption for capture and use or destruction of methane ($CONS_{ELEC}$)
- NMHC concentration in coal mine methane (PC_{NMHC}) to be monitored once a year.

2. Management structure for the implementation of monitoring plan

A specific CDM department will be established by the project owner and a CDM manager will be appointed with responsibility for the implementation of the monitoring plan. The structure for the CDM department is shown below.

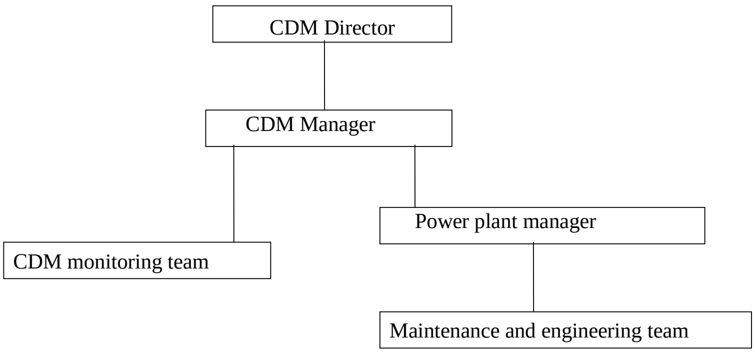


Figure B.7-1 Management structure for the proposed CDM project

All monitored data will be checked and signed off by the CDM manager who will also be responsible for preparing documents required for verification. In addition, the CDM manager will arrange for an audit of the management system periodically and at least once per year. The auditor will not be involved in the daily operation of the power plant and if necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure and the preparation of the monitoring report. Audit findings, and steps taken to address findings will be recorded and reviewed in a Management Review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed and necessary changes implemented.

A CDM monitoring team will have day to day responsibilities for checking instrumentation, record keeping, data handling and data processing, filing, reporting, organizing maintenance and repair of monitoring equipment and ensuring the monitoring plan is adhered to as indicated in the approved methodology. The monitoring staff will receive technical and safety training. At least one member of the monitoring team who has undergone all necessary training courses will be present on every shift.

The PO, through the CDM monitoring team, will use relevant media and industry publications to stay abreast of applicable legal and regulatory requirements facing the utilization of CMM.

3. Monitoring equipment and its installation

The locations of methane flow monitoring and electric energy metering to the CMM utilization plant are shown in Figure B.7-2 below.

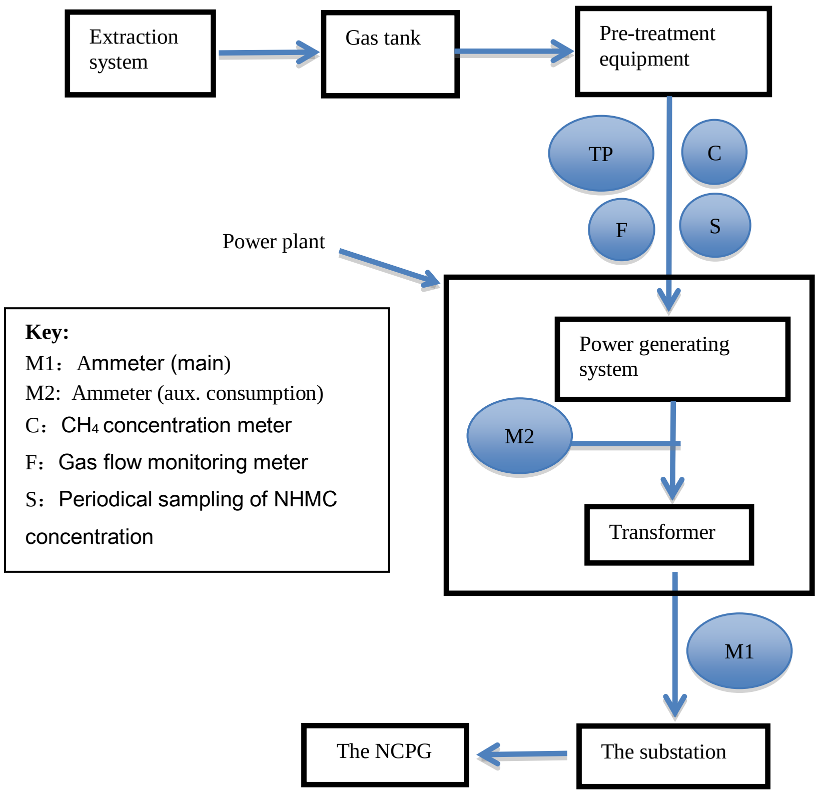


Figure B.7-2 Schematic figure on monitoring system

4. Measurement of Accuracy

The proposed project is still under construction; therefore the measurement equipment for the project has not yet been acquired. However, all the monitoring meters to be purchased and installed by the project participant MUST meet the relevant industry standards for measurement accuracy. As the project is still under construction, the compliance of installed meters with the appropriate national standards will be considered in the future verification of the project.

5. Data collection and management

The instruments installed in the proposed project include electricity meters, concentration meters and flow meter. All instruments will be in compliance with relevant national/sectoral standards and will be calibrated and maintained in accordance with the manufacturers' instructions and relevant national/sectoral standards. All relevant records will be kept for check. The following gives explanation respectively for electricity meters, concentration meters and flow meter.

- Electricity meters:

The electricity meters will be equipped according the requirements of the "*Verification Regulation of Electrical Energy Meters with Electronics (JJG596-1999)".*
The project will install an ammeter on the high voltage side (i.e. grid side) of the transformer. This meter (M1) will be used to measure the net electricity supplied to local power grid company (a back up meter will also be installed in case of the failure of M1). Meter M2 will be used to measure the electricity self used by the project. The accuracy of meters will meet the requirements of national/ industry standard.

The project owner is responsible for the installation of ammeters, and the local power grid company takes charge of checking and supervision. The ammeters should be examined and undergo regular calibration according to the relevant standards and regulations of the power industry so as to ensure the accuracy of the ammeters. After the examination, the meters should be sealed. The unlocking of the seals requires the presence of both the project owner and the grid corporation. One party must not open the seals or tamper with the ammeters without the presence of the other party. If any ammeter requires repair due to the inaccurate readings beyond the error range or the breakdown of the meters, the project owner and the grid corporation should jointly commission a qualified metering verification institution to make tests while the two parties should keep records on calibration and maintenance.

Every month, the grid corporation pays for the electricity based on the data from main gateway ammeter and the project owner provides invoices to the grid corporation. Once the inaccuracy of main gateway ammeter fails beyond the accepted range, data from the back-up ammeter will be used.

- Concentration meters and flow meter:

The concentration meters and flow meter need to be installed at the inlet of the generators. The flow meter measures the CMM entering the generators continuously. The concentration meters are adopted daily to measure the concentration of methane (in mass) in extracted gas (%, on wet basis). The concentration meters are adopted annually to measure the concentration of NMHC (in mass) in extracted gas (%, on wet basis). The personnel of the proposed project should record and collect the readings of the two instruments. Spot readings of other values (methane content, temperature and pressure) will also be recorded periodically and at the times when flow meter readings are taken. These instruments should be calibrated according to the manufacturers' instructions and relevant national/sectoral standards.

- Archiving of data:

The on-line monitoring system will automatically archive data in a safe manner. Electronic document will be saved in a disk for backup. Written document should be safely kept. Calibration data should be saved in a computer or disk. All information related to monitoring such as meeting minutes, data document, maintenance records, failure report, paper document as well as computer record, should be orderly kept at designated location. These data will be stored until 2 years after the final issuance of CERs from the project.

- Reporting Procedures:

• Internal reporting - The CDM monitoring team is responsible for reporting defects and corrective action to the CDM Manager. The CDM Manager 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.

6. Maintenance and calibration of meters

All metering equipment for monitoring will be chosen in accordance with CDM requirements and will be serviced by a qualified third party institute or returned to the manufacturer for maintenance and calibration. The specific technical and calibration standards to be applied to each meter will be in line with manufacturer recommendations.

Installed electricity meters will fulfill the requirements of "Verification Regulation of Electrical Energy Meters with Electronics (JJG596-1999)". A qualified and certified power measurement and inspection organization, entrusted jointly by the project owner and the grid company will undertake the testing of installed meters.

Annual testing by a third party institute will be used to monitor the NMHC concentration in the extracted gas. To assist future verifications, the PO will preserve the historical records from each subsequent testing.

An archive should be established for each meter. The content of the archive should include the location of the meter, serial number, calibration information (when last calibrated, when next due for calibration) and the name of the operator who has performed the calibration. Calibration certificates will be retained for all meters until two years after the end of the final issuance of CERs.

7. Treatment of missing or corrupted data

Where data in the on-line system are corrupted or missing whilst the generators are operating (as shown, for example, by electricity output) the missing data can be estimated by taking the lower of the average value for the parameter in question in the hour before the error arose or the hour immediately after the system came on-line again. If there is evidence to suggest that both of these values are un-representative, the average from the previous 24 hours will be used.

The error will be recorded in the daily log sheet and the occurrence of the error will be investigated and rectified as soon as possible. If the on-line system is compromised for more than 24 hours, data will be manually recorded.

Any deficiencies in methane flow monitoring data will be rectified by back calculation from power generation data.

8. Preparation of monitoring report

A monitoring report will be prepared by CDM department at the end of each year, which can be viewed as summary of monitoring work for the year and used by DOE for verification. The content of the monitoring report should include data monitoring and checking; calculation of emission reductions and record on maintenance and calibration of monitoring meters.

A monitoring plan will be implemented to ensure that the approved monitoring methodology ACM0008 version 07 is correctly implemented in order to enable the accurate and transparent determination of avoided emissions. The plan will incorporate the QA/QC procedures described in 7.1 above.

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

>>

Date of completion of baseline and monitoring study: 19/07/2010

Beijing OC New Energy Technology Ltd. Co.

7 F Pingan International Financial Center Tower B, No1-3, Xinyuan Nanlu, Chaoyang District, Beijing, 100027
Tel: 8613911179371
Ms. Chen Li Email: chenl@cozero.com.au
Mr. Geng Xiaofei Email: xgeng@cozero.com.au

The mentioned persons and entity here is not the project participants.

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:

>>
05/03/2010 (Construction started)

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

>>
11years

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:

>>
N/A

C.2.1.2. Length of the first crediting period:

>>
N/A

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/12/2012 or the date of registration, whichever is earlier.

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

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

>>

Under the law of environmental protection of China, the Environmental Impact Assessment of the project activity has been carried out by environmental protection Institute of Jincheng. Environmental Protection Bureau of Jincheng city has approved the EIA on December 20th 2008 (Approval No.[2008]209).

According to the EIA, the environmental impacts of the project activity and the corresponding controlling measures include:

1. Noises

The source of noise in construction period is mainly from construction machinery, which is usually between 80 to 95 dB(A). The source of noise in operation period is mainly from generator sets, compressor, pump and venting port, which is usually between 70 to 90dB (A).

Construction machinery with low noise level will be selected. Machinery with high noise level, such as pile engine, will not be allowed working during the night. The implementation of these measures will effectively reduce the noise level within the construction site during construction period. Equipment with low noise level will be used during operation period. Noise control measures like absorption and isolation as well as vibration absorption will be taken during operation period. The generator sets used by this project are enclosed in a cargotainer. The inner side of the cargotainer wall is covered with acoustical material. The beds on which the generator sets and the cargotainer are installed are equipped with damping device. Noise absorption device is installed at air inlet. Noise abatement device is installed at the exhaust port. The compressor is equipped with damping device and installed within a house, so that noise can be reduced as much as possible. Trees will be planted around the plant, which will reduce the influence to the environment by the noise.

After these measures being taken, the noise level within the plant can meet “Standard of noise at boundary of industrial enterprises-category III” (GB12348-90), namely: 65dB(A) for daytime and 55dB(A) for the night.

2. Sewage

The purpose on which water is used by this project is the supply of cooling water. The closed circulation cooling system is utilized, which makes the cooling water be recycled and not discharged. Little domestic sewage will be created and will be used for vegetation purposes. As a result, there will be no impact to surrounding water sources.

3. Air Pollution

The pollutant in the construction period is dust, which stems from transportation of construction materials and digging activity within the construction site. CMM belongs to clean energy, the composition of which includes CH_4, N_2, O_2, excluding H_2S and dust. The flue gas created during operation period doses not contain SO_2 and dust. Main pollutant is NO_x.

The soil and stone created in digging activity should be reused for refilling the pits in order to minimize the amount of taken soil. Dust from loose surface in construction period will be effectively abated by timely pressing the surface by a roller. With filtering device being used before CMM and air entering the gas engine, the content of dust in the flue gas can be effectively reduced. Through adjusting the ratio of

CMM to air, and controlling the combustion temperature within the cylinder, the NOx contents of the flue gas can be controlled. After these measures being taken, the emission of dust, SO_2 and NOx can meet the requirement stipulated in "Limits and Measurement Methods for Exhaust Pollutants from Compression Ignition and Gas Fuelled Positive Ignition Engines of Vehicles (IV)" (GB17691-2005).

4. Solid waste

Solid waste created during construction period mainly includes abandoned construction materials; solid waste during operation period mainly includes domestic garbage.
Measures taken includes: covering the vehicle to prevent construction materials from being lost during transportation, removing abandoned construction materials after construction being finished and sending domestic garbage to a landfill.

5. Land occupation and ecological impact

1620m^2 hectares of land will be occupied by the project. The type of land being occupied is wasteland, no farmland will be occupied.

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 EIA concludes that "The proposed project is in compliance with the national policies of industrial development, energy resource and environmental protection".

As shown above the environmental impacts of the project are not substantial.

SECTION E. Stakeholders' comments

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

>>

On May 19, 2009, a meeting for the local villagers was organized by the Project Owner in the meeting room of the company. Because the project is located in a rural area, the geographical barriers to attendance dictated that the project owner use telecommunications to broadcast the meeting with the assistance of local village committees. Stakeholders from the local community aged between 20 and 60 were first identified, and then selected from diversified ages, professions and education background based on the principle of representation and randomness, so as to reflect public opinion and concerns in a way of transparent and equality, and for those selected stakeholders were further invited to attend the meeting for the purpose of receiving the related opinions on the proposed project. The information of the Project was provided during the meeting, including the issues in respect of on energy resources, technology applied, economic benefit and environmental protection aspects, then followed by open discussion. In the end, questionnaires were distributed to the villagers and relative people to better understand stakeholders' comments.

The questionnaire is distributed to some of the residents from the near village and Wujia coal mine. A total of 40 questionnaires were distributed. 40 valid questionnaires were returned after the survey, and the returning rate is 100%.

Contents of the questionnaire:

1) Whether the project is understood;
2) Whether the project is constructed;
3) Negative or positive effect to local economy and environment;
4) Are there ecologically sensitive areas near the project?
5) What environmental effect brings by the project? eg. Noise, dust, water pollution and so on;
6) Are you satisfied with environmental measures taken in this project;
7) Do you think this project can effect local people;
8) Do you support this project;
9) Any suggestions or comments for this project;

E.2. Summary of the comments received:

>>

There were assigned people responsible for the recording of questionnaires and gathering the comments and suggestions. There are 9 terms in the questionnaire. The number of the questionnaires released this time is 40, and 40 questionnaires were reclaimed; the reclaim rate is 100%.

Table E.2-1 Structure of the respondents

Structure of gender		
Gender	**No.**	**Percentage (%)**
Male	32	80%
Female	8	20%

Structure of educational level		
Educational level	**No.**	**Percentage (%)**
Elementary school	16	40%
Senior middle school	20	50%
Junior middle school	4	10%

Structure of age		
Age	**No.**	**Percentage (%)**
20~30	6	15%
31~40	20	50%
41~50	12	30%
Over 50	2	5%

Comments received are as follows:

1) 100% stakeholders know this project well, 40% of them know it well;
2) 100% represents think this project is important to construct;
3) 100% represents think this project has positive effect to local economy and environment;
4) 100% represents think there isn’t ecologically sensitive area near this project;
5) 100% represents think this project brings no environmental effect;
6) 100% represents think the environmental protection measures in this project is acceptable;
7) 100% represents think this project is beneficial to local people, 97.5% of them think the project provide job opportunity;
8) 100% represents support this project;
9) 100% represents consider the project should speed project construction to reduce the environment impact during construction period.

It can be concluded from the above results that local residents expressed high support for the project as it has no adverse environmental impacts to the surrounding area. The feedbacks from local residents were almost all positive as their daily life would not be influenced by the project activity. This project can decrease the emission of CMM with no negative impacts on local residents and create new job opportunities. Local residents agree the construction of this project.

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

>>

Construction of the project received unanimous support from the stakeholders. No changes to the project design or construction or operation pattern of the project need to be made.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Jincheng Runhong New Energy Power Co., Ltd.
Street/P.O.Box:	
Building:	
City:	Jincheng City
State/Region:	Shanxi Province
Postfix/ZIP:	048026
Country:	P.R. China
Telephone:	0356-2085512
FAX:	0356-2085512
E-Mail:	yanxiangjin3418@126.com
URL:	
Represented by:	Yan Xiangjin
Title:	
Salutation:	Mr
Last Name:	Yan
Middle Name:	
First Name:	Xiangjin
Department:	
Mobile:	
Direct FAX:	+86 0356-2085512
Direct tel:	
Personal E-Mail:	yanxiangjin3418@126.com

Organization:	Originate Carbon Ltd
Street/P.O.Box:	PO Box 150, Herschel House, Herschel Steet
Building:	
City:	Slough
State/Region:	
Postcode/ZIP:	SL11PG
Country:	U.K
Telephone:	61 29 011 7808
FAX:	61 29 012 0385
E-Mail:	narmstrong@cozero.com.au
URL:	
Represented by:	Nicholas Armstrong
Title:	CEO
Salutation:	Mr
Last name:	
Middle name:	/
First name:	
Department:	/
Mobile:	/
Direct FAX:	61 29 011 7800
Direct tel:	61 29 012 0385
Personal e-mail:	narmstrong@cozero.com.au

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Calculation of Emission Factor in North China Power Grid

1. Calculation of the simple Operating Margin (*OM*) Emission Factor

Table A1. Total Emissions of the North China Power Grid in 2006

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Emission Factor	Oxidate Rate	Fuel emission factor	Low Caloric Value ($MJ/t,m^3,tce$)	CO_2 Emission (tCO_2e)
									(tc/TJ)	（%）	**($kgCO_2$ /TJ)**	**($MJ/t,km^3$)**	**L=G×J×K/100000(m)**
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	**J**	**K**	**L=G×J×K/10000 (m)**
Raw Coal	10^4t	796.63	1639.2	6867.99	6968.88	8404.05	10930.66	**35607.41**	25.8	100	87,300	20,908	649,930,803
Cleaned Coal	10^4t						39.77	**39.77**	25.8	100	87,300	26,344	914,643
Other Washed Coal	10^4t	6.36		214.13	371.14	61.77	544.6	**1198**	25.8	100	87,300	8,363	8,746,477
Briquette	10^4t	7.97					27.77	**35.74**	26.6	100	87,300	20,908	652,351
Coke	10^4t						3.23	**3.23**	29.2	100	95,700	28,435	87,896
Coke Oveb Gas	10^8m^3	0.38	0.63	5.8	22.32	0.64	5.79	**35.56**	12.1	100	37,300	16,726	2,218,517
Other Gas	10^8m^3	20.66	6.58	69.72	13.79	22.76	7.22	**140.73**	12.1	100	37,300	5,227	2,743,772
Crude Oil	10^4t					0.74		**0.74**	20	100	71,100	41,816	22,001
Gasoline	10^4t			0.01				**0.01**	18.9	100	67,500	43,070	291
Diesel	10^4t	0.21		3.01		0.07	6.32	**9.61**	20.2	100	72,600	42,652	297,577
Fuel Oil	10^4t	6.38		0.08			4.1	**10.56**	21.1	100	75,500	41,816	333,391
PLG	10^4t						0.01	**0.01**	17.2	100	61,600	50,179	309
Refinery Gas	10^4t			2.43			2.32	**4.75**	15.7	100	48,200	46,055	105,443
Natural Gas	10^8m^3	3.41	0.73		0.53			**4.67**	15.3	100	54,300	38,931	987,216
Other petroleum Products	10^4t						0.28	**0.28**	20	100	75,500	41,816	8,840
Other Coking Products	10^4t							**0**	25.8	100	95,700	28,435	0
Other Energy	10^4tce	6.83		47.11	230.76	12.51	132.29	**429.5**	0	0	0	0	0
												Total	667,049,525

Data sources: China Energy Statistical Yearbook 2007

Table A 2. Thermal Power Generation of the North China Power Grid in 2006

	Electricity Generation (MWh)	Used by the Power Plant (%)	Electricity supplied to the Grid (MWh)
Beijing	20,705,000	7.51	19,150,055
Tianjin	35,924,000	6.86	33,459,614
Hebei	143,888,000	6.63	134,348,226
Shanxi	150,250,000	7.45	139,056,375
Inner Mongolia	139,593,000	7.58	129,011,851
Shandong	230,922,000	7.12	214,480,354
Total	721,282,000		**669,506,473**

Data sources: The State Electric Industry Yearbook 2007; China Energy Statistical Yearbook 2007

The North China Power Grid imported 2,618,060MWh electricity from the North East Power Grid in 2006, and the emission factor of the North East Power Grid in 2006 is 1.14972 tCO_2e/MWh.

The North China Power Grid imported 497,060MWh electricity from the Central China Power Grid in 2006, and the emission factor of the Central China Power Grid in 2006 is 1.12157 tCO_2e/MWh.

Table A 3. *OM* Emission Factor of the North China Power Grid in 2006

Electricity supplied to the Grid (MWh)	Total emission (tCO_2e)	OM (tCO_2e/MWh)
672,621,593	670,617,037	0.99702

Table A4. Total Emissions of the North China Power Grid in 2007

Fuel Type	**Unit**	**Beijing**	**Tianjin**	**Hebei**	**Shanxi**	**Inner Mongolia**	**Shandong**	**Total**	**Emission Factor**	**Oxidate Rate**	**Fuel emission factor**	**Low Caloric Value (MJ/t,m^3,tce)**	**CO_2 Emission (tCO_2e)**
									(tc/TJ)	（%）	**(kgCO_2 /TJ)**	**(MJ/t,km^3)**	**L=G×J×K/100000(m)**
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	**J**	**K**	**L=G×J×K/10000 (m)**
Raw Coal	10^4t	816.17	1753.99	7716.13	7510.06	10434.25	11884.83	**40115.43**	25.8	100	87,300	20,908	732,214,267
Cleaned Coal	10^4t						18.43	**18.43**	25.8	100	87,300	26,344	423,859
Other Washed Coal	10^4t	5.76		156.89	478.81	48.57	756.84	**1446.87**	25.8	100	87,300	8,363	10,563,452
Briquette	10^4t	7.93					42.86	**50.79**	26.6	100	87,300	20,908	927,054
Coke	10^4t			0.02			4.09	**4.11**	29.2	100	95,700	28,435	111,843
Coke Oveb Gas	10^8m^3	0.07	0.72	3.13	25.46	2.58	13.61	**45.57**	12.1	100	37,300	16,726	2,843,020
Other Gas	10^8m^3	11.8	7.6	88.38	72.8	28.17	29.64	**238.39**	12.1	100	37,300	5,227	4,647,821
Crude Oil	10^4t							**0**	20	100	71,100	41,816	0
Gasoline	10^4t			0.01				**0.01**	18.9	100	67,500	43,070	291
Diesel	10^4t	0.33		2.35		0.62	5.08	**8.38**	20.2	100	72,600	42,652	259,490
Fuel Oil	10^4t	4.74		0.18			2.35	**7.27**	21.1	100	75,500	41,816	229,522
PLG	10^4t							**0**	17.2	100	61,600	50,179	0
Refinery Gas	10^4t	0.06		2.85			1.65	**4.56**	15.7	100	48,200	46,055	101,225
Natural Gas	10^8m^3	5.03	0.73		0.54	4.22	0.01	**10.53**	15.3	100	54,300	38,931	2,225,993
Other petroleum Products	10^4t	1.72						**1.72**	20	100	75,500	41,816	54,302
Other Coking Products	10^4t	4.74						**4.74**	25.8	100	95,700	28,435	128,986
Other Energy	10^4tce	11.94		77.25	360.26	30.75	163.48	**643.68**	0	0	0	0	0
												Total	754,731,124

Data sources: China Energy Statistical Yearbook 2008

Table A5. Thermal Power Generation of the North China Power Grid in 2007

	Electricity Generation (MWh)	Used by the Power Plant (%)	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	838,100,000		776,346,330

Data sources: The State Electric Industry Yearbook 2008

The North China Power Grid imported1, 789,750MWh electricity from the North East Power Grid in 2007, and the emission factor of the North East Power Grid in 2007 is 1.08186 tCO_2e/MWh.

The North China Power Grid imported 803,000MWh electricity from the Central China Power Grid in 2007, and the emission factor of the Central China Power Grid in 2007 is1.10197 tCO_2e/MWh.

Table A 6. *OM* Emission Factor of the North China Power Grid in 2007

Electricity supplied to the Grid (MWh)	Total emission (tCO_2e)	OM (tCO_2e/MWh)
778,939,080	757,552,268	0.97254

Table A7. Total Emissions of the North China Power Grid in 2008

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Emission Factor	Oxidate Rate	Fuel emission factor	Low Caloric Value (MJ/t,m^3,tce)	CO_2 Emission (tCO_2e)
									(tc/TJ)	(%)	**(kgCO_2/TJ)**	**(MJ/t,km^3)**	**L=G×J×K/100000 （M）**
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	**J**	**K**	**L=G×J×K/10000 (V)**
Raw Coal	10^4t	755.75	1800.12	7353.33	7854.39	12607.82	12360.75	**42732.16**	25.8	100	87,300	20,908	779,976,613
Cleaned Coal	10^4t						23.88	**23.88**	25.8	100	87,300	26,344	549,200
Other Washed Coal	10^4t	5.05		134.52	582.39	66.2	691.21	**1479.37**	25.8	100	87,300	8,363	10,800,731
Coke	10^4t	5.66			32.49		45.38	**83.53**	26.6	100	87,300	20,908	1,524,647
Coke Oveb Gas	10^8m^3			0.02			6.07	**6.09**	29.2	100	95,700	28,435	165,723
Other Gas	10^8m^3	0.11	0.86	8.37	24.55	3.55	16.2	**53.64**	12.1	100	37,300	16,726	3,346,491
Crude Oil	10^4t	10.4	9.08	187.54	36	34.32	29.76	**307.1**	12.1	100	37,300	5,227	5,987,440
Gasoline	10^4t					0.02		**0.02**	20	100	71,100	41,816	595
Diesel	10^4t							**0**	18.9	100	67,500	43,070	0
Fuel Oil	10^4t	0.15		3.08		0.35		**3.58**	20.2	100	72,600	42,652	110,856
PLG	10^4t	2.56		0.25				**2.81**	21.1	100	75,500	41,816	88,715
Refinery Gas	10^4t							**0**	17.2	100	61,600	50,179	0
Natural Gas	10^8m^3	0.44		2.93				**3.37**	15.7	100	48,200	46,055	74,809
Other Petroleum Products	10^4t	11.09	0.7		0.97	2.12		**14.88**	15.3	100	54,300	38,931	3,145,563
Other Coking Products	10^4t	1.45						**1.45**	20	100	72,200	41,816	43,777
Other Energy	10^4tce	7.97		7.61				**15.58**	25.8	100	95,700	28,435	423,968
												Total	806,239,126

Data sources: China Energy Statistical Yearbook 2009

Table A8. Thermal Power Generation of North China Power Grid in 2008

	Electricity Generation (MWh)	Used by the Power Plant (%)	Electricity supplied to the Grid (MWh)
Beijing	243	24,300,000	7.14
Tianjin	397	39,700,000	7.05
Hebei	1580	158,000,000	6.9
Shanxi	1762	176,200,000	8.22
Inner Mongolia	2008	200,800,000	7.96
Shandong	2689	268,900,000	7.14
Total	867,900,000		**802,797,350**

Data sources: The State Electric Industry Yearbook 2009

The North China Power Grid imported 5,286,140MWh electricity from the North East Power Grid in 2008, and the emission factor of the North East Power Grid in 2005 is 1.10489 tCO_2e/MWh.

Table A9. Emission Factor of North China Power Grid in 2008

Electricity supplied to the Grid (MWh)	Total emission (tCO_2e)	OM (tCO_2e/MWh)
808,083,490	812,079,707	1.00495

The averaged three years 'Emission Factor is: $EF_{OM,y}$ =0.9914tCO_2e/MWh

2) Calculation of Build Margin emission factor

Calculation of λ*Coal* , λ*Oil* and λ*Gas*

Table A 10. NCV, oxidation factor and potential emission factor of each fuel

Fuel types	NCV	Emission factor **($kgCO_2$/TJ)**	Oxidation factor
Raw coal	20,908 kJ/kg	87,300	1
Cleaned coal	26,344 kJ/kg	87,300	1
Moulded coal	20,908 kJ/kg	87,300	
Other washed coal[74]	8,363 kJ/kg	87,300	1
Coke	28,435 kJ/kg	95,700	1
Crude oil	41,816 kJ/kg	71,100	1
Gasoline	43,070 kJ/kg	67,500	1
Diesel	42,652 kJ/kg	72,600	1
Fuel oil	41,816 kJ/kg	75,500	1
Other oil products	41,816 kJ/kg	75,500	1
Natural gas	38,931 kJ/m^3	54,300	1
Coke oven gas [75]	16,726 kJ/m^3	37,300	1
Other coal gas[76]	5,227 kJ/m^3	37,300	1
LPG	50,179 kJ/kg	61,600	1
Refinery gas	46,055 kJ/kg	48,200	1

Data sources: the heat value of each fuel is from China Energy Statistical Yearbook 2009 p. 507-508. The potential emission and oxidation factor of each fuel are from *Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories:* Volume 2 Energy, Chapter 1, p. 1.23-1.24, Table 1.3 & 1.4.

[74] Calculated as per NCV of washed coal provided by China Energy Statistical Yearbook 2008 p. 283, and as the average NCV of coal slime is larger than that of middling, it is conservative to conduct by this way.
[75] Calculated as per the lower value of NCV range 16726-17981 kJ/m^3 of Coke oven gas provided by China Energy Statistical Yearbook 2008 p. 283.
[76] Calculated as per the lowest value of NCV of coal gas provided by China Energy Statistical Yearbook 2008 p. 283.

The efficiency level of the best technology commercially available of coal-fired power in the calculation result is set as 600MW domestic subcritical generator sets. The weighted average value of coal consumption of power supply of 30 set of 600MW generator sets newly built in 2008 is taken as the estimation of the efficiency level of the best technology commercially available in the calculation result. The coal consumption of power supply of 600MW domestic subcritical power plant is estimated to be 314.35gce/kWh, which is equivalent to 39.08% of power supply efficiency.

Table A11. Emission factor of the best power technology commercially available

	Variable	Efficiency of power supply	NCV (tc/TJ)	Emission factor (tCO_2/MWh)
		A	B	D=3.6/A/1,000,000×B×C
Coal-fired power plant	$EF_{Coal,Adv}$	39.08	87,300	0.8042
Oil-fired power plant	$EF_{Oil,Adv}$	51.46	75,500	0.5282
Gas-fired power plant	$EF_{Gas,Adv}$	51.46	54,300	0.3799

Table A 12. Calculating the proportion of solid fuel, liquid fuel and gas fuel in the total emission

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Shandong	Inner Mongolia	Total	Low Caloric Value (MJ/t,m^3,tce)	Emission Factor	Oxidate Rate	CO_2 Emission (tCO_2e)
		A	B	C	D	E	F	G=A+…+F	H	I	J	K=G×H×I×J/100,000
Raw Coal	10^4t	755.75	1,800.12	7,753.33	7,854.39	12,360.75	12,607.82	42,732.16	20,908	87,300	1	779,976,613
Cleaned Coal	10^4t	0	0	0	0	23.88	0	23.88	26,344	87,300	1	549,200
Other Washed Coal	10^4t	5.05	0	134.52	582.39	691.21	66.2	1,479.37	8,363	87,300	1	10,800,731
Briquette	10^4t	5.66	0	0	32.49	45.38	0	83.53	20,908	87,300	1	1,524,647
Coke	10^4t	0	0	0.02	0	6.07	0	6.09	28,435	95,700	1	165,723
Other Coking Products	10^4t	7.94	0	7.61	0	0	0	15.58	28,435	95,700	1	423,968
Sub-total								44,340.61				**793,440,881**
Crude Oil	10^4t	0	0	0	0	0	0.02	0.02	41,816	71,100	1	595
Gasoline	10^4t	0	0	0	0	0	0	0	43,070	67,500	1	0
Diesel	10^4t	0.15	0	3.08	0	0	0.35	3.58	42,652	72,600	1	110,856
Fuel Oil	10^4t	2.56	0	0.25	0	0	0	2.81	41,816	75,500	1	88,715
Other petroleum Products	10^4t	1.45	0	0	0	0	0	1.45	41,816	75,500	1	43,777
Sub-total								7.86				**243,942**
Natural Gas	10^8m^3	110.9	7	0	9.7	0	21.2	148.8	38,931	54,300	1	3,145,563
Coke Oven Gas	10^8m^3	1.1	8.6	83.7	245.5	162	35.5	536.4	16,726	37,300	1	3,346,491
Other Gas	10^8m^3	104	90.8	1875.4	360	297.6	343.2	3,071	5,227	37,300	1	5,987,440
PLG	10^4t	0	0	0	0	0	0	0	50,179	61,600	1	0
Refinery Gas	10^4t	0.44	0	2.93	0	0	0	3.37	46,055	48,200	1	74,809
Sub-total								3,759.57				**12,554,302**
Total												**806,239,126**

Data sources: China Energy Statistical Yearbook 2009

According to the data and related calculation formula (4), (5), (6): λ_{Coal} =98.41%， λ_{Oil} =0.03%， λ_{Gas} =1.56%.

Hence, $EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Coal,Adv} + \lambda_{Gas} \times EF_{Gas,Adv}$ **= 0.7975 (tCO_2/MWh)**

Table A 13. Installed capacity of the North China Power Grid 2008

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	4,760	7,490	29,870	35,320	45,740	55,930	179,040
Hydro power	MW	1,050	0	1,540	790	830	1,050	5,260
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and other	MW	0	0	700	0	2,300	370	3,370
Total	MW	5,810	7,490	32,110	36,040	48,860	57,350	187,660

Data sources: The State Electric Industry Yearbook 2009

Table A 14. Installed capacity of the North China Power Grid 2007

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3,900	6,920	29,020	30,950	39,870	54,140	164,8
Hydro power	MW	1050	10	780	790	830	1,050	3461,05
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and other	MW	2.7	0	410	0	1,096.5	210	210
Total	MW	1062,9	16,92	1219,02	820,95	875,966	265,19	4260,946

Data sources: The State Electric Industry Yearbook 2008

Table A 15. Installed capacity of the North China Power Grid 2006

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3,984	6,512	26,087	26,661	28,899	49,395	141,538
Hydro power	MW	1,053	5	785	790	818	553	4,004
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and other	MW	24	24	218	0	565	106	937
Total	MW	5,061	6541	27,090	27,451	30,282	50,054	146,479

Data sources: The State Electric Industry Yearbook 2007

Table A 16. BM calculation of the North China Power Grid

	Installed capacity in 2006	Installed capacity in 2007	Installed capacity in 2008	New added installed capacity 2006-2008	New added installed capacity 2007-2008	The fraction of newly added installed capacity
	A	B	C	D	E	F
Thermal power (MW)	141,538	164,800	179,040	46,111	17,847	93.98%
Hydro power （MW）	4,004	4,510	5,260	520	9	1.06%
Nuclear power (MW)	0	0	0	0	0	0.00%
Wind power （MW）	937	1,719.2	3,370	2,433	1,651	4.96%
Total(MW)	**146,479**	**171,029.2**	**187,660**	**49,064**	**19,508**	**100.00%**
The fraction of installed capacity 2008				26.15%	10.40%	

$EF_{BM,y}$=0.7975×93.98%=0.7495tCO_2/MWh

3. Calculation of Build Margin (*C M*) Emission Factor

$EF_{CM,y}$=0.5*0.9914+0.5*0.7495=0.87045 tCO_2e/MWh

Annex 4

MONITORING INFORMATION

Monitoring will be undertaken as outlined in Section B7.2 and no more information to be provided here.