



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

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

Duerping Coal Mine Methane Utilization Project

Final version 4.10

Completion date 15/11/2012

Version History	Changes	Date
Version Val01	First Draft and 1 <sup>st</sup> GSP Version	Nov 20, 2006
Version Val02	DOE comments	April 27, 2007
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Version 04.02	Final Draft	March 19, 2008
Version 04.03	Final	June 06, 2008
Version 4.04	Final	June 25, 2008
Version 4.05	Final	June 26, 2008
Version 4.06	Final	June 27, 2008
Version 4.07	Final	June 29, 2008
Version 4.08	Final, to address completeness check	September 1 <sup>st</sup> , 2008
Version 4.09	Final, to address request for review and subsequent corrections	February 18 <sup>th</sup> , 2009
Version 4.10	Correction after registration on the geographic coordinates	15/11/2012

**A.2. Description of the project activity:**

Shanxi Coking Coal Group Company Ltd. is China's sixth largest coal producer. The company has a mining area of 2,604 sq km covering parts of the Xishan, Huoxi and Hedong coal fields in Shanxi Province. The total proven reserves are 22 billion tonnes of coal, across 22 operational mines producing 60 million tonnes in 2005. Duerping Coal Mine of the Shanxi Coking Coal Group is situated in the Xishan coalfield located near the city of Taiyuan. It was formerly a key State-Owned, centrally managed coal mine. Duerping has a coal production capacity of 5 million tonnes and produced 4.5 million tonnes in 2005. It has reserves of approximately 700 million tonnes of coal and an operational lifetime of around 50 years, well in excess of the lifetime of the proposed project activity, and is a major source of greenhouse gas emissions.

The current total relative emission of the mine is 17.7m<sup>3</sup> of methane per tonne of coal mined. Future workings are expected to be increasingly gassy as mining gets deeper. Of the gas emitted by the underground mining operations, at present, about 15% is captured by methane drainage and 85% is exhausted to the atmosphere as ventilation air methane (VAM). During the course of the project the mine



anticipates raising the capture efficiency substantially with a possible target of 40%. A graph showing the current coal mine methane (CMM) emissions is presented in Annex 3.

Duerping Coal Mine has installed a new gas extraction station and an additional ventilation shaft to facilitate expanded coal production and a concomitant increase in gas flows at Beishigou Pumping Station. Following the proposal of a CDM Project in 2005, a feasibility study was prepared by Shanxi Electric Power Exploration & Design Institute.

The feasibility study estimates that under current conditions there will be sufficient gas to generate up to 12 MW of electrical power. In view of expected improvements in capture efficiency and increased production, the available amount of gas may be higher than currently predicted.

The project activity's primary aim is utilization of Coal Mine Methane (CMM) that would have been vented in the absence of the project activity. The project activity does not involve the capture of methane, but only its utilization. The capture of methane is already taking place under the baseline scenario.

There will be times when installed generation capacity cannot cope with the quality or volume of gas. Gas of concentration less than the permitted minimum for utilisation (currently <30%) but higher than 25% will be flared and gas less than 25% (i.e. low quality gas) will be vented in accordance with the Chinese Mining Regulations available in the *Coalmine Safety Regulation* (11/2005) item 148.1) and the *Coalmine Methane Treatment and Utilization Macro Plan* published by National Development and Reform Committee (NDRC) in June 2005. Vented gas is not monitored for emission reductions. Approximately 20% of the gas is expected to be flared. The venting of gas is consistent with the methodology because the project activity is not capturing the gas, only utilizing it. The gas is captured under the baseline scenario. Peaks of gas flow which exceed generation capacity, brought about by normal mining operations, may also result in the flaring of methane concentrations in excess of 30%.

Waste heat from the exhaust of the generators will be utilized to provide heat to warm the intake air of the mine during the winter months. The waste heat will displace coal currently used in two coal-fired mine ventilation air heaters that currently provide in the region of 54 TJ of heat energy. These boilers were installed in 2006 and have a remaining technical life in excess of 15 years, well beyond the crediting period of the project. The combined heating duty of the boilers is 4.2MW and the heating season is 5 to 6 months. Waste heat from the generators will satisfy some or all of this heating duty for those 5 to 6 months subject to CMM availability and mechanical performance of the generators.

Under a parallel initiative (not part of the CDM project activity), international gas drainage experts are working with mine staff to improve gas drainage capture efficiency, stability of gas quality and mine safety.

There is currently no legislation requiring the treatment of CMM in China, which is usually released directly to atmosphere. Recently, legislation has been introduced to require improved methane drainage for safety purposes, but this does not extend to mandatory utilisation of the methane. Currently, methane use happens opportunistically within the coal mining sector, and is not practiced at the Duerping Coal Mine.

The project activity will install the necessary pipe-work, monitoring, safety, gas destruction, generation and grid connection to ensure a high proportion of the coal mine methane that would normally be released to atmosphere is combusted. Investment in generation plant will be phased, totalling 5.1MW in year 1, 10.2MW in year 2 and nearly 12.0MW from year 3 onwards. This is an indicative schedule only and will



depend on progress with mine development, methane drainage and coal production, and also on the unit size of generator selected.

The project will contribute to sustainable development in a number of ways:

Environmental: by significantly improving local air quality and addressing greenhouse gas emissions. The project will not lead to the consumption of significant natural resources.

The project will not result in a material increase in energy consumption because the pumping station has already been installed in order to comply with safety requirements; therefore any electricity used by the pumping station is included in the baseline. Generator noise will be mitigated by sound-proofing the containers in which they are placed. Emissions from the generators will not exceed environmental requirements. The waste heat from the generators will remove the need to consume coal to heat the mine intake air, further saving natural resources and contributing to local air quality.

The project will provide social benefits by significantly improving health and safety for workers and economic benefits by providing a new source of clean electricity displacing coal-fired power. The waste heat from the generators will also be used to heat the mine intake ventilation air and thereby improve working conditions within the mine and reduce the consumption of coal.

Technology transfer benefits will arise from the installation of state-of-the-art generation and heat recovery equipment and associated safety and monitoring equipment and systems.

**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)	Shanxi Coking Coal Group Company Ltd	No
United Kingdom of Great Britain and Northern Ireland	Sindicatum Carbon Capital Ltd	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

**A.4. Technical description of the project activity:**

**A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

China

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

Shanxi Province

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

Duerping Coal Mine, Wanbailim District, Taiyuan, Shanxi Province, 030022

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

The coal mine is located 20 km West of Taiyuan, the capital of Shanxi Province. The generation site is 8km South West of the mine. The coal mine reserves are located within the area defined by the following coordinates:

Latitude: North 37° 46' 52"

Longitude: East 112° 14' 27"



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

Sectoral Category 8 – Mining and mineral production

Sectoral category 10 – Fugitive emissions from fuels

Sectoral Category 1 - Energy industries (renewable - / non-renewable sources)

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

State-of-the-art methane combustion and power generation systems will be installed on site. These will involve:

- Pipe-work, valves and flame arrestors connecting the gas extraction station, where methane is currently being vented to atmosphere, to the generators
- Condensate extraction systems
- Monitoring equipment to measure the flow, pressure and temperature and concentration of gases as they are extracted from the mine
- State-of-the-art methane fuelled gas-engines and electricity generating sets
- Grid connections to enable export of electricity to the regional grid
- Power connections to enable use of electricity on site
- Heat exchange units to recover heat from the exhaust and/or engine casings from the generators and transfer this to the mine ventilation intake air
- Monitoring procedures to collect and store the data necessary to demonstrate the combustion of methane in a transparent and accurate manner.

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

The project is expected to reduce GHG emissions as shown in the table below:

<b>Years</b>	<b>Annual estimation of emission reductions in tonnes of CO<sub>2</sub>e</b>
Oct-Dec 08	41,325
2009	325,395
2010	378,748
2011	378,748
2012	378,748
2013	378,748
2014	378,748
2015	378,748
2016	378,748
2017	378,748
Jan-Sep 2018	284,061
<b>Total estimated reductions (tonnes of CO<sub>2</sub>e)</b>	<b>3,680,764</b>
<b>Total number of crediting years</b>	<b>10</b>
<b>Annual average over the crediting period of estimated reductions (tonnes of CO<sub>2</sub>e)</b>	<b>368,076</b>



**A.4.5. Public funding of the project activity:**

The project activity will not be funded by any public money.

**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:**

- ACM0008 version 03 “Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring”.
- ACM0002 Version 06 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”
- “Tool for the demonstration and assessment of additionality” Version 4
- “Tool to determine project emissions from flaring gases containing methane”

Detailed information regarding these methodologies and tools please refer to <http://cdm.unfccc.int/methodologies/approved>.

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

The project activity fulfils the applicability criteria for the use of this methodology:

- The project activity is implemented in a working coal mine
- The mine uses underground boreholes to capture post-mining CMM
- The methane will be captured and destroyed through combustion for electricity generation and flaring.

The project activity does not operate in an open cast mine; involve any decommissioned mines; use virgin coal-bed methane or use CO<sub>2</sub> or any other gas to enhance methane recovery.

The use of this methodology requires access to data to enable ex ante projections of methane demand. As there is no methane demand in the baseline scenario, there is no requirement for such information.

No CBM will be involved – there are no CBM wells in the vicinity of the project, no CBM pipelines and no plans or approval for surface CBM drilling at the mine. This is due to the combination of depth, low permeability of coal seams, difficult terrain and adequate gas drainage capacity underground which makes consideration of surface pre-drainage using CBM unnecessary and in any event too costly. All the CMM to be used by the project is drained underground and transmitted by a pipeline which comes to the surface at the upcast ventilation shaft adjoining the CMM utilisation site.

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

Source	Gas		Justification / Explanation
Emissions of methane as a result of venting	CH <sub>4</sub>	Included	• Main emission source.
Emissions from destruction of methane in the baseline	CO <sub>2</sub>	Excluded	• There is no methane destruction in the baseline
	CH <sub>4</sub>	Excluded	
	N <sub>2</sub> O	Excluded	
Grid electricity	CO <sub>2</sub>	Included	• Only CO <sub>2</sub> emissions associated with the net power



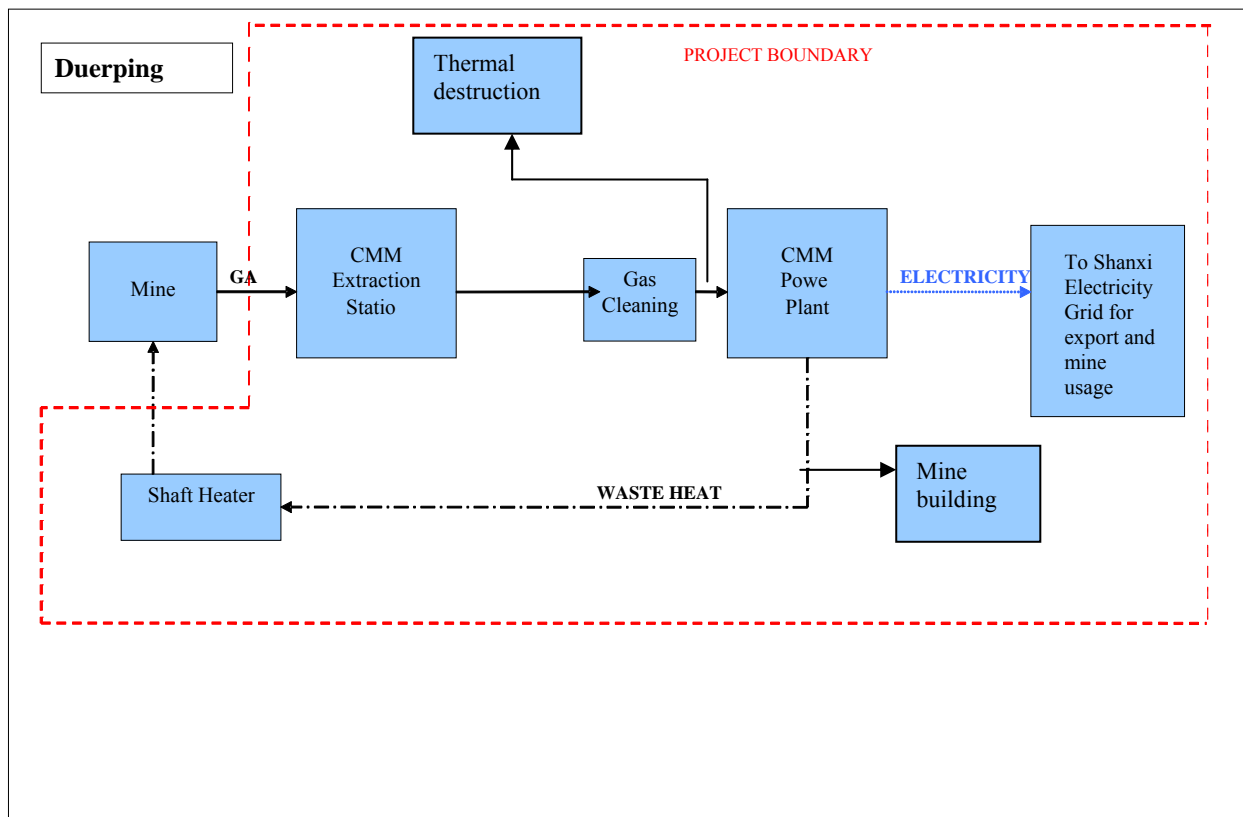


generation (electricity provided to the grid)			generated by the project activity are included. • Use of combined margin method as described in ACM0002 should be used.
	CH <sub>4</sub>	Excluded	• Excluded for simplification. This is conservative.
	N <sub>2</sub> O	Excluded	• Excluded for simplification. This is conservative.
Captive power and/or heat, and vehicle fuel use	CO <sub>2</sub>	Included	• Baseline scenario includes coal combustion for heating mine in-take air in the winter months.
	CH <sub>4</sub>	Excluded	• Excluded for simplification. This is conservative.
	N <sub>2</sub> O	Excluded	• Excluded for simplification. This is conservative.

**Project activity**

Source	Gas		Justification / Explanation
Emissions of methane as a result of continued venting	CH <sub>4</sub>	Excluded	• Only the change in CMM emissions release will be taken into account, by monitoring the methane used or destroyed by the project activity.
On-site fuel consumption due to the project activity, including transport of the gas	CO <sub>2</sub>	Included	• However, the project does not use any additional energy as the pumping station is part of the baseline scenario.
	CH <sub>4</sub>	Excluded	• Excluded for simplification. This emission source is assumed to be very small.
	N <sub>2</sub> O	Excluded	• Excluded for simplification. This emission source is assumed to be very small.
Emissions from methane destruction	CO <sub>2</sub>	Included	• From the combustion of methane in power generation and flaring.
Emissions from NMHC destruction	CO <sub>2</sub>	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 <sub>4</sub>	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 <sub>4</sub>	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 <sub>4</sub>	Excluded	• Excluded for simplification. However taken into account among other potential leakage effects (see leakage section)
Accidental methane release	CH <sub>4</sub>	Excluded	• Excluded for simplification. This emission source is assumed to be very small.

Figure 1 below shows the project boundary:



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

The proof that the project activity is not part of the business as usual scenario is given by firstly identifying the baseline scenario following a series of steps described in the methodology, followed by the application of steps 2 (or 3) to 5 of the additionality tool.

#### ACM0008 Step 1: Identify technically feasible options for capturing and/or using CBM or CMM

##### Step 1a: Options for CBM and CMM extraction

Option for capture	Comment
Ventilation air methane	Removal of coal mine methane through ventilation alone in gassy mines is not practical. Ventilation systems cannot cope with sudden emissions of gas or with increases in gas concentration arising from mining of coal or changes in barometric pressure. Sufficiently high volumes of air to dilute the methane would create dust and particle movement within the mine, consume excessive energy and would not improve the safety of the mine
Pre-mining CMM and CBM	Pre mining CMM extraction is not effective due to the low permeability of the worked seam and at Duerping mine reliance is placed on post mining CMM extraction to control gas emissions. Coal bed methane drainage from the surface is not applied in this mine (nor is it widely applied in China to date). It is not considered practical in this mine because of the low permeability of the coal seams.



Post mining CMM extraction This is practiced and involves drilling holes above and below the coal seam from an underground location. Pipes are inserted into the holes, sealed around the sleeve and then suction pressure applied to withdraw methane. Current legislative programmes, and in particular the pressure upon mine owners to improve safety in Chinese coal mines, means that over time, the efficacy of coal mine methane drainage can be expected to improve.

Conclusion: Duerping Coal Mine relies principally on two types of methane extraction: ventilation air and post mining CMM. The project activity does not impact upon these practices.

#### Step 1b: Options for extracted CBM and CMM treatment

Options	Comment
Venting	This is the current practice and is most likely to continue in the baseline scenario. There are no barriers to this activity.
Use / destruction of ventilation air methane	There is no requirement, nor incentive, to treat VAM. Technologies for its destruction and use are experimental and costly.
Flaring of CBM/CMM	Flaring of CMM is not a likely scenario in the baseline because there is no requirement to do so and there is no reason why mine owners should invest in the equipment where there are no benefits to them.
Use for additional grid power generation	Power generation from CMM is part of the project activity. Although the CMM contains combustible quantities of methane, there is no requirement to treat the methane. Electricity production is not the mine's primary function; investment in efficient, modern CMM utilization equipment is not common in the region, nor in China, and appropriate scale and efficient generators that can reliably operate with the variable qualities of methane experienced are not locally available. The tariffs paid for power generation are very low (0.26 RMB or approximately 3 US cents per kWh) which does not make it a financially attractive option. These factors present a range of barriers, obstacles and risks to the mine operators.
Use for captive power / heat generation	Displacement of captive heat is part of the project activity. Without the power generation component, there would be no excess heat to utilise and therefore this option would not be available. Combustion of the methane for heat alone would not be attractive because of the plentiful and cheap supplies of coal that are available, coal fired boilers have very recently been constructed and are operating without problems.
Use for additional heat requirements	There is no existing heating infrastructure and no interest in investing in such infrastructure. The point where the CMM is released is remote to any settlements, making piping to a community unattractive. Investment in such a system is further discouraged because of the low price of coal adjacent to coal mines. Householders are not willing to pay for gas when they can have coal very cheaply ( <a href="http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf">http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf</a> )
Feed into gas pipeline	There is no gas pipeline available
Combinations of the above	No combination of the above activities is likely because any division of the CMM between different uses would present multiple barriers and detract from the economic rationale.



Conclusion: Venting is the most likely baseline scenario.

#### Step 1c: Options for energy generation

Options	Comment
No generation	This is the current practice and is most likely to continue in the baseline scenario. There are no barriers to this activity.
Use of methane for heating purposes	There is no existing heating infrastructure and no interest in investing in such infrastructure. Investment in such a system is further discouraged because of the low price of coal adjacent to coal mines. Householders are not willing to pay for gas when they can have coal very cheaply ( <a href="http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf">http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf</a> ). The point of release is remote to any community.
Use of methane for power generation for use on site	Power generation from CMM for use on site is part of the project activity. Although the CMM contains combustible quantities of methane, there is no requirement to treat the methane. Electricity production is not the mine's primary function; investment in utilization equipment is not common in the region, nor in China and they already source their power from the grid where the supply is reliable. National regulations do not permit the use of the power on site in theory. In practice, the power may be used, but it must be sold to the grid at a low rate (26 Chinese cents or approximately 3 US cents and bought back at 6 US cents per kWh). These factors present a range of barriers, obstacles and risks to the mine operators.
Use of methane for power generation for export	Power generation from CMM for export is part of the project activity. Although the CMM contains combustible quantities of methane, there is no requirement to treat the methane. Electricity production is not the mine's primary function; investment in utilization equipment is not common in the region, nor in China. Generated power must be sold to the grid and the tariff paid is low – 26 Chinese cents per kWh. Or approximately 3 US cents. These factors present a range of barriers, obstacles and risks to the mine operators.
Use of methane for transport	There is no experience in the use of CMM for transport in the region, only high purity CBM (as CNG) would normally be considered for transport use and the CMM would therefore need treatment to raise the methane purity which would be very costly. Too many barriers exist to consider this means of utilizing the methane.

Conclusion: The baseline scenario is no power generation.

#### **ACM0008 Step 2: Eliminate baseline scenarios that do not comply with legal or regulatory requirements**

##### CMM extraction

Continuation of current practice of pre- and post-mining CMM and ventilation of the mine is a possible baseline scenario, however, in view of increased pressure to improve safety performance in mines in the form of criminal prosecutions for mine owners and incentive programmes and tax benefits, it is more likely that there will be some improvement in the current practice. See for



example: [http://www.chinadaily.com.cn/english/doc/2004-12/02/content\\_396698.htm](http://www.chinadaily.com.cn/english/doc/2004-12/02/content_396698.htm) (website last visited on the 30.08.06) and go to <http://www.china-labour.org.hk/public/main> and search on coal mine explosions to see a long list reports on casualties and government efforts to improve coal mine safety, including through better methane drainage.

This report quoting the China Daily news from January 2004 <http://www.epa.gov/cmop/resources/notes/2004/1-22.html> (website last visited on the 30.08.06) reports a 10% increase in the budget for safety in Chinese coal mines, including increased emphasis on coal mine methane extraction and announces tax incentives for projects that drain and utilize methane.

See also <http://www.china.org.cn/english/2004/Nov/112962.htm> (website last visited on the 30.08.06) which although it pre-dates the above government initiatives, shows that the authorities are prepared to enforce the initiatives.

In view of the above information, it is argued that continuation of current practice in methane drainage and ventilation is unlikely and that a gradual improvement over time, even to a small degree, in the efficiency of methane drainage and ventilation is the more likely baseline scenario.

#### CMM treatment

There are no legal or regulatory requirements concerning the treatment of coal mine methane. As stated in A.4.4. above, the primary legislation makes no reference to coal mine methane emissions; likewise, the 1996 Decision of the State Council on Several Issues Concerning Environmental Protection makes no reference to coal mine methane (go to <http://www.chinalaw.gov.cn/indexEN.jsp> (website last visited on the 30.08.06) and search laws and regulations for “environmental protection”). All of the legal and regulatory requirements focus on the safety aspects of coal mining, which generally involve extracting methane from the mine. There are no requirements concerning the use or treatment of the methane. Therefore all of the above baselines are possible from a legal and regulatory point of view.

The government is working to reduce the unacceptably high incidence of coal mine related accidents and deaths, and those responsible for mines are now being charged with a range of offences – see for example <http://www.china.org.cn/english/2004/Nov/112962.htm> (website last visited on the 30.08.06).

#### **ACM0008 Step 3: Formulate baseline scenario alternatives**

Possible baselines for the extraction of CMM are:

- 1) Improve and extend the current practice of pre- and post-CMM and ventilation of the mine
- 2) Implement coal bed methane drainage

Possible baselines for the treatment of extracted CMM are:

- a) Continued release to atmosphere
- b) Flaring of CMM
- c) Utilisation of CMM for electricity (captive or grid), heat, or motive power

All combinations of the above scenarios are possible baseline scenarios.

#### **ACM0008 Step 4: Eliminate baseline scenario alternatives that face prohibitive barriers**

CMM and CBM extraction



Surface CBM extraction from conventional, vertical, hydrofractured wells is not an option due to the low permeability of the coal seams at Duerping, and the high cost and unproven nature of the latest surface to in seam drilling technologies which can, in some instances, perform better than vertical wells. This is not a viable option.

In view of this evidence, it is clear that the most likely baseline for extraction is continuation of current practice with potential increases in efficiency and effectiveness of extraction over time due to increased output from the mine and government incentives and legislative requirements. Increases in extraction will result in improved safety conditions and also facilitate increased coal production as part of the business as usual scenario and not a result of the CDM project activity.

#### CMM and CBM treatment

There is no surface CBM production in this project, so it is not discussed further in this section.

The options for CMM treatment are described in Step 1b above. There are no legislative requirements to treat methane and although there is government level interest in using coal bed and coal mine methane for power generation, there are a number of barriers to anything other than continued release to atmosphere. These barriers tend to be anecdotal and therefore the following options for CMM treatment remain:

- a) Continued release to atmosphere
- b) Flaring of CMM
- c) Utilization of CMM for electricity (captive or grid), heat, or motive power

Use/destruction of VAM. VAM can only be destroyed with additional energy inputs or by feeding it into a thermal power station. There is no thermal power station close enough to justify the costs of building ducting and the energy required to pump the VAM to the power station. There are no existing plans to utilize the VAM in the power station.

Combinations of the above options do not help because all they do is reduce the capacity for power generation and associated methane destruction.

### **ACM0008 Step 5 Identify the most economically attractive baseline scenario alternative (optional)**

There are three possible options for the treatment of CMM:

- a) Continued release to atmosphere with purchase of coal for the boilers
- b) Flaring of CMM with purchase of coal for the boilers
- c) Utilization of CMM for electricity (captive or grid) and waste heat supply to the boilers

#### ***Sub-step 5a. – Option I. Apply simple cost analysis***

This option cannot be applied because option c has associated cash flows.

#### ***Sub-step 5b. – Option II. Apply investment comparison analysis***

The indicator to be used for financial analysis of the project activity is selected to be the Net Present value (NPV) in accordance with the “Tool for the demonstration and assessment of additionality” (version 04). The interest rate applied is the recommended rate of return for Construction Projects in the



coal and gas sector, jointly published by the Chinese National Development and Reform Commission and Ministry of Construction in “Economic Evaluation Codes and Parameters for Construction Projects” (Version 03)<sup>1</sup>. The recommended rate is 12% before tax. This value is considered appropriate because it is a benchmark for the decision to invest in construction projects in the coal mining sector, against which this project must compete for finance.

**Table B4-1. Data used for the IRR for option a, incremental costs of release of CMM to atmosphere**

Description: Continuation of current practice – release of CMM to atmosphere	
Coal purchase 2200 tonnes per annum at RMB 150 per tonne*	RMB 225,000
NPV at 12%	- RMB 2.49 million

\* Price for unwashed coal at the pithead

**Table B4-2. Data used for the IRR for option b, incremental costs of flaring of CMM**

Description: Coal purchase and flaring of CMM	
Coal purchase 2200 tonnes per annum at RMB 150 per tonne	RMB 225,000
Capital	RMB 1.1 million
Annual running costs	RMB 50,000
NPV @ 12%	-RMB 3.86 million

**Table B4-3. Data used for the IRR calculation from FSR – incremental costs for option c, utilization of CMM for power generation**

The data used in this NPV calculation are drawn from the IRR calculation presented in the approved Feasibility Study Report.

Description: Utilization of CMM for power generation	
Power tariff (Yuan/kWh)*	0.364
Price for power standard gas (Yuan/m3)	0.00
City maintenance tax rate %	7%
Education tax rate %	3%

<sup>1</sup> Source: NDRC and National Construction Committee, 2006, *Economic Evaluation Code and Parameter for Construction Projects (Version 03)* P204



Public welfare fund rate(of the profit after income tax) %	5%
CMM consumption of Deutz engine (m3/h)	1172
Annual operating hours (h)	7000
Auxiliary power consumption rate of the project activity %	2.3%
Static total investment (10,000 RMB)	14771**
Water cost (Yuan/MWh)	5.35
Material cost (Yuan/MWh)	3.00
Other cost (Yuan/MWh)	5.00
Maintenance cost % of static total investment	1.5%
Depreciation period(year)	15
Remained value of the static total investment	5%
Insurance rate(of the remained static total investment)	1.0%
Welfare costs	56%
Salary costs	3
Number of people	12
Capital cost of exhaust heat ducting	RMB 2 million
Refurbishment costs on generator sets after 64000 hours (7 years operation)***	40% of capital cost
RMB : EURO exchange rate in 2007 (1 Euro = 8.75866 RMB)	8.75866
20 year average projected annual inflation rate China (source Global Insight)	3.3%
20 year average project annual inflation rate Western Europe (source Global Insight)	1.8%
NPV at 12%	-RMB 22.07 million
coal cost RMB per tonne, unwashed at the pithead	150
annual consumption (tonnes)	2200

\* There is no power purchase agreement at present because the electricity will be consumed by the mine's own operations, displacing power drawn from the grid. The tariff used here is the tariff at which the mine purchases electricity from the grid.

\*\*The FSR quotes a value of 103,040,000 RMB for the static total investment however, a higher value has been applied in the NPV calculation. This is because the FSR only estimated the costs of the generating equipment which were subsequently found to be significantly higher. Documentation (in the form of the EPC contract for the purchase of the generators and actual receipts) confirms that this price was known before the start date of the project.

This cost has been further increased by RMB 2 million to account for the cost of the installation of insulated piping and heat exchangers for the transfer of waste heat from the generators to the ventilation intake. This cost was identified prior to the start of the project but was not included in the FSR calculations.





The total static investment is determined, based on receipts, as follows:

Receipt description	Cost for 3 engines (*10,000 RMB)	Cost for 1 engine (column 2/3) (*10,000 RMB)	Comment
3 Gensets	4436.34	1478.78	As shown on receipt
3 control units	73.31	24.44	As shown on receipt
1.5 waste heat units	90.00	60.00	Cost for 3 engines is 2 times the face value of the receipt
0.75 gas purification units	108.00	48.00	Cost for three engines 4/3 times the value
Sub-total		1611.22	Proportional cost of one genset and control systems
Sub total for 7 flares		11278.51	Purchased over 2 years
Sub total with non power gen equipment included		14240.54	The percentage of power generation related equipment in the static total investment (79%) – from FSR
One flare unit		330	As shown on receipt
Ducting for heat transfer		200	Estimate (less than 1.5% of total costs)
Total Static Investment		14770.54	

\*\*\* The FSR does not include any costs for the refurbishment of the generators. The engines require an overhaul after 64,000 hours on site, or approximately once per 7 years (see further explanation below). The estimated cost of the overhaul is 40% of the capital cost and the Euro costs have been adjusted to take account of the differences in the long term average inflation rates in Western Europe and China as follows:

Year:	2008	2009	2010	2011	2012	2013	2014	2015	2016
RMB:EUR	9.06	9.28	9.44	9.60	9.71	9.84	9.96	10.08	10.20
Year:	2017	2018	2019	2020	2021	2022	2023	2024	2025
RMB:EUR	10.33	10.44	10.56	10.69	10.82	10.95	11.09	11.22	11.36

Refurbishment costs on generators (gensets) are based on quotations from Deutz, the engine suppliers. Deutz confirm that the estimated costs of refurbishment after 64000 hours of operation under optimal conditions are 40% of equipment cost. As detailed below, the gensets make up the bulk of the capital expenditure and for reasons also detailed below, it is conservative to apply the same factor to the



remaining equipment costs which are included in the Total Static Investment. The following additional document was submitted to the DOE:

- A second letter from Deutz confirming the nature of the costs (Duerping review ref 2).

The adjustment to the exchange rate from RMB to Euro is appropriate as this reflects standard financial practice for calculating forecast exchange rates. The forward exchange rate was calculated over the project period by reference to the difference in the long term projected inflation rates between the Chinese Renminbi and the Euro. This approach is fully described in the document entitled “Duerping Clarification – exchange rates used ref 3.doc” supplied to the DOE, complete with a reference to the technique from a standard text book, the “Principles of Corporate Finance”. A letter from Ernst and Young, international financial accountants, which confirms that purchase price parity (PPP) is a widely accepted economic theory that may be used by investors to provide an estimate of the impact of future foreign exchange rates on assets and investment returns was also supplied to the DOE.

For information, the NPV without CERs including the PPP approach is  $-2207 \times 10^4$  RMB. Fixing the exchange rate at 2006 value (1Euro = 9.06 RMB) increases the NPV to  $-1543 \times 10^4$  RMB. Including or excluding the PPP approach does not make any difference to the outcome of the additionality assessment and therefore is not material.

Total static investment =  $14771 \times 10^4$  RMB is comprised of equipment as detailed below:

Major part: Imported gensets:  $7 \times 1478.87 = 10,351 \times 10^4$  RMB at an exchange rate of 9.06 RMB to 1 Euro.

Remaining part: Other technical equipment:  $7 \times 132.44 = 927.08 \times 10^4$  RMB (for control units, waste heat units and gas purification units) PLUS  $3,492.92 \times 10^4$  RMB (which is calculated according to the FSR, to provide for blowers, pipeline systems, electrical connections and other technical infrastructure. The FSR states that the costs of this additional equipment are set at 79% of total investment). Total cost of other remaining technical equipment =  $4420 \times 10^4$  RMB

The costs of civil works as listed in the Chinese FSR are not included in the IRR spreadsheet in order to be conservative.

Refurbishment costs are estimated at 40% of total equipment cost, as per the evidences supplied by Deutz. The same factor was applied to all other technical equipment to account for anticipated wear and tear. In fact, complete replacement of a significant proportion of locally manufactured equipment is anticipated as the original designs are immature and rapid improvements in new models are being made as a result of the field experience gained and technology transfer from project participant's international experts. In addition, local manufacturers of this kind of equipment do not generally maintain inventories of spare parts or make commitments to customers that spare parts will be available for a given period of time and therefore total replacement is necessary to ensure continued availability.

In view of the extreme operating environment, it assumed that refurbishment is required 64,000 hours after installation, not operation (see point 3 below for a fuller justification). Consequently, the first round of refurbishment costs are incurred at the end of year 7 ( $7 \times 8760 = 61,320$ ) to ensure that parts are available for refurbishment work in the spring of year 8 when the 64,000 hour limit will be reached. The second round of refurbishment costs are similarly incurred at the end of year 8 in preparation for installation in the spring of the following year. Ordering the parts in advance is good practice because of the long lead times and the knock on effects of delays in maintenance schedules. Locally sourced



equipment is also expected to be ordered well in advance because these items are not available “off the shelf”. This is the first time that such an integrated power generation and gas flaring project has been implemented in China. Some parts may need to be custom built and as stated above, the project participant’s international experts may be able to contribute to the design. In these instances, it is likely that equipment will be ordered and paid for in advance. Furthermore:

- Advance notice is required by the mine to stop the co-generation and abatement plant and the mine will want to time the stoppage to correspond with a maintenance period at the extraction plant;
- At the time of signing the EPC contract, the shipping and delivery time for the gensets was 7 months. Although spare parts are more available, delivery times are still expected to be in excess of 3 months (including 8 weeks shipping).

Similarly, the third and fourth round of refurbishment costs are applied in years 14 and 15 with the costs incurred in advance of reaching the 64,000 hour limit.

The refurbishment costs are applied as follows:

Refurbishment activity	Hours since delivery of parts to site when orders for new parts are placed	Refurbishment cost	Adjustment for Purchase Price Parity	Applied refurbishment cost
Phase 1 (3 gensets)	61320	40% of 40% of capex = 2363.36	9.96/9.06	2597.78
Phase 2 (4 gensets)	61320	60% of 40% of capex = 3545.04	10.08/9.06	3944.22
Phase 1 gensets	61320	40% of 40% of capex = 2363.36	10.82/9.06	2823.07
Phase 2 gensets	61320	60% of 40% of capex = 3545.04	10.95/9.06	4285.89

The purchase price parity correction is applied the total refurbishment costs. For information, applying it to the gensets refurbishment costs only (i.e. removing it from the costs of refurbishment of all the additional technical equipment) changes the NPV of the project activity without CERs from  $-2207 \times 10^4$  RMB to  $-2008 \times 10^4$  RMB. As this does not alter the outcome of the additionality assessment, it can be considered to be immaterial. Furthermore, the increase in RMB costs of local equipment due to the PPP adjustment is marginal compared to the much more conservative assumption that the refurbishment costs of the locally sourced equipment are 40%, ignoring the fact that 100% costs will be incurred for total replacement of a significant proportion of locally sourced equipment.

For information:

The cost of refurbishing 40% of locally sourced equipment in year 7 with PPP is  $(40\% \times 40\% \times 4420 \times 10^4 \times (9.96/9.06)) = 777.45 \times 10^4$  RMB.

The cost of the refurbishing 40% of locally sourced equipment in year 7 without PPP is  $(40\% \times 40\% \times 4420 \times 10^4) = 707.2 \times 10^4$

The cost of replacing just 10% of locally sourced equipment and refurbishing the remaining 90% in year 7 is  $(10\% \times 100\% \times 40\% \times 4420 \times 10^4) + (90\% \times 40\% \times 40\% \times 4420 \times 10^4) = 813.3 \times 10^4$  RMB



So even replacing just 10% of locally sourced equipment incurs greater costs than the application of PPP, confirming that this approach is conservative.

There is no double counting in the operation, maintenance and refurbishment costs. The refurbishment costs are added because the FSR did not make provision for major refitting of equipment.

The reference entitled “Appendix 1 ref 5.pdf” and supplied to the DOE details the refurbishment actions for the gensets and shows that the E70 service includes all other service activities, so in this respect, there is some potential double counting between the maintenance costs and the refurbishment costs in years 7, 8, 14 and 15. However, no provision is made for un-scheduled repairs to gensets and the refurbishment costs of the additional technical equipment have only been accounted at 40% whilst, as explained above and below, it is more likely that these parts will be totally replaced. In these cases, any potential double counting would be more than cancelled out.

For confirmation, the refurbishment costs were known at the time of the decision to invest and proof to this effect has been provided to the DOE.

For information, if the maintenance costs in years 7, 8, 14 and 15 are removed, the NPV increases from  $-2207 \times 10^4$  RMB to  $-1939 \times 10^4$  RMB. This does not alter the conclusion on additionality and can therefore be described as not material.

Refurbishment costs of the generators have been calculated on the basis of 40% of the total static investment costs and these have been applied after 64000 hours on site, not 64000 hours of operation, for the reasons stated below:

- a) The refurbishment costs have been correctly calculated on the basis of the total static investment because the total static investment is made up two components, each of which will need to be refurbished:
  - i) Imported gensets, which are the major part of the refurbishment
  - ii) Locally sourced technical equipment which is more likely to be replaced than refurbished. For example, a locally manufactured blower or gas control unit is likely to be replaced rather than have the engine or valves stripped out and replaced because it is likely that the correct parts will not be available after this period of time and the overall condition of the unit will not warrant refurbishment. In this respect, 40% refurbishment cost is conservative. A document entitled “Duerping maintenance and refurbishment ref 4.doc” prepared by SCC’s technical experts, has been provided to the DOE.

This fact is further supported by reference to the Chinese FSR. This includes additional items for civil works including the powerhouse, roads, foundation treatment, civil projects and temporary projects totalling  $125.03 \times 10^4$  RMB which, in order to be conservative, were not included in the calculation of the revised total static investment in the PDD.

- b) The refurbishment costs have been applied 64,000 hours after arrival on site rather than after 64,000 hours of operation for the following reasons:
  - i) Equipment starts to deteriorate as soon as it arrives on site because as soon as packaging is opened (in order to check that the right equipment has been delivered) it becomes susceptible to corrosion, dust and physical damage and it is also susceptible to damage during installation. This is particularly common in the kind of working environment experienced at Duerping – which is in a remote, exposed and rough



terrain with little flat ground, is excessively dirty and dusty and experiences large temperature ranges from very hot to sub zero temperatures.

For information, after the project start date one of the gensets has already required substantial refurbishment before it was commissioned due to damage incurred on site.

- ii) The document “Appendix 1 ref 5.pdf”, supplied to the DOE, details the maintenance schedule for the gensets and clearly states that the servicing intervals are maximum intervals and

“Under difficult operating conditions it may be necessary to shorten the prescribed intervals. The standard maintenance schedule must then be generally revised. Generally the locally prevailing operating conditions are defined already in the configuration phase.

Critical operating conditions are for example:

- contamination of the combustion gases by wear promoting constituents such as silicon,
- sulphur, chlorine, ...
- frequent cold starts
- increased dust load in the intake air”

The letter from Deutz entitled “Duerping Review ref 2.pdf” recognizes the adverse operating conditions. SCC’s engineers have known from the very outset that this site presents extreme operating conditions. These points justify significantly shorter maintenance intervals.

- iii) The gensets will run for more than 7000 hours per year because they will run under full and partial loads. This is because the volume of CMM will vary. At times of lower volume, the control systems will optimize the operation of the gensets and as a result, some will operate under partial load. So although they are estimated to produce 7000 MWh per MW of capacity, they are likely to achieve this by operating more hours at less than their specified maximum capacity. Whether they operate under full or partial generating load makes no difference to wear and tear; bearings, pistons and crankshafts all turn irrespective of the load.
- iv) The equipment is located at a remote, high altitude (1600m) site with adverse climatic conditions in winter including a 5 month winter with extremes of cold. This is expected to cause problems with control system sensors, water separators and valves that can lead to excessive plant damage and wear.
- v) The gensets are running on a waste product from mine which is subject to variations in quality. Such variations in gas quality can cause the engines to overheat, which results in tripping of safety cut outs, causing additional stresses and premature wear (see “Appendix 1 ref 5.pdf”)
- vi) More engine stops and starts are expected due to gas quality fluctuations, voltage fluctuations on the grid, equipment interface and control system problems, as this is the first time in China that engines and flares have been linked in an automatic control system, and to gas extraction plant interruptions. Starts and stops put increased wear on engines.
- vii) Some parts of the systems will run 24 hours a day, 7 days a week because they will cover the gas supply whenever any gensets are operating. Only in the situation of a total shutdown would this equipment cease to operate and the intention of the project activity is to ensure that the plant does not shut down.
- viii) In addition to the time clocked for production of electricity, the gensets are all expected to undergo a minimum of 400 to 500 hours of commissioning tests prior to



starting to generate power. Part of the EPC contract is that Deutz engineers ensure the plants are running smoothly and are fully integrated with the automated control systems before they are handed over. This includes the completion of a 168 hour test program during which the engines must run un-interrupted.

For all of these reasons, SCC estimates that major refurbishment to be required in years 7 and 8 and again in years 14 and 15. In practice, the actual timing of refurbishment will be determined by the actual performance of the engines and determination of the least cost option of refurbishment. For example, it may turn out to be more cost effective to refurbish all of the gensets at the same time, shipping equipment and engineers to the project site during amenable weather conditions and shutting everything down once. In this case it would be essential that all replacement parts and equipment are available on site prior of the start of refurbishment operations. It is also possible that individual engines will require repair due to unexpected failure at any time during their operation.

Income tax, and post-tax returns, were included for the purposes of comparison and tax is NOT included as an expense in the determination of pre-tax IRR and NPV. The pre-tax IRR and NPV is calculated from the pre-tax cash flow in row 31 of the spreadsheet provided. The pre-tax cash flow in row 31 is calculated by taking the net cash flow after tax (row 29) and then removing income tax (row 27). Net cash flow after tax is in turn calculated from cash in minus cash out (row 6 minus row 12). Cash out is calculated from a number of expenditure items, including income tax (in row 27). Therefore, income tax is excluded from the net cash flow before income tax and the IRR and NPV before tax is correctly calculated.

For information, the NPV including both the PPP and the full maintenance costs is  $-2207 \times 10^4$  RMB. Removing the PPP and maintenance costs increases the NPV to  $-1,275 \times 10^4$  RMB. This is still well below the NPV of the baseline and therefore these changes would have no affect on the decision to invest.

**Table B.4-4. Comparison of the project NPV for different potential baseline scenarios**

	NPV after tax (RMB)
Continuation of current practice – release of methane to atmosphere and purchase of coal for heating mine shaft air	-RMB 2.49 million
Coal purchase and flaring of CMM	-RMB 3.86 million
Power generation with CMM	- RMB 22.07 million

This analysis clearly shows that the most attractive (least unattractive) course of action is scenario a), continuation of current practice. Both of the other alternatives have negative NPVs.

***Sub-step 5c. Sensitivity analysis:***

A sensitivity analysis has been performed on the above scenarios;

**Table B4-5: Sensitivity analysis NPV (RMB 10,000)**

Scenario	90.00%	95.00%	100%	105.00%	110.00%
Coal only	-224.59	-237.07	-249.55	-262.02	-274.50
Coal and flare					



Capital costs	-375.75	-380.66	-385.57	-390.48	-395.39
Running costs	-381.79	-383.68	-385.57	-387.46	-389.35
Power generation					
Static total investment	-438.04	-1,319.79	-2,207.42	-3,100.92	-4,000.29
Annual operating cost	-1,918.89	-2,063.05	-2,207.42	-2,351.99	-2,496.76
Power tariff	-3,890.30	-3,048.86	-2,207.42	-1,365.98	-524.54

The most favorable option is the continuation of current practice, which is the purchase of coal and venting of untreated methane. The least favorable option is the generation of electricity from the CMM, which is the proposed project activity.

The data in the table clearly shows that this ranking of the options for highest returns (lowest losses) remains unchanged throughout the sensitivity analysis.

At this stage it is now clear that there is only one likely baseline scenario:

Improvement in the efficiency and extension of methane extraction from the mine combined with continued release of untreated methane to atmosphere and purchase of coal to run ventilation air heating boilers.

This scenario is entirely consistent with what is currently happening at the mine. During an initial visit to ascertain the potential for CDM, coal mine methane drainage and VAM release to atmosphere was observed. The CMM was being drained by three liquid ring gas extraction pumps. This gas extraction station is being replaced by a new installation at a remote surface location situated closer to the current area of mining activity. The plinths for five gas extraction pumps and motors have been cast and three pumps, gearboxes and motors installed. It is planned to add the two remaining pumps at a future stage. The 2BEC72 single lobe water ring seal gas extraction pumps are manufactured by Zibo Ltd, China. The motors are 6 kV, 560 kW 990 rpm. The gearbox is designed to turn the pump at 275 rpm. A recirculation valve will be included in the system to facilitate regulation of suction. The capacity of the pumps exceeds the current mine requirements but is expected to be utilized as the mine production increases.

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

The proposed project activity will not occur without CDM assistance. “Tools for the demonstration and assessment of additionality” (version 04) will be used to test the additionality of the proposed project.

On 1<sup>st</sup> December 2004, as a major annual event in the coal mining industry in China, the 4<sup>th</sup> International Symposium on CBM/CMM was held in Beijing China. In the symposium, CDM was a major topic to encourage coalmines to utilize CMM. After the symposium, the concept of CDM was spread around major Shanxi mining groups, where the project owner alongside numerous other mines started to consider implementing its CMM utilization project with the assistance from CDM.



On 19th January 2005, a CDM meeting was organized by the Shanxi Development and Reform Committee to introduce CDM more actively to the Project Owner. A representative of Sindicatum Ltd attended this meeting and on 20th January 2005, Shanxi Coking Coal Group Co Ltd discussed CDM cooperation in Sindicatum Ltd's Representative office in Beijing.

Sindicatum Carbon Capital was incorporated in March 2005 and one of the Shanxi Coking Coal was one of the projects listed at this early stage. From this time, negotiations continued with Shanxi Coking Coal Group Company Ltd over the development of CDM projects at a number of their mines. Duerping was selected as the first mine to be developed. The first version of the PDD was prepared on 24<sup>th</sup> August 2006. Proposals for validation of the project were received from TUV Sud (dated 1<sup>st</sup> October 2006) and DNV (dated 10<sup>th</sup> October 2006). TUV Sud were appointed to undertake the validation and a contract was signed accordingly. The local stakeholder consultation was performed on 30<sup>th</sup> October 2006 and the international stakeholder consultation commenced on 28<sup>th</sup> November 2006.

As stated in section C below, the starting date of the project activity, when SCC committed to the purchase of generating equipment, was 19<sup>th</sup> March 2007. All efforts and expenditure up to that point were of a preparatory nature, required to create the necessary legal structure for the implementation of the project.

Prior to the start date of the project activity, both:

- a) Documentation relating to the CDM had been in the public domain for several months; and
- b) A contract had been signed with, and a down payment made to, TUV Sud.

These facts provide ample evidence that CDM was seriously considered prior to the start date of the project activity.

Assessment and demonstration of additionality

ACM0008 ver 3 states that “because of the similarity of both approaches used to determine the baseline scenario and the additionality tool, step 1 of the tool for the demonstration and assessment of additionality can be ignored.”

## **Additionality Tool Step 2: Investment Analysis**

### **Step 2a: Determine appropriate analysis method**

The “Tools for the demonstration and assessment of additionality” (version 04) recommends three analysis methods, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III). ACM0008 Ver 3 states that if the investment analysis approach is used, project participants “should identify whether the baseline scenario selected above is economically and/or financially more attractive than the CDM project activity if not registered as a CDM project.”

The baseline scenario selected above is improvement in the efficiency and extension of methane extraction from the mine combined with continued release of untreated methane to atmosphere and purchase of coal to run ventilation air heating boilers. The project activity without CDM is the generation of electricity from the CMM and the use of waste heat to heat ventilation intake air. Improvement in the efficiency and extension of methane extraction from the mine is common to both the project activity and





the baseline scenario so the following investment analysis compares the financial attractiveness of continued release of methane to the atmosphere and coal purchase with power generation from the methane and utilization of waste heat.

### Step 2b: Option II: Investment Comparison Analysis (Option II)

The indicator to be used for financial analysis of the project activity is selected to be the Net Present Value (NPV) in accordance with the “Tool for the demonstration and assessment of additionality” (version 04). The interest rate applied is the recommended rate of return for Construction Projects in the coal and gas sector, jointly published by the Chinese National Development and Reform Commission and Ministry of Construction in “Economic Evaluation Codes and Parameters for Construction Projects” (Version 03)<sup>2</sup>. The recommended rate is 12% before tax. This value is considered appropriate because it is a benchmark for the decision to invest in construction projects in the coal mining sector, against which this project must compete for finance.

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

**Table B5-1. Data used for the IRR for option a, incremental costs of release of CMM to atmosphere**

Description: Continuation of current practice – release of CMM to atmosphere and purchase of coal for mine shaft heaters	
Coal purchase 2200 tonnes per annum at RMB 150 per tonne	RMB 225,000
NPV at 12%	- RMB 2.49 million

**Table B5-2. Data used for the IRR calculation from FSR – incremental costs for option c, utilization of CMM for power generation**

The data used in this NPV calculation are drawn from the IRR calculation presented in the approved Feasibility Study Report.

Description: Utilization of CMM for power generation	
Power tariff (Yuan/kWh)*	0.364
Price for power standard gas (Yuan/m <sup>3</sup> )	0.00
City maintenance tax rate %	7%
Education tax rate %	3%
Public welfare fund rate(of the profit after income tax) %	5%
CMM consumption of Deutz engine (m <sup>3</sup> /h)	1172
Annual operating hours (h)	7000

<sup>2</sup> Source: NDRC and National Construction Committee, 2006, Economic Evaluation Code and Parameter for Construction Projects (Version 03 )P204



Auxiliary power consumption rate of the project activity %	2.3%
Static total investment (10,000 RMB)	14771**
Water cost (Yuan/MWh)	5.35
Material cost (Yuan/MWh)	3.00
Other cost (Yuan/MWh)	5.00
Maintenance cost % of static total investment	1.5%
Depreciation period(year)	15
Remained value of the static total investment	5%
Insurance rate(of the remained static total investment)	1.0%
Welfare costs	56%
Salary costs	3
Number of people	12
Capital cost of exhaust heat ducting	RMB 2 million
Refurbishment costs on generator sets after 64000 hours (7 years operation)***	40% of capital cost
NPV at 12%	-RMB 22.07 million
coal cost RMB per tonne, unwashed at the pithead	150
annual consumption (tonnes)	2200

Please see the explanation and justification for values below Tables B4.3 on pages 18 to 22 above

Table B.5-3 shows the calculated NPV for the two potential scenarios:

**Table B.5-3. Comparison of the baseline scenario NPV with the Project activity NPV**

	NPV after tax
Continuation of current practice – release	- RMB 2.49 million
Power generation with CMM	- RMB 22.07 million

#### Sub-step 2d: Sensitivity analysis

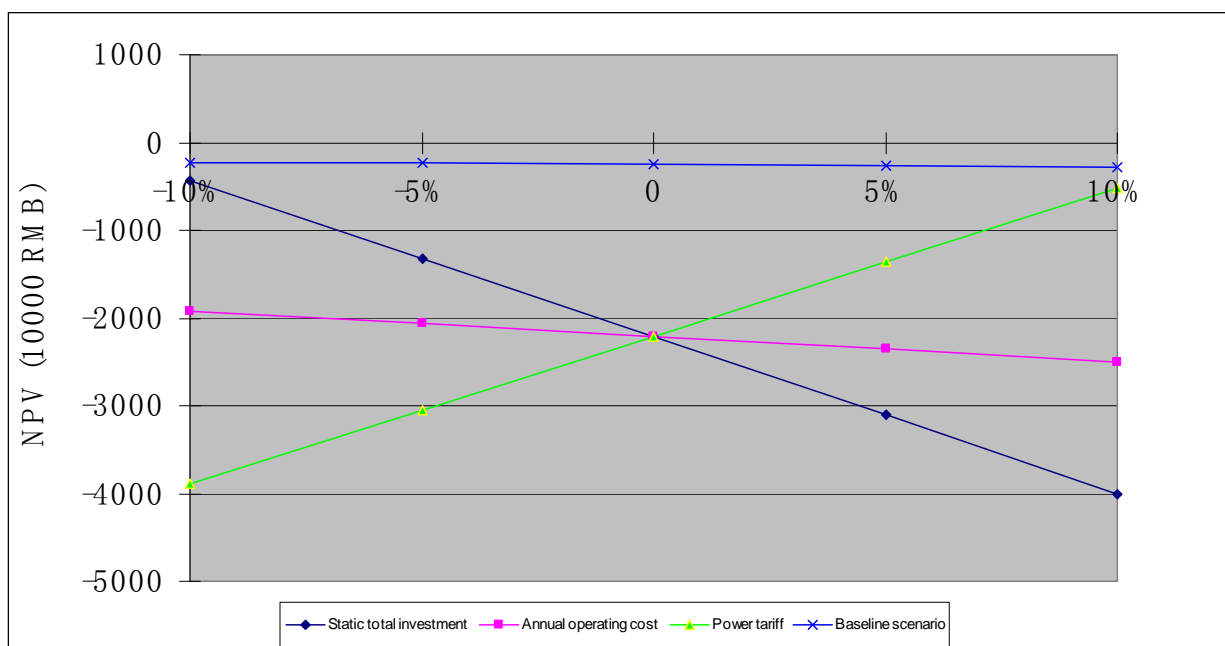
The sensitivity analysis shall show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. For such purpose, three parameters were selected as sensitive factors to check out their effects on project NPV.

1. Static total investment
2. Annual operating cost
3. Annual power supply

The NPV will fluctuate with the variations (-10% to 10%) of the above three factors. The result is demonstrated in Table B.5-3 and Figure B.5-1.

**Table B.5-3. NPV before tax Sensitivity analysis (10,000 RMB)**

Scenario	Variable	-10%	-5%	0	5%	10%
Baseline	Coal price	-224.59	-237.07	-249.55	-262.02	-274.50
Project activity	Static total investment	-438.04	-1,319.79	-2,207.42	-3,100.92	-4,000.29
	Annual operating cost	-1,918.89	-2,063.05	-2,207.42	-2,351.99	-2,496.76
	Annual power supply	-3,890.30	-3,048.86	-2,207.42	-1,365.98	-524.54



**Figure B.5-1. NPV Sensitivity Analysis**

It could be seen from Table B.5-3 and Figure B.5-1 that the project activity does not compare well against the proposed baseline scenario. Under no circumstances is the project even remotely attractive compared to the proposed baseline scenario.

It is quite clear the proposed project activity would not be undertaken without some additional source of



revenue. In SCC's case, that incentive is the CDM. Assuming a CER sales price of USD 10, the NPV increases to approx + RMB 12 million with an IRR of approximately 26%.

**Additionality Tool Step 3: Barrier analysis**

Not selected because most of the evidence to support the presence of barriers is anecdotal.

**Additionality Tool Step 4: Common Practice Analysis*****Sub-step 4a. Analyze other activities similar to the proposed project activities***

Although there is interest in using coal mine methane for power generation, references prove that its development is limited in China.

For example: <http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/005.pdf> (website last visited on the 30.08.06) states that: "There are few CMM power generation schemes in China because local authorities and mining enterprises for social reasons often consider domestic consumers a priority. Additionally, achieving an electrical grid connection can be problematic at present. However, there is potential to develop more CMM schemes to supply power to mines as they have a predictable base load and offer a number of advantages as a customer for the generated power."

These statements are further supported by the PDD for the Pansan Coal Mine utilisation and destruction project:

(<http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?cases=A&single=1&OpenNM=Nm0075>). (website last visited on the 30.08.06)

The paper by Prof Huang Shengchu et al of the China Coal Information Institute available at <http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/001.pdf> (website last visited on the 30.08.06) concludes:

"It has numerous potential in China's coal mine methane mitigation. So far, less than 50% [the body of the text quotes 5.6%] of underground extraction methane annually have been comprehensively utilized. At present, methane drainage level, drainage rate and utilization rate in China are fairly low. Majorities of the methane extracted have been discharged to the air. Total drainage amount and utilization amount of coalbed methane [CMM] resources can be improved significantly and it will make important contributions to the business of methane mitigation under the premise of improving technology level and enhancing the management..... It is concluded that utilization of coal mine methane in China is not common practice in China."

In 2002 only 196 coal mines in China had undertaken methane drainage. The average drainage rate in the country is less than 10%.<sup>3</sup> Moreover, less than 50% of China's drained CMM was utilized,<sup>9</sup> which means that only less than 5% of the total CMM emitted by China is being used at coal mines.

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

In Shanxi province, there are several CMM power generation and utilization projects. All of them are

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<sup>3</sup> China Coal Information Institute (CCII), *Optimal Projects for China's Coal Mine Methane Mitigation*, 3rd International Methane & Nitrous Oxide Mitigation Conference, Beijing, China, November 2003



implemented with CDM consideration.

**Table B.5-4**

Project name	Installation Capacity(MW)	Status	CDM (Y/N)
Yangquan Coal Mine Methane (CMM) Utilization for Power Generation Project, Shanxi Province, China	90	Registered	Y
Shanxi Coal Transport Market Ltd., Co. Yangquan Branch CMM Utilization Project	30	Registered	Y
Shanxi Liulin Coal Mine Methane Utilization Project	12	Registered	Y
China Jincheng Sihe 120 MW Coal Mine Methane Power Generation Project	120	Registered	Y
Shanxi Yangcheng Coal Mine Methane Utilization Project	16.5	Registered	Y

Data Source: UNFCCC website

#### **B.6.1. Explanation of methodological choices:**

##### **Baseline emissions:**

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \quad (1)$$

Where

$BE_y$	Baseline emissions in year y (tCO <sub>2</sub> e)
$BE_{MD,y}$	Baseline emissions from destruction of methane in the baseline scenario in year y (tCO <sub>2</sub> e)
$BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO <sub>2</sub> e)
$BE_{Use,y}$	Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO <sub>2</sub> e)

$BE_{MD,y}$  (baseline emissions from the destruction of methane in the baseline scenario) are zero.

$$BE_{MR,y} = GWP_{CH_4} \times \left[ \sum_i (CBMe_{i,y} - CBM_{BLi,y}) + \sum_i (CMM_{PJi,y} - CMM_{BLi,y}) + \sum_i (PMM_{PJi,y} - PMM_{BLi,y}) \right] \quad (2)$$

Where,

$BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO <sub>2</sub> e)
-------------	---



I	Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
$CBMe_{i,y}$	Eligible CBM captured, sent to and destroyed by use $i$ in the project for year $y$ (expressed in $tCH_4$ ) = 0
$CBM_{BLi,y}$	CBM that would have been captured, sent to and destroyed by use $i$ in the baseline scenario in the year $y$ (expressed in $tCH_4$ ) = 0
$CMM_{PJ,i,y}$	Pre-mining CMM captured, sent to and destroyed by use $i$ in the project activity in year $y$ (expressed in $tCH_4$ )
$CMM_{BL,i,y}$	Pre-mining CMM that would have been captured, sent to and destroyed by use $i$ in the baseline scenario in year $y$ (expressed in $tCH_4$ ) = 0
$PMM_{PJ,i,y}$	post-mining CMM captured, sent to and destroyed by use $i$ in the project activity in year $y$ ( $tCH_4$ )
$PMM_{BL,i,y}$	post-mining CMM that would have been captured, sent to and destroyed by use $i$ in the baseline scenario in year $y$ ( $tCH_4$ ) = 0
$GWP_{CH_4}$	Global warming potential of methane (21 $tCO_2e/tCH_4$ )

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

The baseline emissions are determined ex post by measuring the methane emitted from the methane drainage system at the point where it enters the equipment.

### Baseline emissions from grid power

The CEF\_electricity is calculated as per ACM0002, from the average of the operating margin and build margin in the North China Power Grid. The build margin is calculated from the newly installed capacity since 1999, which represents just over 20% of the total grid. Raw data is presented in Annex 3.

CEF_OM	1.1208	China Electric Power Yearbook 2006
CEF_BM	0.9397	China Electric Power Yearbook 2006

According to ACM0002, the baseline emission factor is the simple average of BM and OM:

$$1.1208 + 0.9397 / 2 = 1.03025$$

### Emission factor for heat generation

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



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

where:

$EF_{heat,y}$	Emissions factor for heat generation (tCO <sub>2</sub> /GJ)
$EF_{CO2,i}$	CO <sub>2</sub> emissions factor of fuel 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%

### Total emissions displaced by use of coal mine methane

There is no CBM

There is no vehicle fuel used by this project, and therefore  $VFUEL_y \times EF_V$  is not considered. Also, heat provided by the boilers is waste heat, and therefore creates zero emissions so  $EF_{HEAT}$  is also not considered. Therefore,  $PBE_{Use,y}$  is defined for this project as:

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

(5)

Where,

$PBE_{Use,y}$	Potential total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO <sub>2</sub> e)
$GEN_y$	Electricity generated by project activity in year y (MWh), including through the use of CBM
$EF_{ELEC}$	Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO <sub>2</sub> /MWh) = 1.03025 (see above)
$HEAT_y$	Heat generation by project activity in year y (GJ), including through the use of CBM

$$ER_y = BE_y - PE_y - L_y$$

(6)

Where

$ER_y$  = Emission reduction in year y  
 $BE_y$  = baseline emissions in year y  
 $PE_y$  = project emissions in year y  
 $L_y$  = Leakage in year y = 0

### Project emissions:



$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (9)$$

where:

$PE_y$	Project emissions in year y (tCO <sub>2</sub> e)
$PE_{ME}$	Project emissions from energy use to capture and use methane (tCO <sub>2</sub> e)
$PE_{MD}$	Project emissions from methane destroyed (tCO <sub>2</sub> e)
$PE_{UM}$	Project emissions from un-combusted methane (tCO <sub>2</sub> e)

$PE_{ME} = 0$  because the project activity simply takes the methane already captured and released in the baseline scenario. No additional energy is utilised.

$$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT} + MD_{GAS}) \times ((1-r) \times CEF_{CH_4} + r \times CEF_{NMHC}) \quad (10)^4$$

with:

$$r = PC_{NMHC} / PC_{CH_4} \quad (11)$$

where:<sup>5</sup>

$PE_{MD}$	Project emissions from CMM/CBM destroyed (tCO <sub>2</sub> e)
$MD_{FL}$	Methane destroyed through flaring (tCH <sub>4</sub> )
$MD_{ELEC}$	Methane destroyed through power generation (tCH <sub>4</sub> )
$MD_{HEAT}$	Methane destroyed through heat generation (tCH <sub>4</sub> ) = 0
$MD_{GAS}$	Methane destroyed after being supplied to gas grid or for vehicle use (tCH <sub>4</sub> ) = 0
$CEF_{CH_4}$	Carbon emission factor for combusted methane (2.75 tCO <sub>2</sub> e/tCH <sub>4</sub> )
$CEF_{NMHC}$	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO <sub>2</sub> eq/tNMHC)
$r$	Relative proportion of NMHC compared to methane
$PC_{CH_4}$	Concentration (in mass) of methane in extracted gas (%)
$PC_{NMHC}$	NMHC concentration (in mass) in extracted gas (%)

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

$$PE_{UM} = GWP_{CH_4} \times \sum_i MM_i \times (1 - Eff_i) \quad (12)$$

where:

$PE_{UM}$	Project emissions from un-combusted methane (tCO <sub>2</sub> e)
$GWP_{CH_4}$	Global warming potential of methane (21 tCO <sub>2</sub> e/tCH <sub>4</sub> )

<sup>4</sup> A factor of (1-r) is included to correctly weight the CEF by percentage of the respective gases

<sup>5</sup> Note that throughout this baseline methodology, it is assumed that measured quantities of coal mine gas are converted to tonnes of methane using the measured methane concentration of the coal mine gas and the density of methane.





- I Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
- MM<sub>i</sub> Methane measured sent to use i (tCH<sub>4</sub>)
- Eff<sub>i</sub> Efficiency of methane destruction in use i (%)

Eff<sub>ELEC</sub> (Efficiency of methane destruction/oxidation in power plant) will be taken as 99.5% from the 2006 Revised IPCC Guidelines for efficiency of methane oxidation/destruction in a power plant and as proscribed by to ACM0008 version 03.

### Leakage:

ACM0008 requires consideration of leakage from two sources: Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y (tCO<sub>2</sub>e) and leakage emissions due to other uncertainties in year y (tCO<sub>2</sub>e).

There is no baseline thermal energy use therefore there is no leakage to consider in this category. As discussed above, the project will not have any direct impact upon coal production. Since it has no direct impact upon coal production, the project activity is not expected to have any impact upon coal prices and market dynamics. The project does not involve any CBM.

### To determine project emissions from flaring gases containing methane

For the enclosed flares, the following option will be used to determine the flare efficiency:

(a) To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.

Applicable steps include:

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

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

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

STEP 6: Determination of the hourly flare efficiency

STEP 7: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

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

This step calculates the residual gas mass flow rate in each hour  $h$ , based on the volumetric flow rate and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h} \quad (1)$$

Where:

Variable	SI Unit	Description
FM <sub>RG,h</sub>	kg/h	Mass flow rate of the residual gas in hour $h$
$\rho_{RG,n,h}$	kg/m <sup>3</sup>	Density of the residual gas at normal conditions in hour $h$
FV <sub>RG,h</sub>	m <sup>3</sup> /h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour $h$

and:



and:

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n} \quad (2)$$

Where:

Variable	SI Unit	Description
$\rho_{RG,n,h}$	kg/m <sup>3</sup>	Density of the residual gas at normal conditions in hour <i>h</i>
$P_n$	Pa	Atmospheric pressure at normal conditions (101 325)
$R_u$	Pa.m <sup>3</sup> /kmol.K	Universal ideal gas constant (8 314)
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour <i>h</i>
$T_n$	K	Temperature at normal conditions (273.15)

and:

$$MM_{RG,h} = \sum_i (fv_{i,h} * MM_i) \quad (3)$$

Where:

Variable	SI Unit	Description
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour <i>h</i>
$fv_{i,h}$	-	Volumetric fraction of component <i>i</i> in the residual gas in the hour <i>h</i>
$MM_i$	kg/kmol	Molecular mass of residual gas component <i>i</i>
<i>I</i>		The components CH <sub>4</sub> , CO, CO <sub>2</sub> , O <sub>2</sub> , H <sub>2</sub> , N <sub>2</sub>

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

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, as follows:

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}} \quad (4)$$

Where:

Variable	SI Unit	Description
$fm_{j,h}$	-	Mass fraction of element $j$ in the residual gas in hour $h$
$fv_{i,h}$	-	Volumetric fraction of component $i$ in the residual gas in the hour $h$
$AM_j$	kg/kmol	Atomic mass of element $j$
$NA_{j,i}$	-	Number of atoms of element $j$ in component $i$
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour $h$
$j$		The elements carbon, hydrogen, oxygen and nitrogen
$i$		The components $CH_4$ , $CO$ , $CO_2$ , $O_2$ , $H_2$ , $N_2$

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

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ( $FV_{RG,h}$ ), the volumetric fraction of methane in the residual gas ( $fv_{CH_4, RG,h}$ ) and the density of methane ( $\rho_{CH_4,n,h}$ ) in the same reference conditions (normal conditions and dry or wet basis). It is necessary to refer both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) to the same reference condition that may be dry or wet basis. If the residual gas moisture is significant (temperature greater than 60°C), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis).

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH_4, RG,h} \times \rho_{CH_4,n} \quad (13)$$

Where:

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour $h$
$FV_{RG,h}$	m <sup>3</sup> /h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour $h$
$fv_{CH_4, RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour $h$ (NB: this corresponds to $fv_{i, RG,h}$ where $i$ refers to methane).
$\rho_{CH_4,n}$	kg/m <sup>3</sup>	Density of methane at normal conditions (0.716)

#### STEP 6. Determination of the hourly flare efficiency

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

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

### STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour  $h$ , based on the methane flow rate in the residual gas ( $TM_{RG,h}$ ) and the flare efficiency during each hour  $h$  ( $\eta_{\text{flare},h}$ ), as follows:

$$PE_{\text{flare},y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{\text{flare},h}) \times \frac{GWP_{CH_4}}{1000} \quad (15)$$

Where:

Variable	SI Unit	Description
$PE_{\text{flare},y}$	tCO <sub>2</sub> e	Project emissions from flaring of the residual gas stream in year $y$
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour $h$
$\eta_{\text{flare},h}$	-	Flare efficiency in hour $h$
$GWP_{CH_4}$	tCO <sub>2</sub> e/tCH <sub>4</sub>	Global Warming Potential of methane valid for the commitment period

### Emission Reductions:

Emission reductions due to the project activity are determined by subtracting the project emissions during period  $y$  from the baseline emissions during the same period  $y$ :

$$ER_y = BE_y - PE_y - LE_y \quad (13)$$

where:

$ER_y$	Emissions reductions of the project activity during the year $y$ (tCO <sub>2</sub> e)
$BE_y$	baseline emissions during the year $y$ (tCO <sub>2</sub> e)
$PE_y$	project emissions during the year $y$ (tCO <sub>2</sub> e)
$LE_y$	leakage emissions in year $y$ (tCO <sub>2</sub> e) = 0

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

Data / Parameter:	CEF – CH <sub>4</sub>
Data unit:	tCO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Carbon emission factor of coal mine methane



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Source of data used:	2006 Revised Guidelines for IPCC
Value applied:	2.75
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stoichiometric calculation
Any comment:	No comment

<b>Data / Parameter:</b>	<b>CEFelecpj</b>
Data unit:	tCO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Carbon emission factor of coal mine methane
Source of data used:	2006 Revised Guidelines for IPCC
Value applied:	2.75
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stoichiometric calculation
Any comment:	No comment

<b>Data / Parameter:</b>	<b>EF co2</b>
Data unit:	tCO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Carbon emission factor of coal mine methane
Source of data used:	2006 Revised Guidelines for IPCC
Value applied:	2.75
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stoichiometric calculation
Any comment:	No comment

<b>Data / Parameter:</b>	<b>GWP – CH<sub>4</sub></b>
Data unit:	tCO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Global warming potential of methane
Source of data used:	2006 Revised Guidelines IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value



applied :	
Any comment:	No comment

<b>Data / Parameter:</b>	<b>PCnmhc</b>
Data unit:	%
Description:	Percentage of non-methane hydrocarbon in methane
Source of data used:	Periodic analysis
Value applied:	0 (zero)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Tests performed by TES Bretby in UK on four tube samples collected from the mine in August 2006 recorded levels of 0.02% or less for all non-methane hydrocarbons (Appendix 2). Samples will be re-analysed annually and if more than the concentrations of all NMHCs combined exceed 1%, they will be incorporated in the calculations.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>CEFnmhc</b>
Data unit:	tCO <sub>2</sub> /tnmhc
Description:	Carbon emission factor per tonnes of non-methane hydrocarbon
Source of data used:	Stoichiometric analysis
Value applied:	Depends on type of hydrocarbon. Calculated dividing the molecular weight of CO <sub>2</sub> produced by the molecular weight the hydrocarbon. For example, 1 mole of C <sub>3</sub> H <sub>8</sub> (propane) with MW 44 yields 3 moles of CO <sub>2</sub> with MW 68. CEF = $3 \times 44 / 44 = 3$ tonnes of CO <sub>2</sub> per tonne of C <sub>3</sub> H <sub>8</sub> .
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stoichiometric calculation
Any comment:	No comment

<b>Data / Parameter:</b>	<b>EFelec</b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Baseline emissions from grid power
Source of data used:	Calculated from NDRC Values
Value applied:	1.03205
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated using ACM0002. See Annex 3
Any comment:	No comment



<b>Data / Parameter:</b>	<b>EF<sub>OM</sub>; EF<sub>BM</sub>; F<sub>ijv</sub>; COEF<sub>ik</sub>; GEN<sub>i</sub></b>
Data unit:	Various
Description:	EF for operating and build margins; fuel used to produce power; emission factor of each fuel; power generated
Source of data used:	China Electric Power Yearbook(s)
Value applied:	Various – see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated using ACM0002. See Annex 3
Any comment:	No comment

<b>Data / Parameter:</b>	<b>EF<sub>i</sub></b>
Data unit:	tCO <sub>2</sub> /GJ
Description:	Emission factor of fuel used for captive power / heat generation
Source of data used:	IPCC GHG Inventory reference Manual Vol 3
Value applied:	0.094
Justification of the choice of data or description of measurement methods and procedures actually applied :	Conservative emission factor of 25.65 TC/TJ = 0.02565 TC/GJ 0.02565 * 44/12 = 0.0940 TCO <sub>2</sub> per GJ
Any comment:	No comment

<b>Data / Parameter:</b>	<b>Eff<sub>ELEC</sub></b>
Data unit:	percentage
Description:	Efficiency of methane destruction / oxidation in power plant
Source of data used:	ACM0008 ver 3
Value applied:	99.5%
Justification of the choice of data or description of measurement methods and procedures actually applied :	ACM0008 ver 3 specifies this value to be applied
Any comment:	No comment

<b>Data / Parameter:</b>	<b>Eff<sub>i</sub></b>
Data unit:	Percentage
Description:	Efficiency of methane destruction / oxidation in use i (in this case, flaring)
Source of data used:	ACM0008 ver 3
Value applied:	90%
Justification of the	According to the Tool to determine project emissions from flaring gases



choice of data or description of measurement methods and procedures actually applied :	containing methane.
Any comment:	n/a

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

Ex-ante calculations have been made for year 1, 2 and 3 only. Values and calculations from year 4 onward are the same as year 3.

**I. Estimated baseline emissions****A) Determination of baseline emissions from destruction of methane in the baseline scenario ( $BE_{MD,y}$ )**

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

**B) Determination of baseline emissions from release of methane into the atmosphere that is avoided by the project activity ( $BE_{MR,y}$ )**

Item	$GWP_{CH_4}$ (tCO <sub>2</sub> e/tCH <sub>4</sub> )	$CMM_{tot,y}$ (tCH <sub>4</sub> /yr)	$BE_{MR,y}$ (tCO <sub>2</sub> e/yr)
I.D.	A	B	C
Data for Year 1(Oct-Dec)	21	15,844	142,590
Year 2			285,201
Year 3			332,724
Data source or calculation formulae	ACM0008	the feasibility study report	$C=A \times B$

**C) Determination of baseline emissions from the production of power or heat replaced by the project activity ( $BE_{Use,y}$ )**

Item	$CEF_{CH_4}$ (MW)	Working hours (h)	$EF_{ELEC}$ (tCO <sub>2</sub> e/MWh)	$HEAT_y$ (GJ/yr)
I.D.	D	E	F	G
Data for Year 1	2.75	7000	1.03025	55,188
Year 2				
Year 3				
Data source or	IPCC 2006	IPCC 2006	Notification on Determining	See Annex 3 for detail





calculation formulae			Baseline Emission Factor of China's Grid	
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Item	$EF_{CO_2,i}$ (tCO <sub>2</sub> e/tCH <sub>4</sub> )	$Eff_{ELEC}$ (%)	$EF_{heat,y}$ (tCO <sub>2</sub> e/GJ)	$BE_{Use,y}$ (tCO <sub>2</sub> e/yr)
I.D.	H	I	J	K
Data for Year 1	2.75	99.5	0.0946	42,001
Year 2				78,781
Year 3				91,041
Data source or calculation formulae	IPCC 2006	ACM0008	ACM0008	$K=(MW \times E) \times F + G \times J$

## II. Estimated project emissions

### A) Project emissions from energy use to capture and use methane ( $PE_{ME}$ )

Item	$CONS_{ELEC,PJ}$ (MWh/yr)	$PE_{ME}$ (tCO <sub>2</sub> e/yr)
I.D.	L	M
Data for Year 1	0	0
Year 2		
Year 3		
Data source or calculation formulae	Methane capturing system is in the baseline and power meters of generators show net not gross power produced.	$M=L \times F$

### B) Project emissions from methane destroyed ( $PE_{MD}$ )

Item	$PE_{MD}$ (tCO <sub>2</sub> e/yr)
I.D.	N
Data for Year 1	18,579
Year 2	37,161
Year 3	43,353
Data source or	$N= B \times I \times J$



calculation formulae	
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**C) Project emissions from un-combusted methane ( $PE_{UM}$ )**

Item	$PE_{UM}$ (tCO <sub>2</sub> e/yr)
I.D.	O
Data for Year 1	713
Year 2	1,426
Year 3	1,664
Data source or calculation formulae	$O=C \times (1-I)$

**III. Estimated leakage**

According to the consolidated baseline methodology ACM0008, no leakage is considered in the Project (see Section B.6.1. for details).

**IV. Estimated emission reductions**

Item	$BE_y$ (tCO <sub>2</sub> e/yr)	$PE_y$ (tCO <sub>2</sub> e/yr)	$L_y$ (tCO <sub>2</sub> e/yr)	$ER_y$ (tCO <sub>2</sub> e/yr)
I.D.	P	Q	R	S
Data for Year 1	184,591	19,292	0	165,299
Year 2	363,982	38,587		325,395
Year 3	423,765	45,017		378,748
Data source or calculation formulae	$P=C+K$	$Q=M+N+O$	ACM0008	$S=P-Q-R$

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

Year	Estimation of project activity emissions (tonnes CO <sub>2</sub> e)	Estimation of baseline emissions (tonnes CO <sub>2</sub> )	Estimation of leakage (tonnes CO <sub>2</sub> e)	Estimation of overall emission reductions (tonnes CO <sub>2</sub> e)
1 (Oct-Dec)	4,823	46,147	0	41,325



2	38,587	363,982	0	325,395
3	45,017	423,765	0	378,748
4	45,017	423,765	0	378,748
5	45,017	423,765	0	378,748
6	45,017	423,765	0	378,748
7	45,017	423,765	0	378,748
8	45,017	423,765	0	378,748
9	45,017	423,765	0	378,748
10	45,017	423,765	0	378,748
11 (Jan-Sep)	33,763	317,824	0	284,061
Total	437,309	4,118,073	0	3,680,764

**B.7 Application of the monitoring methodology and description of the monitoring plan:**
**B.7.1 Data and parameters monitored:**

<b>B.7.1 Data and parameters monitored:</b>	
<b>Data / Parameter:</b>	<b>PEy</b>
Data unit:	T CO <sub>2</sub>
Description:	Project emissions in period y
Source of data to be used:	Calculated from sum of emissions from combustion of methane and emissions of un-combusted methane
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2.75 t CO <sub>2</sub> per tonne of methane combusted plus 0.005 t CO <sub>2</sub> per tonne of methane burnt in the generators from un-combusted methane
Description of measurement methods and procedures to be applied:	See PEmd and PEum below
QA/QC procedures to be applied:	Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. Actual project emissions will be compared with predicted project emissions at the prevailing generation capacity as a logic check.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>PEme</b>
Data unit:	TCO <sub>2</sub>
Description:	Project emissions from energy use to capture and use methane
Source of data to be	n/a



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used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	n/a
Any comment:	No additional energy is used. Capture and removal of methane is the business as usual scenario.

<b>Data / Parameter:</b>	<b>PEmd</b>
Data unit:	tCO <sub>2</sub>
Description:	Project emissions from destruction of methane
Source of data to be used:	Calculated from volume of methane at normal temperature and pressure combusted by generators multiplied by 2.75.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Ex ante volume of methane consumed is in Nm <sup>3</sup> , therefore no conversion is necessary before applying the density. For the ex ante prediction no conversion for NTP is required, but ex post, temperature and pressure will be recorded and the volume adjusted to NTP using the gas law $P_1V_1/T_1=P_2V_2/T_2$
Description of measurement methods and procedures to be applied:	Volume of pure methane destroyed is calculated from volume and concentration measurements taken at the inlet to the generators. See MDelec below
QA/QC procedures to be applied:	Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. The volume of methane destroyed will be cross checked by correlation with gross power output from the generators.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>PEum</b>
Data unit:	T CO <sub>2</sub> e
Description:	Un-combusted methane emitted from the generators
Source of data to be used:	Calculated from mass of methane burnt in generators
Value of data applied for the purpose of calculating expected emission reductions in	Default efficiency is 99.5%, therefore un-combusted methane is $0.05 * PE_{md}$



section B.5	
Description of measurement methods and procedures to be applied:	See PEmd above
QA/QC procedures to be applied:	Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. Application of a constant so no measurement necessary
Any comment:	No comment

<b>Data / Parameter:</b>	<b>MDelec</b>
Data unit:	T CH <sub>4</sub>
Description:	Methane destroyed by power generators
Source of data to be used:	Calculated from the flow and concentration of methane at the inlet to the generators.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Based on specifications of generators which consume 6.75 Nm <sup>3</sup> of pure methane per minute, density 0.00067 t/m <sup>3</sup> at NTP for an average of 7000 hours per year, each 1.7 MW generator will consume 1331.42 tonnes of methane per year, of which 0.5% (10 tonnes) will be emitted un-combusted.
Description of measurement methods and procedures to be applied:	See MMelec and PC CH <sub>4</sub>
QA/QC procedures to be applied:	Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. The volume of methane destroyed will be correlated with gross power output from the generators.
Any comment:	

<b>Data / Parameter:</b>	<b>MMelec</b>
Data unit:	M <sup>3</sup>
Description:	Volume of methane combusted for electricity generation
Source of data to be used:	Measured by a flow meter on the inlet to each generator and summed. For the ex ante prediction on conversion for NTP (given by the methodology as 0.67 kg/m <sup>3</sup> ) is required, but ex post, temperature and pressure will be recorded and the volume adjusted to NTP using the gas law $P_1V/T_1 = P_2V_2/T_2$
Value of data applied	Based on generator specifications of 6.75 Nm <sup>3</sup> of pure methane per minute



for the purpose of calculating expected emission reductions in section B.5	(equivalent to 270 NM <sup>3</sup> /h per MW)
Description of measurement methods and procedures to be applied:	A flow meter will be used to determine flow to all generator sets. For cross checking purposes the generator sets will be fitted with individual flow meters (differential pressure, turbine or flow meter). Measurements will be taken continuously and logged at nominal 30 second intervals.
QA/QC procedures to be applied:	Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. Flow meters will be calibrated and monitored according to the manufacturer's specifications. Total flow to the generators will be checked against mine methane drainage data.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>Effelec</b>
Data unit:	%
Description:	Efficiency of combustion of methane in power generators
Source of data to be used:	Default taken from methodology
Value of data applied for the purpose of calculating expected emission reductions in section B.5	99.5%
Description of measurement methods and procedures to be applied:	N/A
QA/QC procedures to be applied:	This figure will be built into a spreadsheet for calculating emissions. The spreadsheet will be archived periodically and stored in two locations. Access to this figure will be controlled. This is a constant so no measurement uncertainty
Any comment:	No comment

<b>Data / Parameter:</b>	<b>CEF-nmhc</b>
Data unit:	T CO <sub>2</sub> / T NMHC
Description:	Carbon emission factor for non-methane hydrocarbons.
Source of data to be used:	If necessary, the value for specific non-methane hydrocarbons will be determined by stoichiometric calculation.
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. (See results of gas analysis in Appendix 2)
Description of measurement methods	Derived using measurements described in PCnmhc



and procedures to be applied:	
QA/QC procedures to be applied:	n/a
Any comment:	No comment

<b>Data / Parameter:</b>	<b>PC CH4</b>
Data unit:	%
Description:	Percentage of pure methane (wet basis) in drained gas (by volume)
Source of data to be used:	Methanometer at the inlet to each generator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This figure is not used in the ex ante calculations however, in order for the generators to operate, the methane concentration must be above 30%.
Description of measurement methods and procedures to be applied:	Methane concentration will be measured by proprietary infra red instrumentation mounted in the gas pipework at the gas treatment unit and the generator sets. Accuracy of analysis +/-2.5%FSD. Gas analysed as sample (gas dried by pre-treatment). Measurements will be taken continuously and logged at nominal 30 second intervals.
QA/QC procedures to be applied:	Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. Methanometers will be calibrated and monitored according to the manufacturer's specifications. Methane purity to the generators will be checked against mine methane drainage data.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>PCnmhc</b>
Data unit:	%
Description:	Percentage of non-methane hydrocarbons in CMM, by mass
Source of data to be used:	Will be determined from annual tests of samples of coal mine methane
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, samples of gas will be extracted into gas sampling bottles using the appropriate procedures and analyzed by an qualified laboratory, for example, TES Bretby in the UK or an equivalent qualified laboratory in China.



QA/QC procedures to be applied:	A minimum of 3 samples will be collected in secure gas sample vessels, suitable for storage and transport to the selected laboratory. Samples will be taken in accordance with protocol procedures in the CDM monitoring manual and analysed in a qualified laboratory. 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 the longer of two years longer than the crediting period or two years after the last issuance of CERs.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>R</b>
Data unit:	Ratio
Description:	Relative proportion of NMHC to methane
Source of data to be used:	Calculated from PC nmhc / PC CH <sub>4</sub>
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:	See PC nmhc and PC CH <sub>4</sub>
QA/QC procedures to be applied:	This figure will be built into a spreadsheet for calculating emissions. The spreadsheet will be archived periodically and stored in two locations. Access to this figure will be controlled.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>GENy</b>
Data unit:	MWh
Description:	Electricity generated by the project,
Source of data to be used:	Electrical out meters on generators (sum of gross output from generators minus the power consumed at the plant)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	In year 1, it is anticipated that a total of 5.1 MW of power generation capacity will be installed. In year two this will increase to 10.2 and in year 3 onwards, 12 MW Assuming uptime of 7000 hours per year, this will equate to an estimated power generation of: 35,700 MWh in year 1 71,400 MWh in year 2; and 83,300 MWh in year 3 onwards
Description of measurement methods and procedures to be applied:	Power generation will be metered on each generator and at the link from the generators to the grid. The priority measurement will be the cumulative net power exported meter. The secondary will derive from the sum of generator output less project site power use. The secondary data collection system will be





	derived from the sum of the generator output less project site power use (measured and calculated for all plant at a normal load. It is a cumulative measurement and is therefore continuous.
QA/QC procedures to be applied:	Calculations will be performed by spreadsheet which will be audited periodically and protected from being over-written or altered by unauthorized personnel. Data will be backed up and archived in two different locations, where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. The net export meter will be approved by the local power company and calibrated and monitored in accordance with their instructions.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>BE<sub>y</sub></b>
Data unit:	T CO <sub>2</sub>
Description:	Baseline emissions in year y
Source of data to be used:	Equals BE <sub>mr,y</sub> . See below
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See BE <sub>mr,y</sub> below
Description of measurement methods and procedures to be applied:	See BE <sub>mr,y</sub> below
QA/QC procedures to be applied:	See BE <sub>mr,y</sub> below
Any comment:	No comment

<b>Data / Parameter:</b>	<b>BE<sub>mr,y</sub></b>
Data unit:	T CO <sub>2</sub> e
Description:	Baseline emissions from the release of methane to the atmosphere that is avoided by the project activity, in this case equal to the methane destroyed in MDelec.
Source of data to be used:	MDelec
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See MDelec above
Description of measurement methods and procedures to be applied:	See MDelec above



QA/QC procedures to be applied:	See MDelec above
Any comment:	No comment

<b>Data / Parameter:</b>	<b>HEATy</b>
Data unit:	GJ
Description:	Heat generated by the coal fired boilers which are displaced by heat produced by the project activity.
Source of data to be used:	Temperature and flow rates on outward and returning heating pipes
Value of data applied for the purpose of calculating expected emission reductions in section B.5	55.188 GJ per year
Description of measurement methods and procedures to be applied:	Waste heat will be transferred from the generators to the mines ventilation, heater and building by way of closed circuit heat transfer system. The circuits will be fitted with constant flow pumps, thermocouples in the flow and return pipes and flow meters. Actual heat transferred will be determined by measuring the flow, inlet and return temperatures and logging the data. Measurements will be taken continuously and logged at nominal 30 second intervals.
QA/QC procedures to be applied:	Temperature and flow rate data will be used to calculate heat supplied and this will be fed into a data logger for determination of heat supply. Heat will be supplied to meet demand which is determined by need for compliance with mine air temperature regulations and hence on ambient temperature which will also be recorded. Measurement equipment will be calibrated and monitored in accordance with manufacturer instruction.
Any comment:	No comment

<b>Data / Parameter:</b>	<b>T</b>
Data unit:	Kelvin
Description:	Temperature of CMM
Source of data to be used:	Temperature sensor on gas pipework between the treatment unit and the generators
Value of data applied for the purpose of calculating expected emission reductions in section B.5	293
Description of measurement methods and procedures to be applied:	Thermocouple or similar suitable device
QA/QC procedures to be applied:	Calibrated and monitored as per manufacturers' instructions. Logging of data and storage for 2 years after crediting lifetime.
Any comment:	No comment



<b>Data / Parameter:</b>	<b>CONS<sub>ELEC-PJ</sub></b>
Data unit:	MWh
Description:	Additional power consumption by project activity
Source of data to be used:	N/A, since the project activity does not use any additional power when compared to the baseline
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Zero
Description of measurement methods and procedures to be applied:	N/A
QA/QC procedures to be applied:	N/A
Any comment:	No comment

<b>Data / Parameter:</b>	<b>EFF<sub>HEAT</sub></b>
Data unit:	Percentage
Description:	Efficiency of heat conversion in the baseline
Source of data to be used:	ACM0008 ver 3
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100 %
Description of measurement methods and procedures to be applied:	N/A. The approved methodology provides two different options. Option B is selected whereby the boilers are assumed to convert 100% of the heat value of the coal into heat for the mine air. This is a conservative assumption because no data on efficiency of conversion is available.
QA/QC procedures to be applied:	None
Any comment:	No comment

<b>Data / Parameter:</b>	<b>MM<sub>i</sub></b>
Data unit:	tCH <sub>4</sub>
Description:	Methane measured sent to use i
Source of data to be used:	ACM0008 ver 3
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100 %
Description of	Flow meters will electronically record gas volumes, pressure and



measurement methods and procedures to be applied:	temperature. Data will be stored for 2 years
QA/QC procedures to be applied:	None
Any comment:	No comment

<b>Data / Parameter:</b>	<b>PMM<sub>pi,iv</sub></b>
Data unit:	tCH <sub>4</sub>
Description:	Post-mining CMM captured, sent to and destroyed by use I in the project activity in year y
Source of data to be used:	ACM0008 ver 3
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100 %
Description of measurement methods and procedures to be applied:	N/A
QA/QC procedures to be applied:	N/A
Any comment:	No comment

<b>Data / Parameter:</b>	<b>FVRG<sub>h</sub></b>
Data unit:	m <sup>3</sup> /h
Description:	volumetric flow rate of the residual gas at normal conditions in the hour h (residual gas to flare)
Source of data to be used:	Measured by project participants using a V-cone flow meter with +/-0.5% accuracy
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A
Description of measurement methods and procedures to be applied:	Ensure that the same basis is considered for this measurement and the measurement of the volumetric fraction of all components in the residual gas when the residual gas temperature exceeds 60 Degree
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	No comment



<b>Data / Parameter:</b>	$f_{vi,h}$
Data unit:	-
Description:	Volumetric fraction of component $i$ in the residual gas in the hour $h$ where $i = \text{CH}_4, \text{CO}_2$
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Ensure that the same basis wet is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ( $F_{VRG,h}$ ) when the residual gas temperature exceeds 60 °C
Description of measurement methods and procedures to be applied:	Continuously. Values to be averaged hourly time interval
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project participants may only measure the Methane content of the residual gas and consider the remaining part as N <sub>2</sub> .

<b>Data / Parameter:</b>	$f_{v \text{ CH}_4, RG, h}$
Data unit:	-
Description:	volumetric fraction of methane in the residual gas on dry basis in hour $h$
Source of data to be used:	Measured by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50%
Description of measurement methods and procedures to be applied:	Ensure that the same basis is considered for this measurement and the measurement of the volumetric flow rate of the residual gas when the residual gas temperature exceeds 60 Degree
QA/QC procedures to be applied:	Analyzers must be periodically calibrates according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N <sub>2</sub> .



<b>Data / Parameter:</b>	$T_{flare}$
Data unit:	°C
Description:	Temperature of the flue gas of the flare
Source of data to be used:	Temperature thermocouple
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A
Description of measurement methods and procedures to be applied:	Monitored continuously by a Type N thermocouple. A temperature above 500 Degree indicates that a significant amount of gases are still being burnt and that the flares is operating.
QA/QC procedures to be applied:	Data will be backed up and archived where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs. Thermocouple will be calibrated according to the manufacturer's specifications.
Any comment:	N/A

<b>Data / Parameter:</b>	<i>Manufacturer's specifications</i>
Data unit:	various
Description:	Certified specifications of equipment
Source of data to be used:	Commissioning reports, certificates and approval notices provided by manufacturers or suppliers
Value of data applied for the purpose of calculating expected emission reductions in section B.5	n/a
Description of measurement methods and procedures to be applied:	Periodic checking, monitoring or calibration of equipment according to the manufacturers specifications
QA/QC procedures to be applied:	Implementation of maintenance and calibrations schedules, with results (e.g. calibration certificates) to be stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.
Any comment:	n/a

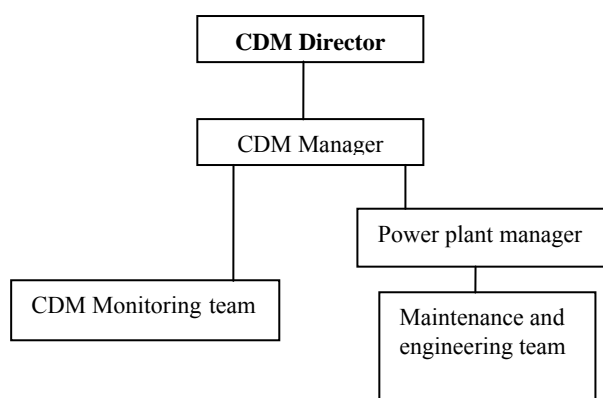
**B.7.2 Description of the monitoring plan:**

A monitoring plan will be implemented to ensure that the approved monitoring methodology ACM0008 version 03 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.



**Scope:** This procedure covers the project activity described in the CDM project entitled Duerping Coal Mine Methane Project.

Duerping CDM Management Structure



**Responsibility and CDM management:** A CDM manager will be appointed at Duerping mine with responsibility for monitoring all Project related activities and organising training. The CDM Project Manager is responsible for overseeing the implementation of this procedure. Competency requirements for the position of Project Manager will be defined and applied to ensure that the Project Manager is able to implement this procedure.

All calculations will be checked and signed off by the CDM monitoring manager who will also be responsible for preparing and checking documents required for verification.

A CDM monitoring team will report directly to the monitoring manager and who will have day to day responsibilities for checking instrumentation, record keeping, data handling and data processing, filing, reporting, organising repair and maintenance of monitoring equipment and ensuring the monitoring plan is adhered to as indicated in the approved PDD. The monitoring staff will receive technical training and refresher training as well as safety training to minimise exposure to workplace hazards. At least one fully trained technical member of the monitoring team will be present on every shift.

Operational staff with existing responsibilities for gas monitoring at the extraction plant will receive additional training and will collaborate with the monitoring staff. A management level link will be established to ensure effective co-operation between mine staff and CDM monitoring staff.

All relevant information, notes of meetings, data files, maintenance records, defect reports, hard copy and computerised records of monitoring will be kept at a designated location and arranged in an orderly and transparent manner to facilitate audit as and when required.

Responsibilities, procedures, methods, equipment types and specifications are described in detail in a site-specific CDM monitoring manual.

**On-line monitoring system:** All key meters required to determine GHG emissions and emission reductions will be monitored from a central control point which will record meter readings at a pre-



determined interval as specified in the CDM monitoring manual. These data will be used to continually update total emission reductions as long as the generating plants are in operation.

Key meters will measure parameters MMelec (volume of methane sent to generators), PC CH<sub>4</sub> (percentage methane by volume), temperature and pressure of the CMM at the flow meter and GEN<sub>y</sub> (electricity generated in year y) and heat transferred to the shaft air heater. Annual measurements of PC<sub>nmhc</sub> will also be undertaken.

Calculation of avoided emissions:

The data required for calculating baseline and project emissions will be fed into a processor (spreadsheet or logarithm application) which will calculate the emission reductions according to the formulae described above, using the defined default values. Access to the computer programme will be controlled for security. The process will include various checks, such as a comparison of total methane consumed against total power generated and will be regularly audited to ensure it is operating correctly.

#### **Non essential data**

The on-line monitoring system will also record “non-essential” data. Such data is termed non-essential because it is not directly listed in the CDM Monitoring Methodology, but it will constitute a means of corroborating the on-line system. Non-essential data will include measurements of net and gross output from individual generators, certificated conversion efficiency, data from extraction plant, flow rate upstream of the vacuum pumps (can also be compared with name plate capacity of pumps, pump(s) operational and service history) and methane concentration in CMM at other points of the CMM system. Any subsequent CDM and non CDM utilisation/destruction additions to the gas supply circuit will be monitored.

#### **Accuracy and calibration of instruments**

All meters will be purchased and maintained as specified in the CDM monitoring manual to achieve an accuracy of  $\pm 5\%$  methane mass flow. All key meters will be subject to a quality control regime that will include regular maintenance and calibration. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration) and who performs the calibration service. Evidence of calibration will be retained for all meters until two years after the end of the crediting period.

Mass flow of methane supplied to the engines will be corroborated by comparison with the sum of the gross engine power outputs, the relationship being a function of engine efficiency which can be considered a constant under the proposed maintenance regime

#### **Archiving of data**

The on-line system will automatically archive data to a secure and retrievable storage format on a periodic e.g. weekly basis. Calibration records will be archived in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period.

#### **Document Control**

The Project Manager will implement a document control system that ensures that the current versions of necessary documents are available at the point of use.

#### **Preparation of monitoring report**





The archived / live data will be used to prepare a periodic monitoring report to be submitted to the CDM EB for verification and issuance of CERs. A standard format for the monitoring report will be prepared and prior to the submission of the first monitoring report.

**Manual data recording system**

The Site Manager will implement a manual data recording system to act as a back-up for the on-line system. This will involve completion of a weekly log sheet.. These log sheets will act as a back-up for massvolume combusted and a means of estimating other essential data in the event of a prolonged failure of the on-line system. Prolonged failure will constitute more than 24 hours (cumulative) without on-line monitoring.

**Treatment of missing or corrupted data**

Where data in the on-line system are corrupted or missing and no secondary data are available 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.

**Audit function and management review**

The Project 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 mine 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.

**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)**

26/06/2008.

The PDD was completed by Gareth Phillips, Chief Climate Change Officer, Sindicatum Carbon Capital (project developer) [gareth.phillips@carbon-capital.com](mailto:gareth.phillips@carbon-capital.com).

**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:**

19/03/2007 (Purchase of equipment)

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

10 years; the utilization scheme is expected to continue after the end of the designated crediting period for a substantial part of the anticipated remaining lifetime of the mine

**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:**

01/10/2008 or date of registration, which ever is later

**C.2.2.2. Length:**

10 years

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

Environmental impacts have been analyzed in the Feasibility Study number F2171K-A-01 prepared by the Xishan Electric Power Design Institute. The document concludes (on page 55) that “The suggested gas power plant is in compliance with the national policy of comprehensive utilization of resources and environmental protection.”

The revised feasibility study (to include the waste heat utilisation) has been completed and approved by local government. An EIA has been undertaken in accordance with regulations and has been approved by the EPB.

Under the law of environmental protection of China, analysis and assessment of environmental impacts created by this project have been carried out. Environmental Protection Bureau of Shanxi province has approved the implementation of the project on September 30th 2006 (Approval No.: [2006]396).

According to Environmental Impacts Report, the environmental impacts that are possible to be influenced by this project include:

**1. Noises**

First of all, project owner will use the type of equipments which are in line with national standard. Project owner also will take several measures to mitigate noises level produced during project period, like



enclosing the generators in noise proof containers. As for constructors, project owner will provide them with noise reduction equipments in line with national regulations.

## **2. Living Sewage**

Little amounts of waste water will be created as all water will be recycled by the coal mine for internal use. The generators have a closed circuit and any changes of water will be treated with maximum care and sent to the local sewage system for treatment. All the sewage that is discharged out will meet the requirement of “Sewage discharge standards” (GB8978-1996).

## **3. Air Pollution**

The generators and flares installed will not produce any pollutant emissions and energy in heat form will be produced from the destruction units.

## **4. Ecological Impact**

In order to reduce ecological impact, some measures are taken, like marking the construction area clearly, banning the activities of smoking, fire, hunting, fishing and so on. The power production plant will be situated around the coal mine to ensure that no vegetated area is disturbed due to the project.

**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:**

Environmental impacts are not considered significant by project participants or the host party.

## **SECTION E. Stakeholders' comments**

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

A Stakeholder consultation meeting was convened at Duerping Coal Mine at 08.30 – 11.00, Monday 30<sup>th</sup> October 2006. 24 participants were invited from a list of stakeholders compiled by Shanxi Coking Coal in consultation with SCC. A notice was also displayed in the foyer of Duerping Coal Mine (see fig 3).

24 Participants took part in the meeting (see list of participants in Appendix 1). See Figs 4- 6 showing the meeting.

Questions from the participants and answers provided were recorded during the meeting.



Fig 1: Duerping Coal Mine



Fig 2: Duerping Coal Mine



Fig 3: Public announcement of meeting



Fig 4: Stakeholder consultation in process



Fig 5: Presentation of the project by (left to right) Sheng Jin Ming, Zhang Neng Hu and Wu Dong Sheng



Fig 6: Answering questions from villagers

#### **E.2. Summary of the comments received:**

In summary, all of the participants understood the objectives of the project were supportive of the project and urged all parties to implement the project as soon as possible. Cheng Shi Xin from Xin Hua Village asked that the project developers specifically ensure that land is used most efficiently and that no land is wasted, as land is the basis of the farmer's existence and there is not much farming land available. In response to this request, it was confirmed that the generators will be placed as close to each other as safety permits and that the total area occupied by the first batch of generators would not be much bigger than the room we were in.

In particular, the following questions were received and answers provided:

Q: What gases are coming from the mine and what will the project do to them?

A: Methane is the main gas, which has a global rather than local impact. The project will burn the methane, converting it to CO<sub>2</sub> and water vapour. Waste heat from the generators will be used to heat the mine intake air, removing the need to run two coal fired boilers, which will have a positive impact upon local air quality.

Q: How will the computers control the equipment?

A: The computers monitor the quality and quantity of methane coming from the mine and stop and start the generators accordingly.

Q: Will there be much noise?

A: No. Each generator will be enclosed within a sound proofed container. The noise levels will be well below the Chinese legislative requirements.

Q: So, the project will improve local air quality, not use much land, not make much noise?

A: Correct.

Q: Did Xishan buy the land or lease it?



A: Xishan has secured a long term land rental agreement for the land (999 year lease).

Q: Could the methane be used for cooking purposes?

A: Yes, in theory, but in practice, it would require a pipeline to be laid and varying qualities of methane might mean that the system was not always operating.

<b>E.3. Report on how due account was taken of any comments received:</b>
---

Care will be taken to ensure that no land is wasted.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	Shanxi Coking Coal Group Company Ltd
Street/P.O.Box:	Room 1705 no1 Section 1 Xin Jin Si Rd
Building:	
City:	Taiyuan
State/Region:	Shanxi Province
Postfix/ZIP:	
Country:	China
Telephone:	+86 0351 8305170
FAX:	
E-Mail:	
URL:	
Represented by:	Du Fuxin
Title:	Chairman, Shanxi Coking Coal Group Company Ltd.
Salutation:	Mr.
Last Name:	Du
Middle Name:	
First Name:	Fuxin
Department:	Shanxi Jaimei Group
Mobile:	+86 15935137988
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Organization:	Sindicatum Carbon Capital Ltd.
Street/P.O.Box:	Hanover Square
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State/Region:	
Postfix/ZIP:	W1S 1HX
Country:	UK
Telephone:	+ 44 20 3008 4759
FAX:	+44 20 3008 4752
E-Mail:	<a href="mailto:Gareth.phillips@carbon-capital.com">Gareth.phillips@carbon-capital.com</a>
URL:	
Represented by:	Simon Zuanic
Title:	CEO SCC Asia
Salutation:	Mr
Last Name:	Zuanic
Middle Name:	
First Name:	Simon



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Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	





**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

No public funding is utilized.

Annex 3

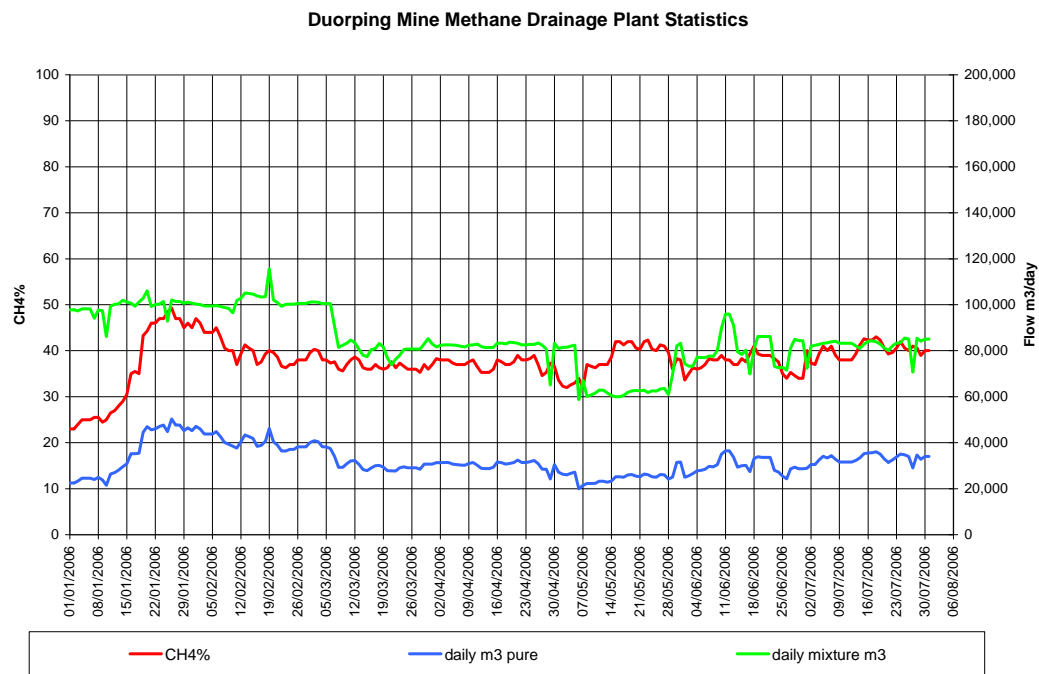
## BASELINE INFORMATION

**Coal Production**

Year	Coal production (Mt/year)
2000	2.8
2001	2.7
2002	3.6
2003	3.9
2004	4.5
2005	4.5
2006	4.3
2007 onwards	5.0



## Data on coal mine methane emissions over a 9 month period





## Grid emission factor

## Calculation of OM information

Table A3-1. Calculation of simple OM emission factor of North China Power Grid in 2003

Fuels	Units	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	OXID	NCV	Emission (tCO <sub>2</sub> e)
									(tC/TJ)	(%)	(MJ/t,km <sup>3</sup> )	$K=G*H*I*J*44/12/1000$ (in mass)
		A	B	C	D	E	F	G=A+B+...+F	H	I	J	$K=G*H*I*J*44/12/1000$ (in volume)
Raw coal	10,000 tonnes	714.73	1052.74	5482.64	4528.5	3949.32	6808	22535.94	25.8	100	20908	445737636.11
Washed coal	10,000 tonnes						9.41	9.41	25.8	100	26344	234510.60
Other washed coal	10,000 tonnes	6.31		67.28	208.21		450.9	732.7	25.8	100	8363	5796681.31
Coke	10,000 tonnes					2.8		2.8	25.8	100	28435	75318.63
Coke oven gas	0.1billion m <sup>3</sup>	0.24	1.71		0.9	0.21	0.02	3.08	12.1	100	16726	228559.67
Other gas	0.1billion m <sup>3</sup>	16.92		10.63		10.32	1.56	39.43	12.1	100	5227	914399.71
Crude oil	10,000 tonnes						29.68	29.68	20	100	41816	910139.18
Gasoline	10,000 tonnes						0.01	0.01	18.9	100	43070	298.48
Diesel	10,000 tonnes	0.29	1.35	4		2.91	5.4	13.95	20.2	100	42652	440693.26
Fuel oil	10,000 tonnes	13.95	0.02	1.11		0.65	10.07	25.8	21.1	100	41816	834672.45



LPG	10,000 tonnes							0	17.2	100	50179	0.00
Refinery gas	10,000 tonnes			0.27			0.83	1.1	18.2	100	46055	33807.44
Natural gas	0.1billion m3		0.5				1.08	1.58	15.3	100	38931	345076.60
Other petroleum products	10,000 tonnes							0	20	100	38369	0.00
Other coking products	10,000 tonnes							0	25.8	100	28435	0.00
Other energy	10,000 tCe	9.83					39.21	49.04	0	100	0	0.00
											Subtotal	45555179

Data source: China Energy Statistical Yearbook 2004.

Table A3-2. The amount of electricity generated by thermal power plant in North China Power Grid in 2003

Province	The amount of electricity generated	The proportion of electricity consumed by the project	The amount of electricity delivered
	(MWh)	(%)	(MWh)
Beijing	18608000	7.52	17208678.4
Tianjin	32191000	6.79	30005231.1
Hebei	108261000	6.5	101224035
Shanxi	93962000	7.69	86736322.2
Inner Mongolia	65106000	7.66	60118880.4
Shandong	139547000	6.79	130071759
<b>Total</b>			425364906

Data source: China Electric Power Yearbook 2004

Table A3-3. Calculation of simple OM of North China Power Grid in 2003

The Net electricity Amount imported from North China Power Grid (MWh)	4,244,380
Average emission factor for North China Power Grid (tCO <sub>2</sub> e/MWh)	1.13656
Total CO <sub>2</sub> emission of North China Power Grid (tCO <sub>2</sub> e)	460,375,781



<b>Total amount of electricity delivered by North China Power Grid (MWh)</b>	429,609,286
<b>Simple OM of North China Power Grid (tCO<sub>2</sub>e/MWh)</b>	1.071615



Table A3-4. Calculation of simple OM emission factor of North China Power Grid in 2004

Fuels	Units	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	OXID	NCV	Emission (tCO <sub>2</sub> e)
									(tC/TJ)	(%)	(MJ/t,km <sup>3</sup> )	$K = G * H * I * J * 44 / 12 / 1000$ (in mass)
		A	B	C	D	E	F	G=A+B+...+F	H	I	J	$K = G * H * I * J * 44 / 12 / 1000$ (in volume)
Raw coal	10,000 tonnes	823.09	1410	6299.8	5213.2	4932.2	8550	27228.29	25.8	100	20908	538547476.6
Washed coal	10,000 tonnes						40	40	25.8	100	26344	996856.96
Other washed coal	10,000 tonnes	6.48		101.04	354.17		284.22	745.91	25.8	100	8363	5901190.882
Coke	10,000 tonnes					0.22		0.22	25.8	100	28435	5917.8922
Coke oven gas	0.1billion m <sup>3</sup>	0.55		0.54	5.32	0.4	8.73	15.54	12.1	100	16726	1153187.451
Other gas	0.1billion m <sup>3</sup>	17.74		24.25	8.2	16.47	1.41	68.07	12.1	100	5227	1578574.385
Crude oil	10,000 tonnes							0	20	100	41816	0
Gasoline	10,000 tonnes								18.9	100	43070	0
Diesel	10,000 tonnes	0.39	0.84	4.66				5.89	20.2	100	42652	186070.4874
Fuel oil	10,000 tonnes	14.66		0.16				14.82	21.1	100	41816	479451.3838
LPG	10,000 tonnes							0	17.2	100	50179	0
Refinery gas	10,000 tonnes		0.55	1.42				1.97	18.2	100	46055	60546.05223
Natural gas	0.1billion		0.37		0.19			0.56	15.3	100	38931	122305.6296



	m3											
Other petroleum products	10,000 tonnes							0	20	100	38369	0
Other coking products	10,000 tonnes							0	25.8	100	28435	0
Other energy	10,000 tCe	9.41		34.64	109.73	4.48		158.26	0	100	0	0
											Subtotal	54903157

Data source: China Energy Statistical Yearbook 2005.



**Table A3-5. The amount of electricity of North China Power Grid generated by thermal power plants in 2004**

Province	The amount of electricity generated	The proportion of electricity consumed by the project	The amount of electricity delivered
	(MWh)	(%)	(MWh)
Beijing	18579000	7.94	17,103,827
Tianjin	33952000	6.35	31,796,048
Hebei	124970000	6.5	116,846,950
Shanxi	104926000	7.7	96,846,698
Inner Mongolia	80427000	7.17	74,660,384
Shandong	163918000	7.32	151,919,202
<b>Total</b>			489,173,110

Data source: China Electric Power Yearbook 2005

**Table A3-6. Calculation of simple OM of North China Power Grid in 2004**

The Net electricity amount imported from North China Power Grid (MWh)	4,514,550
Average emission factor for North China Power Grid (tCO <sub>2</sub> e/MWh)	1.17411
Total CO <sub>2</sub> emission of North China Power Grid (tCO <sub>2</sub> e)	554,332,148
Total amount of electricity delivered by North China Power Grid (MWh)	493,687,660
Simple OM of North China Power Grid (tCO <sub>2</sub> e/MWh)	1.122840



Table A3-7. Calculation of simple OM emission factor of North China Power Grid in 2005

Fuels	Units	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	OXID	NCV	Emission (tCO <sub>2</sub> e)
									(tC/TJ)	(%)	(MJ/t,km <sup>3</sup> )	$K=G*H*I*J*44/12/1000$ (in mass)
		A	B	C	D	E	F	G=A+B+...+F	H	I	J	$K=G*H*I*J*44/12/1000$ (in volume)
Raw coal	10,000 tonnes	897.75	1675.2	6726.5	6176.5	6277.23	10405.4	32158.53	25.8	100	20908	636062535.8
Washed coal	10,000 tonnes						42.18	42.18	25.8	100	26344	1051185.664
Other washed coal	10,000 tonnes	6.57		167.45	373.65		108.69	656.36	25.8	100	8363	5192725.191
Coke	10,000 tonnes					0.21	0.11	0.32	25.8	100	28435	8607.8432
Coke oven gas	0.1billion m <sup>3</sup>	0.64	0.75	0.62	21.08	0.39		23.48	12.1	100	16726	1742396.483
Other gas	0.1billion m <sup>3</sup>	16.09	7.86	38.83	9.88	18.37		91.03	12.1	100	5227	2111027.27
Crude oil	10,000 tonnes					0.73		0.73	20	100	41816	22385.49867
Gasoline	10,000 tonnes			0.01				0.01	18.9	100	43070	298.4751
Diesel	10,000 tonnes	0.48		3.54		0.12		4.14	20.2	100	42652	130786.3867
Fuel oil	10,000 tonnes	12.25		0.23		0.06		12.54	21.1	100	41816	405689.6325
LPG	10,000 tonnes							0	17.2	100	50179	0
Refinery gas	10,000 tonnes			9.02				9.02	18.2	100	46055	277221.0107
Natural gas	0.1billion	0.28	0.08		2.76			3.12	15.3	100	38931	681417.0792



	m3											
Other petroleum products	10,000 tonnes							0	20	100	38369	0
Other coking products	10,000 tonnes							0	25.8	100	28435	0
Other energy	10,000 tCe	8.58		32.35	69.31	7.27	118.9	236.41	0	100	0	0
											Subtotal	6476862

**Data source: China Energy Statistical Yearbook 2006.**

**Table A3-8. The amount of electricity of North China Power Grid generated by thermal power plants in 2005**

Province	The amount of electricity generated	The proportion of electricity consumed by the project	The amount of electricity delivered
	(MWh)	(%)	(MWh)
Beijing	20880000	7.73	19,265,976
Tianjin	36993000	6.63	34,540,364
Hebei	134348000	6.57	125,521,336
Shanxi	128785000	7.42	119,229,153
Inner Mongolia	92345000	7.01	85,871,616
Shandong	189880000	7.14	176,322,568
<b>Total</b>			560,751,013

Data source: China Electric Power Yearbook 2006

**Table A3-9 Calculation of simple OM of North China Power Grid in 2005**

<b>The Net electricity amount imported from North China Power Grid (MWh)</b>	23,423,000
<b>Average emission factor for North China Power Grid (tCO<sub>2</sub>e/MWh)</b>	1.1578
<b>Total CO<sub>2</sub> emission of North China Power Grid (tCO<sub>2</sub>e)</b>	674,805,425
<b>Total amount of electricity delivered by North China Power Grid (MWh)</b>	584,174,013
<b>Simple OM of North China Power Grid (tCO<sub>2</sub>e/MWh)</b>	1.155145

The weighted average emission factor over three years is 1.1207601 tCO<sub>2</sub>/MWh.

**Calculation of BM emission factor**

Step1: Calculation the proportion of CO2 emissions from solid fuels, liquid fuels and gas fuels against the total emission

**Table A3-10. Pproportion of CO2 emissions from solid fuels, liquid fuels and gas fuels against the total emission**

Fuels	Units	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Emission factor	OXID	NCV	Emission (tCO <sub>2</sub> e)
									(tC/TJ)	(%)	(MJ/t, km <sup>3</sup> )	$K = G * H * I * J * 44 / 12 / 1000$ (in mass)
		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G=A+B+...+F</b>	<b>H</b>	<b>I</b>	<b>J</b>	$K = G * H * I * J * 44 / 12 / 100$ (in volume)
Raw coal	10,000 tonnes	897.75	1675.2	6726.5	6176.5	6277.23	10405.4	32158.53	25.8	100	20908	636,062,536
Washed coal	10,000 tonnes						42.18	42.18	25.8	100	26344	1,051,186
Other washed coal	10,000 tonnes	6.57		167.45	373.65		108.69	656.36	25.8	100	8363	5,192,725
Coke	10,000 tonnes					0.21	0.11	0.32	25.8	100	28435	8,608
<b>Total of solid fuels</b>												<b>642,315,054</b>
Crude oil	10,000 tonnes					0.73		0.73	20	100	41816	22,386
Gasoline	10,000 tonnes			0.01				0.01	18.9	100	43070	2,986
Diesel	10,000 tonnes	0.48		3.54		0.12		4.14	20.2	100	42652	130,786
Fuel oil	10,000 tonnes	12.25		0.23		0.06		12.54	21.1	100	41816	405,690
Other petroleum products	10,000 tonnes							0	20	100	38369	0
<b>Total of liquid fuels</b>												<b>559,160</b>
Natural gas	0.1billion m3	0.28	0.08		2.76			3.12	15.3	100	38931	681,417
Coke oven gas	0.1billion m3	0.64	0.75	0.62	21.08	0.39		23.48	12.1	100	16726	1,742,396
Other gas	0.1billion m3	16.09	7.86	38.83	9.88	18.37		91.03	12.1	100	5227	2,111,027
LPG	10,000 tonnes							0	17.2	100	50179	0
Refinery gas	10,000 tonnes			9.02				9.02	18.2	100	46055	277,221



Total of gas fuels												4,812,062
Total of solid, liquid and gas fuels												647,686,276

According to Table A3-10 and formula (7), (8) and (9),  $\lambda_{Coal} = 99.17\%$ ,  $\lambda_{Oil} = 0.08\%$ ,  $\lambda_{Gas} = 0.74\%$ .

Step2: Calculation corresponding thermal power emission factor

Table A3-11 presents the optimal efficiency and emission factor of commercialized coal-fired, oil-fired and gas-fired power plant

**Table A3-11. Optimal efficiency and emission factor of commercialized coal-fired, oil-fired and gas-fired power plant**

Type of Power plant	Variables	Power supply efficiency (%)	Emission factor of the fuels (tC/TJ)	Oxidation rate	Emission factor (tCO <sub>2</sub> e/MWh)
		A	B	C	D=3.6/A/1000*B*C*44/12
Coal fired power plant	EF coal,Adv	35.82%	25.8	1	0.9508
Gas fired power plant	EF gas,Adv	47.67%	15.3	1	0.4237
Oil fired power plant	EF oil,Adv	47.67%	21.1	1	0.5843

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} = 0.9465 \text{ (tCO}_2\text{/MWh)}$$

**Table A3-12. Installed capacity of North China Power Grid in 2005**

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3833.5	6149.9	22333.2	22246.8	19173.3	37332	111068.7
Hydro power	MW	1025	5	784.5	783	567.9	50.8	3216.2
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and others	MW	24	24	48	0	208.9	30.6	335.5



Total	MW	4882.5	6178.9	23165.7	23029.8	19950.2	37413.4	114620.5
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Data source: China Electric Power Yearbook 2006

**Table A3-13. Installed capacity of North China Power Grid in 2004**

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3458.5	6008.5	19932.7	17693.3	13641.5	32860.4	93594.9
Hydro power	MW	1055.9	5	783.8	787.3	567.9	50.8	3250.7
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and others	MW	0	0	13.5	0	111.7	12.3	137.5
Total	MW	4514.4	6013.5	20730	18480.6	14321.2	32923.5	96983.2

Data source: China Electric Power Yearbook 2005

**Table A3-14. Installed capacity of North China Power Grid in 2003**

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3347.5	6008.5	17698.7	15035.8	11421.7	30494.4	84006.6
Hydro power	MW	1058.1	5	764.3	795.7	592.1	50.8	3266
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and others	MW	0	0	13.5	0	76.6	0	90.1
Total	MW	4405.6	6013.5	18476.5	15831.5	12090.4	30545.2	87362.7

Data source: China Electric Power Yearbook 2004

**Table A3-15. Calculation of BM emission factor for North China Power Grid**

	Installed capacity in 2002	Installed capacity in 2003	Installed capacity in 2004	Newly added installed capacity from 2002 till 2004	Proportion against newly added installed capacity
	A	B	C	D=C-A	
Thermal power (MW)	84006.6	93594.9	111068.7	27062.1	99.28%
Hydro power (MW)	3266.0	3250.7	3216.2	-49.8	-0.18%
Nuclear power (MW)	0	0	0	0	0.00%
Wind power (MW)	90.1	137.5	335.5	245.4	0.90%
Total (MW)	87362.7	96983.1	114620.4	27257.7	100.00%
Share in 2004 installed capacity	76.22%	84.61%	100%		

$$EF_{BM, y} = 0.9465 \times 99.28\% = 0.9397 \text{ tCO}_2/\text{MWh.}$$

Heat displacement: Calculated using Option B, assuming 100% efficient heat transfer

### 3. Emission Reductions achieved from displacing the in intake air heating boilers

2	Number of boilers
2.1	Capacity of each boiler in MW
4.2	Total capacity of boilers in MW
8760	h/year
13,140,00	Number of operating seconds of the boilers during 5 winter months (lower range of operating time)
55,188,00	
0	Amount of MJ of energy output generated by the boilers
55,188	Amount of GJ of energy output generated by the boilers





	(1/1000)
0.094	T CO2 per GJ of energy output
5,188	Tonnes of CO2 emitted by the coal fired boilers in due course



#### **Annex 4**

### **MONITORING INFORMATION**

Monitoring will be undertaken as outlined in Section B7.2 and the operational details are described in a CDM monitoring manual specifically developed for the project and which will be made available to the validator.

The locations of methane flow monitoring to the CMM utilisation plant are shown in the Schematic below. Monitoring of the waste heat supply from the engines to the shaft heater has been excluded from the diagram for clarity.

