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

I. CONTENTS

A. Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Zhengzhou Coal Industry (Group) Co., Ltd. Coalmine Methane Utilization Project

Version 2.4
Completed on: 10/06/2008

A.2. Description of the project activity:

Zhengzhou Coal Industry (Group) Co., Ltd. (ZCG) is a state-owned industry group located in Henan Province, Central China. Its current coal production is about 11 million tons of coal a year and is forecast to increase to about 14 million tons within the next 5 years. During its mining activities, methane gas is released and needs to be discharged in order to comply with Chinese mining safety regulations. About 45% of gas is released in the form of coalmine methane (CMM), which is drained directly from ZCG's coal seams. About 55% is released in the form of ventilation air methane (VAM), and is vented through the mines' ventilation shafts.

The project includes 9 coalmines within ZCG and will utilize this available gas for the production of both electricity and heat. This will be done in two ways. Firstly a set of 16 gas engines with a total capacity of 8 MW will utilize extracted CMM to produce electricity and heat. The power produced will be used for ZCG's own consumption, replacing electricity that would otherwise be purchased from the Central China Electricity Grid. Waste heat from the engines will be utilized to supply hot water to nearby mining facilities. Secondly, up to seven units of a newly developed methane oxidation technology (known as the *Vocsidizer*) will be installed at various mine sites to destroy ventilation air methane with low CH_4 concentrations (below 1%). This technology will also produce thermal energy that can be substituted for coal-based heat. The following table shows the project's total gas utilization and expected energy output.

Table 1: Project's methane utilization and energy output of project (at full capacity)

CMM utilization (m3 CH4/year)	11,312,832
VAM utilization (m3 CH4/year)	22,050,000
Electricity production (MWh/year)	39,200
Heat production (GJ/year)	152,794

Total emission reductions over a ten-year crediting period are estimated at **3,820,186tCO2e**.

The project will contribute to China's sustainable development in the following ways:

- Avoid emissions of various pollutants such as SO_2 and nitric oxides (NOx) as a result of the replacement of coal boilers.
- Decrease the need for additional power production in the Central China Electricity Grid because of power substitution taking place from the project.
- Introduce a new VAM oxidation technology to China with strong replicability effects.
- Create employment for the operation of the above-described technologies.

A.3. Project participants:

Party Involved	Private or Public Entity	Project Participant
People's Republic of China (host)	Zhengzhou Coal Industry (Group) Co., Ltd (public)	No
United Kingdom	EDF TRADING Limited	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

People's Republic of China

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

Henan Province

A.4.1.3. City/Town/Community etc:

Xinmi

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

ZCG is located in the surroundings of Xinmi, about 40 km southwest of Zhengzhou, which is the capital of Henan province.

Figure 1: Henan Province

People's Republic of China

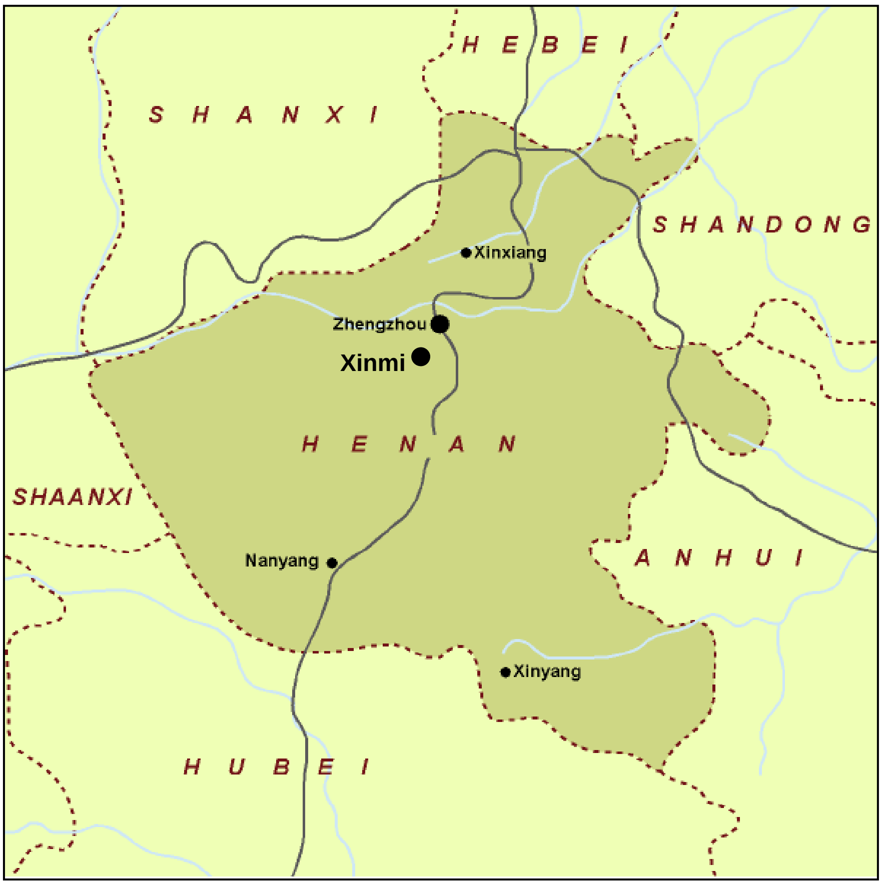
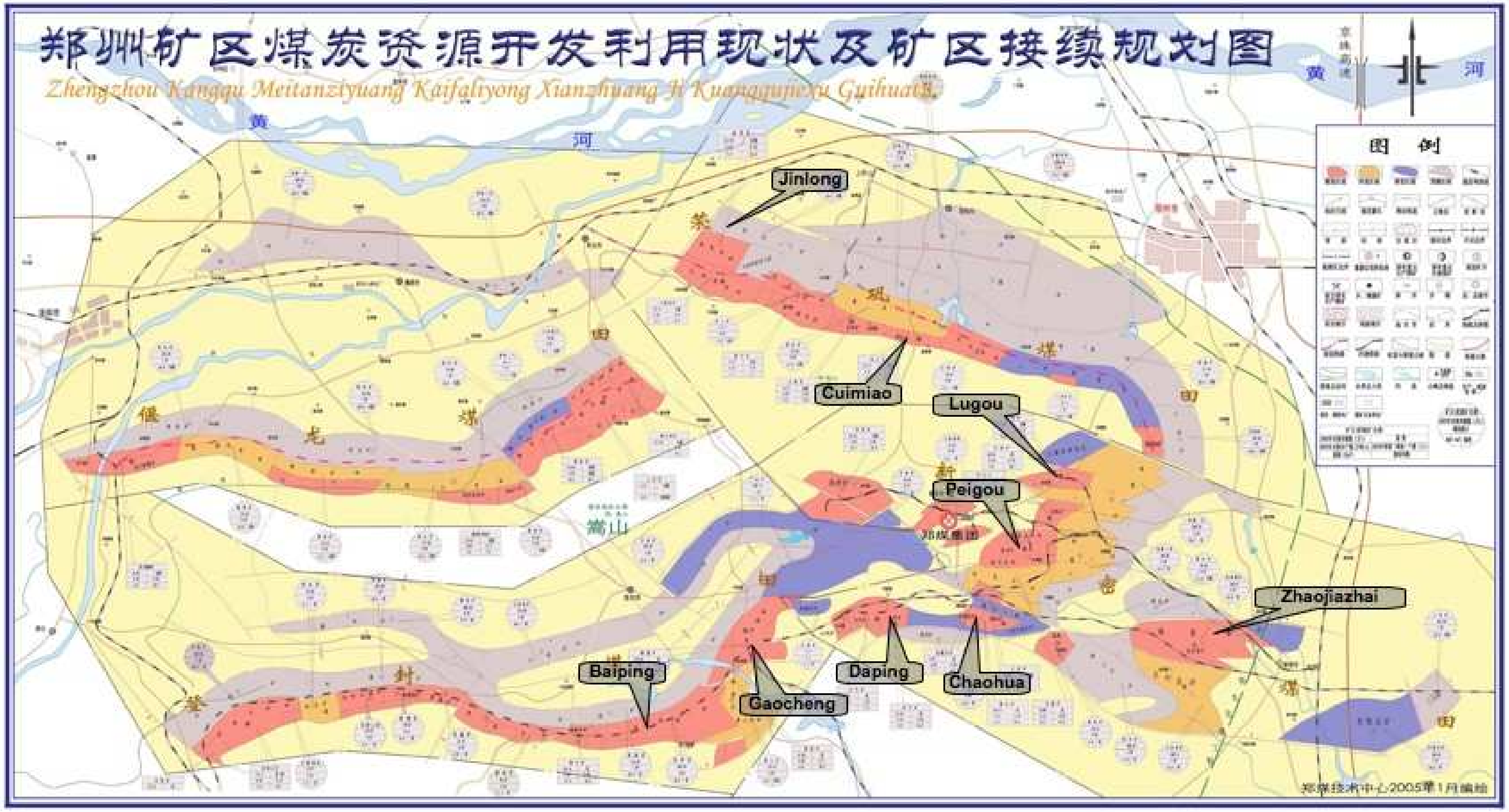


Figure 2: Map of ZCG Coalfield



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

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

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

Gas Engines: Gas engines are Chinese-manufactured 500FG1-3RW models from Shengdong Oilfield Shengli Power Machinery Co., Inc. Engines and gas transport equipment are specifically designed to permit the safe combustion of low-concentration CMM. Engine capacity is 500kW and actual engine performance is estimated at 70-80% for electricity production (350-400 kW). Other ancillary equipment associated with the gas engines includes cooling water towers, water pumps and heat exchangers.

Vocsidizers: Up to seven Vocsidizer units will be installed at ZCG's mineshafts. Each module can process up to 125,000 m^3 of VAM per hour, with methane concentrations typically ranging from 0.2% to 0.8%. The gas passes through a ceramic bed inside the Vocsidizer, and is gradually heated until the methane is oxidized, producing CO_2 and thermal energy. Through embedded tubes, this energy can be recovered in the form of hot water. The hot water will be substituted for thermal energy from onsite coal boilers. The project will begin with the installation of one Vocsidizer module, and after a successful test period, additional modules may be added.

If the methane concentration in the VAM entering the Vocsidizer is considered to be too low to ensure a reliable performance of the Vocsidizer, additional CMM from a nearby extraction station may be added to the VAM stream. This would raise its methane concentration and make the methane oxidation process more stable (mechanisms exist whereby CMM can be added automatically whenever the methane concentration of the VAM dips below a certain point). Any CMM added would otherwise have been vented into the atmosphere, so its addition to the VAM stream would not affect the performance of the rest of the project.

Table 2: Installed Equipment[1]

Mine	Equipment installed	Timing
Daping	2 x 500kW gas engines	End-2008
Peigou	4 x 500kW gas engines 1 Vocsidizer	2 x 500 kW: end-2007 2 x 500 kW: end-2008 Vocsidizer: 2009
Chaohua	4 x 500 kW gas engines 1 Vocsidizer	2 x 500 kW: end 2007 2 x 500 kW: end 2008 Vocsidizer: 2009
Gaocheng	2 x 500 kW gas engines 1 Vocsidizer	Beginning-mid 2008
Lugou	1 Vocsidizer	2009
Cuimiao	4 x 500kW gas engines	2 x 500 kW: end 2007

[1] Based on a preliminary site assessment, the mines listed in this table have been identified as the most promising locations for Vocsidizer installation. However, it is possible that other sites within the pre-defined project boundaries may be chosen if the conditions there are more favourable, or that more than one Vocsidizer unit will be installed at the same mine. Choosing another location within the project boundaries would not affect the CER estimate or additionality of the project.

		2 x 500 kW: end 2008
Jinlong	1 Vocsidizer	2009
Baiping	1 Vocsidizer	2009
Zhaojiazhai	1 Vocsidizer	2009
Total	**16 x 500 kW gas engines 7 Vocsidizers**	

Technology transfer is taking place through the following activities:

- Vocsidizers: This technology, although successfully tested at coalmines in the UK and Australia, has not yet been installed in China. The project will therefore be among the first demonstrations of VAM abatement and energy production at a Chinese coalmine. Its replicability is likely to lead to similar projects being carried out in other parts of China.
- Chinese-manufactured gas engines and other ancillary equipment will be equipped with monitoring equipment to ensure accurate gas measurements throughout the project's lifetime.
- Throughout the project's preparation, international mining experts have conducted visits to ZCG to provide advice concerning the improvement of its CMM extraction system. A specially designed training seminar was also organized in Europe to discuss recent international experience in gas drainage and utilization.

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

Table 3: Estimated Emission Reductions throughout crediting period

Years	Annual estimation of emission reductions in tCO_2e
2008	**66,566**
2009	**201,516**
2010	**434,952**
2011	**434,952**
2012	**434,952**
2013	**434,952**
2014	**434,952**
2015	**434,952**
2016	**434,952**
2017	**434,952**
2018	**72,492**
Total estimated reductions (tCO_2e)	**3,820,186**
Total number of crediting years	**10 years**
Annual average of emission reductions over the crediting period (tCO_2e)	**382,019**

A.4.5. Public funding of the project activity:

No public funding is involved in the financing of this project.

SECTION B. Application of a baseline and monitoring methodology

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

The project uses the consolidated methodology ACM0008 for “coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring” (Version 03). Based on ACM0008, the project also employs ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” Version 06, to calculate the emission factor of the Central China Electricity Grid. Lastly, the project uses the “Tool for the demonstration and assessment of additionality” Version 03 for its demonstration of additionality.

ACM0008 and ACM0002 are available at:
http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_UAHWQGQYAJVSO577503JFMY2OWJJMG

The Additionality Tool is available at:
http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

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

Table 4: CMM extraction techniques eligible under ACM0008

CMM extraction techniques eligible under ACM0008	Activities of Project
Underground boreholes to capture pre-mining CMM	Included. CMM is extracted using pre-mining boreholes.
Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques	May be included in future. ZCG is working on improving and implementing goaf-capture techniques.
Ventilation CMM that would normally be vented	Included. In the absence of the project, 100% of VAM is vented.

Table 5: CMM utilization techniques eligible under ACM0008

CMM utilization techniques eligible under ACM0008	Activities of Project
Methane is captured and destroyed through utilization to produce electricity and thermal energy	Included. CMM is extracted and captured for power generation in gas engines. Some engine waste heat as well as a share of VAM is also used for heat production. Emission reductions are claimed for displacing both electricity and heat.
The remaining share of methane, to be diluted for safety reasons, may still be vented	VAM that is not fed to the Vocsidizer for heat generation will be vented.
All the CBM or CMM captured by the project	All of the captured CMM is used to generate

should either be used or destroyed, and cannot be vented.	electricity and heat. No CBM is used in the project.

Table 6: Other eligibility criteria of ACM0008

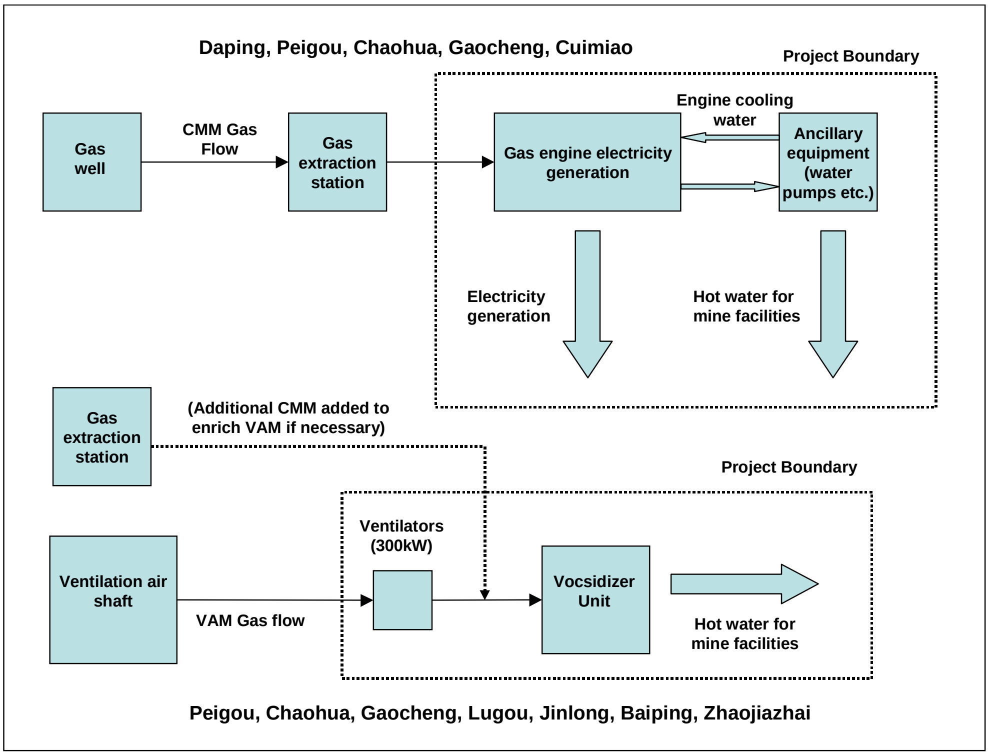
Other eligibility criteria of ACM0008	**Activities of Project**
The project cannot operate in open cast mines	All mines included in project are underground.
The project cannot capture methane from abandoned/decommissioned mines	All mines included in project are active.
The project should capture/use virgin coal-bed methane independently of any mining activities	No CBM will be used in project.
The project cannot use CO2 or any other fluid/gas to enhance CBM drainage before mining takes place	No CBM will be used in project.
Project participants must be able to supply the necessary data for ex-ante projections of methane demand as described in Sections 7 and 8 of ACM0008	All necessary data is available.

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

	Source	**Gas**		**Justification/Explanation**
Baseline	Emissions from vented CMM	CH4	Included	All CMM and VAM captured in the baseline scenario is vented. This is the main emission source.
	Emissions from destruction of methane in the baseline	CO2	Excluded	No methane is destroyed in the baseline.
		CH4	Excluded	No methane is destroyed in the baseline.
		N2O	Excluded	No methane is destroyed in the baseline.
	Grid electricity generation	CO2	Included	Emissions from Central China Electricity Grid equivalent to power generated by project activity.
		CH4	Excluded	Excluded for simplification. This is conservative.
		N2O	Excluded	Excluded for simplification. This is conservative.
	Captive heat use	CO2	Included	Emissions from coal boilers that will be displaced by heat generated by gas engines and Vocsidizers.
		CH4	Excluded	Excluded for simplification. This is conservative.
		N2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	Emissions of methane as a result of continued venting	CH4	Excluded	Only the change in CMM and VAM emissions will be taken into account, by monitoring the methane utilized or destroyed by the project activity.
	On-site fuel (energy) consumption due to the project activity	CO2	Included	Electricity consumed by the Central China Electricity Grid required to operate Vocsidizer fans and ancillary equipment for CMM utilization such as cooling water pumps.
		CH4	Excluded	Excluded for simplification as per ACM0008.
		N2O	Excluded	Excluded for simplification as per ACM0008.
	Emissions from methane destruction	CO2	Included	Emissions from CMM utilized in gas engines and emissions from VAM utilized in Vocsidizer.
	Emissions from NMHC destruction	CO2	Included	NMHCs account for less than 1% of volume in extracted gas (gas analysis provided to validator). The level of NMHCs will be continuously monitored throughout the

				project.
	Fugitive emissions of unburned methane	CH4	Included	Unburned methane from gas engines and Vocsidizer
	Fugitive methane emissions from on-site equipment	CH4	Excluded	Excluded for simplification as per ACM0008
	Accidental methane release	CH4	Excluded	Excluded for simplification as per ACM0008

Figure 3: Project Boundaries



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

The baseline methodology ACM0008 is applied through the following steps:

<u>Identification of baseline scenario</u>

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

Step 1a. Options for CBM and CMM extraction

The options include:

A. Ventilation air methane
B. Pre-mining CMM extraction including CBM to goaf drainage and/or indirect CBM to goaf only
C. Post-mining CMM extraction
D. Possible combinations of A, B and C. This is part of the **project activity** in the absence of the CDM.

CBM extraction is not considered to be a technically feasibly option primarily because the permeability of ZCG's coal seam (0.008 millidarcy) is not at all suitable for this type of gas extraction.[2] As a result, ZCG has no intention to pursue efforts to extract CBM from its mines.

At ZCG's mines, gas extraction is currently a combination of ventilation air methane and pre-mining CMM. Plans to supplement these gas capture techniques with post-mining drainage (goaf etc.) exist but have not yet been implemented. However, pre-mining and post-mining CMM will both be brought to the surface through the same drainage system, and it is therefore not possible to specify the shares of gas of each technique. For the purposes of the project, therefore, pre- and post-mining gas will be referred to as "CMM".

The following tables show the share between CMM and VAM extracted from ZCG's mines:

Table 7: Share of CMM and VAM gas extraction (2006)

Mine	VAM (m3 CH4/year)	CMM (m3 CH4/year)	VAM %	CMM %
Daping	7,227,000	6,570,000	52.38%	47.62%
Peigou	10,512,000	7,884,000	57.14%	42.86%
Chaohua	9,881,280	7,884,000	55.62%	44.38%
Gaocheng	9,460,800	7,358,400	56.25%	43.75%
Lugou	4,204,800	3,153,600	57.14%	42.86%
Total	**41,285,880**	**32,850,000**	**55.69%**	**44.31%**

Table 8: Share of CMM and VAM gas extraction (forecast 2007-2008)

Mine	VAM (m3 CH4/yr)	CMM (m3 CH4/yr)	VAM %	CMM %
Cuimiao	5,256,000	9,460,800	35.71%	64.29%
Jinlong	5,781,600	7,884,000	42.31%	57.69%
Baiping	7,884,000	9,460,800	45.45%	54.55%
Zhaojiazhai	6,307,200	6,307,200	50.00%	50.00%
Total	**25,228,800**	**33,112,800**	**43.24%**	**56.76%**

Step 1b. Options for extracted CBM and CMM treatment

i. CMM Venting

[2] Mazumder et al (2002). *CO2 Injection in Coal Seams for Sequestration and Enhanced Methane Recovery*. Delft University of Technology, Netherlands. Available at: http://www.nwo.nl/nwohome.nsf/pages/NWOP_5WCGTL/$file/TransitionPreSaikat21nov02.pdf

ii. Using/destroying ventilation air methane rather than venting it
iii. Flaring of CBM/CMM
iv. Use for power generation
v. Use for heat generation
vi. Supply to local users as cooking/heating fuel
vii. A combination of options ii and iv. This is part of the **project activity** in the absence of the CDM. About 16.6% of total methane extracted from ZCG's mines would be utilized in option ii in the form of VAM, and about 8.5% would be utilized in option iv in the form of CMM.

Step 1c. Options for energy production (electricity and heat)

1. Purchase of electricity from the Central China Electricity Grid.
2. Electricity production from ZCG-owned and operated captive coal power plants.
3. Heat generation from coal boilers.
4. Electricity production using captured methane.
5. A combination of options 1, 2, 3 and 4. This is the **project activity** in the absence of the CDM.

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

Chinese regulations require that the maximum concentration of methane in a mine's ventilation air remain below 1% (National Coalmine Safety Regulation of 2005). ZCG's mines are too rich in gas to ensure that this regulation is met using any of the gas extraction options A, B or C individually. To comply with the safety requirements, these extraction techniques need to be used jointly. Therefore option D is the only gas extraction option that complies with legal requirements, and options A, B and C can be eliminated.

ACM0008 states: *If an alternative does not comply with all applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country.*

This situation applies to the gas engine technology designed to utilize low-concentration methane. China's mining code requires that CMM which is utilized should have a minimum methane concentration of 30%. However in some regions in China (including Henan Province), geological factors prevent extracted CMM from reaching this concentration consistently despite technical efforts to do so. Specifically, some coal seams have a permeability that is too low to allow for gas extraction techniques that are used elsewhere. Evidence of CMM extraction with methane concentrations below 30% has been observed at all major coalmine groups of Henan province.[3]

To address this issue, the engine manufacturer Shengdong has developed a technology that permits the safe utilization of CMM below 30% by introducing several safety features such as flame arresters and by injecting water vapour into the gas flow during transport above ground, which largely eliminates the risk of explosion. This technology has been successfully tested and the test results were verified by the scientific and technology committee of the Chinese Mining Safety Bureau in December 2005 (proof of this verification has been provided to validator).

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[3] Observed during visits to Hebi, Yima, Zhengzhou, Jiaozuo and Pingdingshan coalmine groups in 2005, 2006 and 2007.

Application of this engine technology for CDM projects is becoming more and more widespread in China, indicating that the requirements of the mining code are not being enforced. According to Shengdong, 260 such engines have already been sold to coalmines throughout China for CDM projects. More importantly, the development of these projects is being officially approved by both the Chinese NDRC and provincial DRCs, who are required to give their authorization before project commissioning.[4] In addition, the project received a confirmation letter from Coalmine Safety Supervision Bureau of Henan Province on November 26, 2007 which certifies that the project has been operating safely within a methane concentration range of 6% to 30% (copy of letter provided to validator). This demonstrates that Chinese authorities consider this technology to be safe and not in contradiction with the current mining code. As a result it can be concluded that regulations concerning the utilization of CMM with methane concentrations below 30% are not systematically enforced.

Step 3. Formulate baseline scenario alternatives

On the basis of the baseline options that are technically feasible and comply with regulatory requirements, the following baseline scenarios can be formulated. Note that Option D is the only option under Step 1a that was retained. Option D is therefore assumed to be part of all baseline scenarios.

Scenario I (business as usual scenario): Gas extraction is a combination of CMM ventilation, as well as pre- and post-mining extraction as defined in option D. All extracted CMM and VAM is vented into the atmosphere with no utilization taking place. ZCG currently operates two coal power plants of 12 MW and 103 MW capacity. The group's electricity demand is met through a combination of grid purchases (30%) and captive coal power (70%). Heat demand is met by using onsite coal fired boilers fed with ZCG-produced coal.

Scenario II (utilization of VAM): A share of extracted VAM is utilized for heat production. This would involve a newly developed oxidation technology such as the *Vocsidizer*. One *Vocsidizer* twin unit can process about 125,000 m3 of VAM per hour with methane concentrations ranging from 0.2-0.8%. Heat generated by the oxidation process can be used to produce hot water at about 70-100 C. It is assumed that up to 7 such units would be installed, utilizing about 32% of extracted VAM. Depending on the methane concentration of the VAM, these units could produce approximately 33% of ZCG's annual heat demand for all mines included in the project, provided that the units are located in proximity to the facilities requiring this heat. The remaining heat would continue to be produced in coal boilers, and electricity consumption would be met through purchases from the grid and captive coal power as in Scenario I.

Scenario III (flaring of CMM): The extracted CMM with a methane concentration above at least 25% is destroyed by flaring torches. No energy is produced in this process. ZCG's energy needs continue to be met by coal boilers, electricity purchases from the grid and captive coal power.

Scenario IV (electricity generation from CMM): The extracted CMM is used to generate electricity from gas engines. A total of 16 x 500kW engines are installed, utilizing approximately 17% of available extracted CMM. Estimated electricity production would be about 39,200 MWh per year. This power would be used to meet ZCG's own needs, and would account for about 3.3% of the group's annual

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[4] In addition to the present project, NDRC and provincial DRC approval has been given to coalmine methane projects developed by by Pingdingshan Coal (Group) Co., Ltd., Yima Coal Industry (Group) Co., Ltd., and Hebi Coal Industry (Group) Co., Ltd. in Henan province. All of these projects employ the Shengdong engine technology for low-concentration CMM utilization.

electricity consumption. The remaining electricity would continue to be purchased from the grid and produced from captive coal power as previously. Waste heat from these engines could be transformed into hot water and supplied to nearby mining facilities. About 11% of ZCG's total heat demand could be met this way. The remaining heat requirements would be met by coal boilers.

Scenario V (heat generation from CMM using converted coal boilers): Coal-fired boilers would be converted into gas-fired boilers and extracted methane could be used to produce heat for ZCG's own consumption (showers, kitchens etc.). ZCG could theoretically meet 100% of its heat requirements by using 30.4 million m3 CH4/year, accounting for about 46% of total CMM extracted in 2007 (assuming an NCV of 37.8 MJ/m3 methane). The remaining share of the gas would be vented. Electricity demand would continue to be met by purchases from the grid and captive coal power.

Scenario VI (supply of CMM to local users as a cooking fuel): A gas distribution network for surrounding households (primarily for mine employees) would be constructed. Captured CMM would be supplied to end-users for cooking purposes. In theory, 100% of available extracted CMM could be supplied to households, although in practice, the extent of the distribution network would be limited by its distance to the mines, the quality of the gas, and the costs of laying pipelines. Additional equipment required would be gas tanks, gas pumps and other ancillary equipment. ZCG's electricity demand would continue to be met by purchases from the grid and captive coal power.

Scenario VII (project activity in absence of the CDM): This is a combination of Scenarios II and IV. It would involve the utilization of about 32% of total extracted VAM in seven *Vocsidizer* units, producing around 114,307 GJ/year of usable heat. A set of 16 x 500kW gas engines would utilize about 17% of available extracted CMM for electricity production (39,200 MWh/year) and heat production (38,487 GJ/year). The remaining electricity would continue to be purchased from the grid and produced from captive coal power. The remaining heat requirements would be met by coal boilers.

Step 4. Eliminate baseline scenario alternatives that face prohibitive barriers

Scenario I (business as usual scenario): This is the business as usual scenario and faces no barriers.

Scenario II (utilization of VAM): The destruction of VAM in the Vocsidizer or a similar technology has taken place only on a few select sites in the form of pilot projects, and never before on Chinese soil.[5] As a result, this technology is untried in China, the risks are perceived as being significant. Personnel trained to operate the Vocsidizer are not available, and coalmine groups in China are very reluctant to be the first to try a new technology. Access to funding to pay for this technology in Euros is therefore also very limited. These risks and technical barriers exclude this scenario from being a realistic baseline option.

Scenario III (flaring of CMM): No regulatory requirements in China exist to mandate flaring of captured CMM. As a result, Chinese coal mine groups are very unfamiliar with flaring equipment, and its usage in China is rare.[6] Some mines interested in exploring this option were obliged to obtain special

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[5] Information obtained by MEGTEC. Pilot projects have been carried out in the UK, the United States and more recently, Australia. With the exception of the Australian site, VAM volumes were significantly smaller than those likely to be processed in the present project.

[6] Westlake A, Creedy D P, Hu Yuhong. *CDM, a Trigger for Coal Mine Methane Emission Reductions in China*, 2003. Available at: http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/005.pdf

permission from the relevant safety authorities, creating additional barriers to its implementation.[7] In addition, an important technical barrier would prevent ZCG from flaring extracted CMM. Flaring of CMM is generally considered to be possible only when methane concentrations are above 25%. At ZCG's mineshafts, however, the methane concentration is generally too low, ranging from 10-20% most of the time. As a result, flaring is not a technically suitable option at ZCG and this scenario can be eliminated.

Scenario IV (electricity generation from CMM):

Technological barriers: ZCG has no experience with gas engines outside the scope of this project. The most important technical barrier to CMM utilization by gas engines has been the low concentration of ZCG's CMM (ranging from 10-20% in almost all mines). These low concentrations require the application of the Shengdong gas engine technology which is able to utilize lower concentration methane safely. This technology is very recent (distributed only in 2006) and the perceived technology risk is therefore significantly higher than with conventional gas engine technology. It also involves training personnel for the operation of such equipment. Further technological barriers include the know-how and experience that is required to improve the gas extraction system in order to ensure a stable and consistent gas supply. Without such improvements, the project is at financial risk, as engine performance will suffer when the gas supply drops.

Barriers due to prevailing practices: These barriers are also confirmed by common practice in China and Henan Province. In the absence of the CDM, current CMM utilization rates in China are very low. In 2004, CMM drainage accounted for only 23% of total gas released in mining operations. Of this, only about 50% was actually utilized.[8] Nearly 70% of utilization involves gas supply for residential use.[9] As a result, overall utilization rates for electricity generation are extremely low. This is also the case in Henan province, where no other mine group has undertaken investments in CMM electricity production outside of the framework of the CDM.[10] As a result, this scenario can be eliminated.

Scenario V (heat generation from CMM using converted coal boilers): The current system of heat generation using coal-fired boilers is common practice at all mines in Henan Province[11] and is seen as the most economical and technically suitable option for heat generation. Its costs are relatively low due to the waste coal that can be used as a heating fuel. In addition to these barriers due to prevailing practice, ZCG faces the same technical challenge as with other options describe above. Its CMM quality is not high enough to guarantee the safe functioning of gas-fired boilers, which would require methane concentrations of above 30%. In view of these technical barriers, this scenario can be eliminated.

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[7] Vrolijk, C. et al. Enhancing Coal Mine Methane Utilisation in China. Report No. COAL R298 DTI/Pub URN05/1816, 2005. Available at: www.berr.gov.uk/files/file29223.pdf

[8] China Coal Information Institute (CCII), *New Development of CMM Projects in China*, The 5th International Symposium on CBM/CMM in China, Beijing, China, November 30 – December 2, 2005; cited in Jiangxi Fengcheng Mining Administration CMM Utilization Project.

[9] Ibid.

[10] The five most important mine groups in Henan province are Pingdingshan, Hebi, Zhengzhou, Yima and Jiaozuo Coal Group Industries. All five groups are currently preparing CMM utilization projects under the CDM (information obtained from onsite visits in 2005).

[11] Information obtained from visits to all five major mine groups in 2005.

Scenario VI (supply of CMM to local users as a cooking fuel): The main technical barrier is as with Scenario V above. Methane concentrations of ZCG's extracted CMM are generally below 25% and fluctuate strongly. This makes the gas unreliable and unsuitable as a cooking fuel. This scenario can therefore be eliminated.

Scenario VII (project activity in the absence of the CDM): This scenario is a combination of scenarios II and IV, and faces the same above-identified barriers. It can therefore be eliminated.

As a result, **Scenario I (business as usual scenario)** is the only scenario that does not face prohibitive barriers. It is therefore considered to be the baseline scenario.

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):

As required by baseline methodology ACM0008, the latest *Tool for the demonstration and assessment of additionality* (version 03) is applied to show how emission reductions under the project are additional to those that would have occurred in the absence of the registered CDM project activity.

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

As per ACM0008, this step can be ignored.

Step 2. Investment Analysis.

Sub-step 2a. Determine appropriate analysis method

The additionality tool gives the choice between a simple cost analysis (Option 1), an investment comparison (Option II), and a benchmark analysis (Option III). Because the proposed project has financial benefits other than CER revenue, a simple cost analysis is not appropriate. An investment comparison is not suitable either, because the alternative baseline scenario is the Central China Power Grid rather than another project. As a result, the benchmark analysis (Option III) has been selected.

Sub-step 2b – Option III. Apply Benchmark Analysis.

Various methods exist to determine the minimum rate of return of an investment. This evaluation must take into account both the cost of money and the investment's perceived risk. The most common approach to selecting the appropriate discount rate or "hurdle rate" is to look at the investor's weighted cost of capital (WACC), which is usually a combination of debt and equity. However, the WACC approach is generally considered to be appropriate only if the investment has the same risk profile as the average risk of the company (and therefore the same cost of capital).[12] If this is not the case, an investment-specific risk adjusted discount rate must be used.

[12] Kester, G.W. et al. (1999). Capital Budgeting Practices in the Asia-Pacific Region: Australia, Hong Kong, Indonesia, Malaysia, Philippines, and Singapore. Financial Practice and Education.

A survey conducted by the University of New York concluded that the average cost of capital for energy industries is about 6.8%.[13] Another survey from the magazine *Corporate Finance* indicates that an appropriate risk premium for project investment in China is 5%, which would make the IRR hurdle rate 11.8%.[14]

This number is confirmed by looking at other projects' hurdle rates. A survey of the World Bank and the Asian Development Bank, for example, indicates that for hydro projects in China, the cost of capital is generally between 10-12%.[15] For wind projects in China, this hurdle rate has been estimated at high as 20%.[16] Another survey of companies active in Asia estimates the cost of capital in the energy sector of upper middle-income countries (which includes China) at about 10-11%, and the cost of equity at about 13%.[17]

An IRR hurdle rate of 11.8% has therefore been assumed for this project.

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

Table 9: Cost and Revenue Assumption for Project Investment Analysis

Parameter	
Electric capacity installed (MW)	8
Vocsidizers installed	7
Total investment (RMB)	177 million
Annual operating costs (RMB)	16.8 million
Electricity cost (RMB/kWh, after tax)	0.383
Heat cost (RMB/GJ, after tax)	20
Electricity generation (MWh/Year)	39,200
Heat generation (GJ/Year)	152,794
Operational lifetime of the project (Years)	20

Available at: http://207.36.165.114/JAF/fpess993.pdf

[13] Cited in *Huainan Panyi and Xieqiao Coal Mine Methane Utilization Project*, version 4, 2006; p. 17.

[14] Cited in ibid., p. 17.

[15] Lagman, A.S.; Aylward, B. (2000). Survey of Multilateral Bank Practice on Financial and Economic Analysis of Large Dams. Secretariat of the World Commission on Dams, Available at: http://www.wca-infonet.org/servlet/BinaryDownloaderServlet?filename=1066822636382_bank.pdf

[16] Brennand, T.P. Wind Energy in China: Policy Options for Development, in Energy for Sustainable Development, Volume V. No. 4, December 2001. Available at: http://www.ieiglobal.org/ESDVol5No4/windpolicy.pdf

[17] Estache, A.; Pinglo, M.E. Are Returns To Private Infrastructure In Developing Countries Consistent With Risks Since The Asian Crisis? World Bank Policy Research Working Paper 3373, August 2004. Available at: http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN019815.pdf

Table 10: Results of Investment Analysis [18]

	16 x 500kW 7 Vocsidizers
Project IRR without CERs	**2.53%**
Project IRR with CERs	**23.90%**

See **Annex 3** for complete financial analysis and assumptions.

The analysis is based on the feasibility report and financial analysis completed by ZCG. In the absence of the CDM, the only revenue is from electricity and heat production. The results show that the project is not profitable in the absence of the CDM, with an IRR that falls clearly below the above discussed hurdle rate. With CER revenue, the project's IRR is raised to 23.99%, which is significantly above the hurdle rate. It should also be noted that the analysis does not include additional costs from underground methane extraction and capture activities that are incurred to guarantee the consistency and stability of CMM flows and methane concentrations.

Sub-step 2d. Sensitivity analysis.

Table 11: Sensitivity analysis for gas engine component of project

Parameters	**-10%**	**-5%**	**0**	**5%**	**10%**
Investment	4.61	3.53	2.53	1.59	0.70
Operational costs	3.56	3.05	2.53	2.00	1.46
Electricity tariff	0.56	1.57	2.53	3.47	4.37
Heat price	1.42	1.98	2.53	3.07	3.60
Gas engine operating hours	0.27	1.43	2.53	3.59	4.62

The above table summarizes the results of the sensitivity analysis carried out for the project. Even a 10% increase in the most sensitive parameter, which is engine operating hours, remains far below the hurdle rate. It can therefore be concluded that the results of the investment analysis are robust.

Step 3. Barrier analysis (optional).

No barrier analysis has been chosen for this additionality test.

[18] Although the project incorporates nine different mines, the financial return is only calculated for the project as a whole. All mines belong to and are operated by ZCG, and the investment decision is made with reference to the project as a whole. This is also reflected in the fact that there is only one feasibility report and one environmental impact assessment approved by Chinese authorities.

Step 4. Common Practice Analysis

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

The similarity of other activities can be assessed on the basis of two main factors: a) the geological conditions of the coal seam and the quality of the extracted CMM; b) the technology used in the project.

Concerning the geological conditions and the quality of CMM, other mine groups in Henan province provide a suitable basis for comparison. Various academic references show that coal permeability (measured in mD) is an important factor in determining the quality of extracted CMM using pre-mining drainage techniques.[19] Low coal permeability prevents methane trapped in the coal seam from easily migrating through the coal deposits. Onsite visits to the four major coal groups in Henan showed that coal permeability was comparatively low[20] (i.e. far below 1 mD):

Table 12: Coal permeability at major mine groups in Henan Province[21]

Mine group	Coal permeability (mD)
Pingdingshan Coal (Group) Co., Ltd.	0.0019
Zhengzhou Coal Industry (Group) Co., Ltd.	0.008
Yima Coal Industry (Group) Co., Ltd.	0.05
Hebi Coal Industry (Group) Co., Ltd.	0.03-0.045

In part due to these geological circumstances, CMM extracted in Henan Province is consistently below 30%.[22] This demonstrates that other coal groups in the province face the same challenges as ZCG in extracting high quality CMM with sufficient methane concentrations for large-scale utilization. An analysis of Henan confirms that none of the other major coal groups has a history of utilizing significant amounts of CMM for commercial purposes.[23]

Concerning the technology used in the project, MEGTEC, the manufacturer of the Vocsidizer has confirmed that there is no ongoing or planned project in China that will use the Vocsidizer without benefiting from the CDM. The same has been confirmed by Shengdong concerning their gas engine model able to utilize lower-concentration CMM. This model has only been only the market since 2006, and it has been sold exclusively to projects operating within the CDM. Indeed, one of its most important markets has been Henan Province, where lower-concentration engines have been sold to seven coalmine groups to be used in CDM project activities.

[19] See: Westlake A, Creedy D P, Hu Yuhong. *CDM, a Trigger for Coal Mine Methane Emission Reductions in China*, 2003. Available at: http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/005.pdf

See: Vrolijk, C. et al. Enhancing Coal Mine Methane Utilisation in China. Report No. COAL R298 DTI/Pub URN05/1816, 2005. Available at: www.berr.gov.uk/files/file29223.pdf

[20] Mazumder et al (2002). *CO_2 Injection in Coal Seams for Sequestration and Enhanced Methane Recovery*. Delft University of Technology, Netherlands. Available at:
http://www.nwo.nl/nwohome.nsf/pages/NWOP_5WCGTL/$file/TransitionPreSaikat21nov02.pdf

[21] Site visits to Pingdingshan, Zhengzhou, Yima and Hebi coal groups in 2005 and 2006.

[22] Visits to Yima, Zhengzhou, Hebi, Pingdingshan, and Jiaozuo coalmine groups in 2005 and 2006.

[23] Visits to Yima, Zhengzhou, Hebi, Pingdingshan, and Jiaozuo coalmine groups in 2005 and 2006.

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

Based on the above analysis, it can be concluded that no other projects using the same technology and facing the same geological conditions as ZCG are occurring.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

1. Project emissions

Based on Methodology ACM0008, the following formulae are used to calculate project emissions.

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

Where:

PE_y	Project emissions in year y (tCO2e)
PE_{ME}	Project emissions from energy use to capture and use methane (tCO2e)
PE_{MD}	Project emissions from methane destroyed (tCO2e)
PE_{UM}	Project emissions from un-combusted methane (tCO2e)

PE_{ME}: Emissions from additional energy use to capture and use methane

Additional energy use for methane capture will consist only of electricity consumption (water pumps, Vocsidizer VAM fans).

$$PE_{ME} = CONS_{ELEC,PJ} \times EF_{ELEC} \qquad \textbf{(2)}$$

Where:

$CONS_{ELEC,PJ}$	Additional electricity consumption for capture and use of methane (MWh)
EF_{ELEC}	Emission factor of Central China Electricity Grid (tCO_2e/MWh)

PE_{MD}: Emissions from methane destroyed

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

Where:

MD_{ELEC}	Methane destroyed through power generation (tCH_4)
MD_{HEAT}	Methane destroyed through heat generation (tCH_4)
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)
r	$r = PC_{NMHC} / PC_{CH4}$ (relative proportion of NMHC compared to methane)
CEF_{NMHC}	Carbon emission factor for combusted non-methane hydrocarbons ($tCO_2eq/tNMHC$)

PC_{CH4}	Concentration (in mass) of methane in extracted gas (%) measured on wet basis
PC_{NMHC}	NMHC concentration (in mass) in extracted as (%)

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

(5)

Where:

MM_{ELEC}	Methane measured sent to power plant (tCH_4)
Eff_{ELEC}	Efficiency of methane destruction in power plant (set at 99.5% from IPCC)
MM_{HEAT}	Methane measured sent to Vocsidizer (tCH_4)
Eff_{HEAT}	Efficiency of methane oxidation in Vocsidizer (97% as per manufacturer's specifications)

PE_{UM}: Emissions from un-combusted methane

(6)

Where:

i	Use of methane (power generation, heat generation)
MM_i	Methane measured sent to use *i* (tCH4)
Eff_i	Efficiency of methane destruction in use i (%)

2. Baseline emissions

Based on Methodology ACM0008, the following formulae are used to calculate baseline emissions.

(7)

Where:

BE_y	Baseline emissions in year y (tCO2e)
$BE_{MD,y}$	Baseline emissions from destruction of methane in the baseline scenario in year y (tCO2e)
$BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO2e)
$BE_{Use,y}$	Baseline emissions from the production of power or heat replaced by the project activity in year y (tCO2e)

$BE_{MD,y}$: Baseline emissions from destruction of methane in the baseline scenario

There is no methane destruction in the baseline scenario, so emissions for this part of the formula are zero.

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

As discussed in section B.4, for the purposes of the project no distinction is made between pre- and post-mining CMM. Therefore, the formula reads as follows:

$$BE_{MR,y} = GWP_{CH4} \times \sum_{i} (CMM_{PJi,y} - CMM_{BLi,y}) \qquad \textbf{(8)}$$

Where:

$CMM_{PJi,y}$	Pre-mining CMM captured, sent to and destroyed by use *i* in the project activity in year y (tCH4)
$CMM_{BLi,y}$	Pre-mining CMM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in year y (tCH_4)
GWP_{CH4}	Global warming potential of methane (21 tCO_2e/tCH_4)

Note that $CMM_{BLi,y}$ is zero, as there is no baseline utilization of CMM.

$BE_{Use,y}$: Baseline emissions from the production of power and heat replaced by the project activity

$$PBE_{Use,y} = GEN_y \times EF_{ELEC} + HEAT_y \times EF_{HEAT} \qquad \textbf{(9)}$$

Where:

$PBE_{Use,y}$	Potential total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO2e)
GEN_y	Electricity generated by project activity in year y (MWh)
EF_{ELEC}	Emissions factor of electricity (Central China Electricity Grid) replaced by project (tCO2/MWh)
$HEAT_y$	Heat generation by project activity in year y (GJ)
EF_{HEAT}	Emissions factor for heat production replaced by project activity (tCO2/GJ)

EF_{ELEC}: Grid emission factor

As per ACM0008, the methodology ACM0002 is used to calculate the grid emission factor. For the proposed project, this emission factor is based on the Central China Electricity Grid and is calculated as follows:

$$EF_{ELEC,y} = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y} \qquad \textbf{(10)}$$

Where:

$EF_{OM,y}$	Emission factor of the grid's operating margin (tCO2e/MWh)
$EF_{BM,y}$	Emission factor of the grid's build margin (tCO2e/MWh)
w_{OM}	0.5
w_{BM}	0.5

$EF_{OM,y}$: Operating margin (OM) emission factor

ACM0002 states that the dispatch data analysis should be the first choice to calculate the OM. In China, this information is a commercial secret, and is not available to the public. Therefore, an alternative method will be used.

The Simple OM method may be used where low-cost/must run resources constitute less than 50% of total grid generation over an average of the five most recent years. This is the case for the Central China Electricity Grid. Therefore the simple OM method is used.

The Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad \textbf{(11)}$$

Where:

Fi ,j,	Amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*
j	Power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid
COEFi,j y	CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*
GENj,y	Electricity (MWh) delivered to the grid by source *j*

The CO_2 emission coefficient $COEF_i$ of fuel *i* can be calculated as follows:

$$COEF_i = NCV_i \times EF_{CO2,i} \times OXID_i \times 44/12 \qquad \textbf{(12)}$$

Where:

NCV_i	Net calorific value per mass or volume unit of a fuel i
$OXID_i$	Oxidation factor of the fuel
$EF_{CO2,i}$	CO2 emission factor per unit of energy of the fuel i.

$EF_{BM,y}$: Build margin (BM) emission factor

Based on Methodology ACM0002, the BM can be calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i.m} F_{i.m,y} \cdot COEF_{i.m}}{\sum_{m} GEN_{m,y}} \qquad \textbf{(13)}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method above for plants *m*.

As per ACM0002, Option 1 was selected to identify the sample group *m* to calculate the BM *ex ante*. According to this option, the sample group consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (MWh) and that have been built most recently.

However, because information on electricity generation and fuel consumption of individual plants is regarded as a commercial secret in China, the CDM Executive Board has allowed for a deviation from ACM0002 in China.[24] This deviation allows for the following steps to be used in order to calculate the BM under Option 1:

- Use of capacity additions for estimating the build margin emission factor for grid electricity.
- Use of weights estimated using installed capacity in place of annual electricity generation.
- Use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy, for each fuel type in estimating the fuel consumption to estimate the build margin (BM).

The BM is therefore calculated as follows:

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Adv,Thermal} \qquad \textbf{(14)}$$

Where:

CAP_{Total}	Total capacity addition
$CAP_{Thermal}$	Fossil fuel-fired capacity addition
$EF_{Adv,Thermal}$	CO2 emission factor of the best thermal power technology commercially available

EF_{HEAT}: Emissions factor for heat production

ACM0008 uses the following formula to calculate the emission factor of heat that is displaced by the project:

[24] http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ

$$EF_{heat,y} = \frac{EF_{CO2,i}}{Eff_{heat}} \times \frac{44}{12} \times \frac{1TJ}{1000GJ} \qquad \textbf{(15)}$$

Where:

$EF_{heat,y}$	Emissions factor for heat generation (tCO2/GJ)
$EF_{CO2,i}$	CO2 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

To select the boiler efficiency, Option B was chosen: assume a boiler efficiency of 100% based on the net calorific values as a conservative approach.

3. Leakage

Project leakage LE_y is calculated from the following formula:

$$LE_y = LE_{d,y} + LE_{o,y} \qquad \textbf{(16)}$$

Where:

LE_y	Leakage emissions in year y (tCO2e)
$LE_{d,y}$	Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y (tCO2e)
$LE_{o,y}$	Leakage emissions due to other uncertainties in year y (tCO2e)

$LE_{d,y}$: Leakage emissions due to displacement of other baseline thermal energy uses

Because there is no baseline thermal demand, this form of leakage can be excluded.

$LE_{o,y}$: Leakage emissions due to other uncertainties

Three types of leakage due to other uncertainties are considered in ACM0008:

a) CBM drainage from outside the de-stressed zone
b) Impact of CDM project activity on coal production
c) Impact of CDM project activity on coal prices and market dynamics

Leakage category a) can be excluded because the project does not involve any CBM capture. Leakage category b) requires a discount factor to be applied *if the project activity is CBM/CMM extraction and the baseline scenario is ventilation only*. This does not apply to the current project because CMM extraction is already part of the baseline. Leakage category c) may be further considered by the CDM Executive Board at a later date when more information concerning the price and market impacts of this project type is available. It is therefore not relevant at this point in time.

As a result, leakage emissions due to uncertainties can be safely excluded from the project.

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

Data / Parameter:	**Density of methane**
Data unit:	kg/m3
Description:	
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.67
Justification of the choice of data or description of measurement methods and procedures actually applied :	Actual density will be measured by pressure transmitters and temperature sensors connected to the flow of both CMM and VAM to the project equipment.
Any comment:	Applies at atmospheric pressure and 20C

Data / Parameter:	$\mathbf{EF_{CO2,i}}$
Data unit:	tC/TJ
Description:	CO2 emissions factor of fuel used in heat generation
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	25.8
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC reference
Any comment:	Used to calculate the emission factor of coal in coal boilers which is replaced by methane-based thermal energy.

Data / Parameter:	$\mathbf{Eff_{HEAT}}$
Data unit:	%
Description:	Efficiency of methane oxidation in Vocsidizer
Source of data used:	Manufacturer’s specifications
Value applied:	97%
Justification of the choice of data or description of measurement methods and procedures actually applied:	The Vocsidizer is based on a technology that oxidizes VAM over a heated ceramic bed. Every few minutes, the direction of the flow of VAM over the bed changes, and the molecules which change direction will not be fully oxidized. This results in an oxidation efficiency of 97%.
Any comment:	Used to calculate the actual amount of methane that is oxidized by the Vocsidizer during the project activity.

Data / Parameter:	$\mathbf{Eff_{ELEC}}$
Data unit:	%

Description:	Efficiency of methane destruction in power plant
Source of data used:	As per ACM0008 (IPCC)
Value applied:	99.5%
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC reference
Any comment:	Used to calculate efficiency of gas destruction power electricity production in gas engines.

Data / Parameter:	**$EF_{OM,y}$**
Data unit:	tCO2/MWh
Description:	Operating margin (OM) of Central China Electricity Grid
Source of data used:	*China Electricity Yearbooks 2004-2006*
Value applied:	1.2899
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according to ACM0002. See Annex 3.
Any comment:	

Data / Parameter:	**$EF_{BM,y}$**
Data unit:	tCO2/MWh
Description:	Build Margin (BM) of Central China Electricity Grid
Source of data used:	*China Electricity Yearbooks 2003-2006*
Value applied:	0.6594
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according to ACM0002. See Annex 3.
Any comment:	

Data / Parameter:	**EF_{HEAT}**
Data unit:	tCO2/GJ
Description:	Emissions factor for heat production
Source of data used:	Calculated as per ACM0008
Value applied:	0.095
Justification of the choice of data or description of measurement methods	Based on **$EF_{CO2,I}$** of 25.8 tC/TJ from IPCC.

and procedures actually applied:	
Any comment:	Used to calculate emissions from coal boilers replaced by project's heat production.

B.6.3 Ex-ante calculation of emission reductions:

1. Project Emissions

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \qquad (17)$$

PE_{ME}: Project emissions from energy use to capture and use methane

Table 13: Energy requirements for methane capture and utilization[25]

Mine	Vocsidizer ventilation fans (kW)	Water cycle pumps (kW)	Hot water pumps (kW)	Cold water pumps (kW)	Cooling water towers (kW)	Water to steam conversion (kW)	Water softener pumps (kW)
Daping	0	22.5	5	0.25	5.5	5.5	0.4
Peigou	300	45	10	0.5	11	11	0.8
Chaohua	300	45	10	0.5	11	11	0.8
Gaocheng	300	22.5	5	0.25	5.5	5.5	0.4
Lugou	300	0	0	0	0	0	0
Cuimiao	0	45	10	0.5	11	11	0.8
Jinlong	300	0	0	0	0	0	0
Baiping	300	0	0	0	0	0	0
Zhaojiazhai	300	0	0	0	0	0	0
Total	**2,100**	**180.0**	**40.0**	**2.0**	**44.0**	**44.0**	**3.2**

Operating hours of gas engine ancillary equipment: 7,000 hours/year
Operating hours of Vocsidizer ventilators: 7,200 hours/year
EF_{ELEC}: 0.9747 tCO2e/MWh

Vocsidizer electricity consumption
= (2,100 kW x 7,200 hrs)/1000 = 15,120 MWh/year

Gas engine ancillary equipment electricity consumption:
= [(180 + 40 + 2 + 44 + 44 + 3.2) x 7,000 hrs]/1000 = 2192.4 MWh/year

$CONS_{ELEC,PJ}$ = 15,120 + 2192.4 = 17,312.4 MWh/year

[25] These values are based on an estimate provided by the equipment suppliers for this type of installation. The above estimate is conservative because it assumes that all gas engine ancillary equipment will be operational from the beginning of the project, but in reality it will be phased in over at least a year.

PE_{ME}: 17,312.4 x 0.9747 = **16,874 tCO2e/year**

PE_{MD}: Project emissions from methane destroyed

Operating hours of gas engines:	7,000 hours/year
Methane destruction per gas engine:	101 m3 CH4/engine/hour
Number of gas engines installed:	16
Operating hours of Vocsidizer:	7,200 hours/year
Methane destruction per Vocsidizer unit:	437.5 m3 CH4/Vocsidizer/hour
Number of Vocsidizer units installed:	7
Density of methane:	0.67 kg/m3
Eff_{ELEC}:	0.995
Eff_{HEAT}:	0.97
CEF_{CH4}:	2.75

MM_{ELEC} = 16 x 7,000 x 101 x 0.67/1000 = 7,579 tCH4/year

MM_{HEAT} = 7 x 7,200 x 437.5 x 0.67/1000 = 14,774 tCH4/year

MD_{ELEC} = 7,579 x 0.995 = 7,541 tCH4/year

MD_{HEAT} = 14,774 x 0.97 = 14,331 tCH4/year

PE_{MD}= (7,541 + 14,331) x 2.75 = **60,148 tCO2e/year**

PE_{UM}: Project emissions from un-combusted methane

PE_{UM} = (7,579 x [1-0.995] + 14,774 x [1-0.97]) x 21 = **10,103 tCO2e/year**

Total Project Emissions = 16,874 + 60,148 + 10,103 = 87,125 tCO2e/year

2. Baseline Emissions

(18)

$BE_{MD,y}$: Baseline emissions from destruction of methane in the baseline scenario

Methane destruction in the baseline scenario is zero.

$BE_{MR,y}$: Baseline emissions from release of methane into the atmosphere that is avoided by the project activity

Methane emissions avoided by gas engines:	7,579.6 tCH4/year
Methane emissions avoided by Vocsidizer:	14,773.5 tCH4/year
$CMM_{PJi,y}$ (total methane emissions avoided by project activity):	22,353.1 tCH4/year
GWP_{CH4}:	21 tCO2e/tCH4

$BE_{MR,y}$ = 22,353.1 x 21 = **469,415 tCO2e/year**

$BE_{Use,y}$: Baseline emissions from the production of power and heat[26]

Gas engine estimated performance:	0.35 MW
Gas engine waste heat generation:	0.34 GJ/hour
Operating hours of gas engines:	7,000 hours/year
Vocsidizer heat generation:	2.27 GJ/hour
Operating hours of Vocsidizers:	7,200 hours/year
EF_{ELEC}:	0.9747 tCO2e/MWh
EF_{HEAT}:	0.095 tCO2e/GJ

GEN_y (Electricity generated by project):
= 16 x 0.35 x 7,000 = 39,200 MWh/year

$HEAT_{ENG}$ (Heat generated by gas engines):
= 16 x 0.34 x 7,000 = 38,487 GJ/year (difference in value due to rounding)

$HEAT_{VOCS}$ (Heat generated by Vocsidizers):
= 7 x 2.27 x 7,200 = 114,307 GJ/year (difference in value due to rounding)

$BE_{Use,y}$ = (39,200 x 0.9747) + (38,487 + 114,307) x 0.095 = **52,662 tCO2e/year**
(differences in value due to rounding)

Total baseline emissions = 0 + 469,415 + 52,662 = 522,077 tCO2e/year

3. Leakage

As determined in section B.6.1, leakage emissions are zero.

[26] Actual heat output from gas engines and Vocsidizers is likely to be higher, but a heat utilization rate of 30% has been conservatively assumed for both technologies in case facilities in the vicinity of the equipment sites do not require the total heat output.

4. Emission reductions

$$ER_y = BE_y - PE_y - LE_y \tag{19}$$

ERy = 522,077 – 87,125 – 0 = 434,952 tCO2e/year (differences in value due to rounding)

Table 14: Summary of Project Emission Reductions

						Baseline Emissions (tCO2e)					Emission Reductions (tCO2e)
	Equipment installation		Project Emissions (tCO2e)					$BE_{Use,y}$		Leakage (tCO2e)	
Year	Gas engines	Vocsidizers	$PE_{ME,y}$	$PE_{MD,y}$	$PE_{UM,y}$	$BE_{MD,y}$	$BE_{MR,y}$	Electricity	Heat	LE_y	ER_y
2008	16	1	4,242	8,938	1,085	0	69,340	9,552	1,940	0	66,566
2009		6	16,874	26,369	2,125	0	203,492	38,207	5,186	0	201,516
2010			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2011			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2012			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2013			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2014			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2015			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2016			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2017			16,874	60,148	10,103	0	469,415	38,207	14,454	0	434,952
2018			2,812	10,025	1,684	0	78,236	6,368	2,409	0	72,492

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

Table 15: Total Emission Reductions

Year	BEy:Total baseline emissions (tCO2e)	PEy: Total project emissions (tCO2e)	LEy: Total leakage emissions (tCO2e)	**ERy: Total emission reductions (tCO2e)**
2008	80,832	14,266	0	**66,566**
2009	246,885	45,369	0	**201,516**
2010	522,077	87,125	0	**434,952**
2011	522,077	87,125	0	**434,952**
2012	522,077	87,125	0	**434,952**
2013	522,077	87,125	0	**434,952**
2014	522,077	87,125	0	**434,952**
2015	522,077	87,125	0	**434,952**
2016	522,077	87,125	0	**434,952**
2017	522,077	87,125	0	**434,952**
2018	87,013	14,521	0	**72,492**
Total	**3,982,253**	**669,510**	**0**	**3,820,186**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$CONS_{ELEC,PJ}$**
Data unit:	MWh
Description:	Electricity consumed for capture and use of methane: includes Vocsidizer ventilation fans and ancillary equipment like water pumps for gas engines.
Source of data to be used:	Based on estimate from equipment supplier (see Table 13).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	19,832 MWh/year
Description of measurement methods and procedures to be applied:	Electricity consumption will be measured by electricity flow meters conforming to Chinese national standards.
QA/QC procedures to be applied:	Meters will be subject to regular maintenance and calibration according to the manufacturer's specifications.
Any comment:	See details of monitoring plan.

Data / Parameter:	**MM_{ELEC}**
Data unit:	tCH4
Description:	Methane sent to gas engines for power generation
Source of data to be used:	Based on engine manufacturer specifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	7,580 tCH4/year
Description of measurement methods and procedures to be applied:	In order to calculate the amount of methane sent to gas engines, the following parameters will be measured: - Concentration of methane in coalmine gas (measured by gas analyzer) - Volume of coalmine gas (measured by gas flow meter) - Pressure of coalmine gas (measured by pressure transmitter) - Temperature of coalmine gas (measured by temperature sensor) These parameters will be fed into a data logger that will calculate and record the mass of methane sent to gas engines.
QA/QC procedures to be applied:	All meters and sensors will be subject to regular maintenance and calibration according to manufacturer's specifications.
Any comment:	See details of monitoring plan.

Data / Parameter:	**MD_{ELEC}**
Data unit:	tCH4

Description:	Methane destroyed by power generation
Source of data to be used:	Calculation based on MM_{ELEC} and Eff_{ELEC}
Value of data applied for the purpose of calculating expected emission reductions in section B.5	7,541 tCH4/year
Description of measurement methods and procedures to be applied:	Methane destroyed by power generation will be calculated monthly using the following formula: $MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC}$
QA/QC procedures to be applied:	The data will be archived electronically and all data will be kept till at least 2 years after the end of the crediting period.
Any comment:	

Data / Parameter:	**MM_{HEAT}**
Data unit:	tCH4
Description:	Methane sent to Vocsidizers for heat generation
Source of data to be used:	Manufacturer's estimate.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	14,774 tCH4/year
Description of measurement methods and procedures to be applied:	The weight of methane will be determined as above, measuring concentration, volume, pressure and temperature of the incoming ventilation air methane.
QA/QC procedures to be applied:	All meters and sensors will be subject to regular maintenance and calibration according to manufacturer's specifications.
Any comment:	See details of monitoring plan.

Data / Parameter:	**MD_{HEAT}**
Data unit:	tCH4
Description:	Methane destroyed by heat generation
Source of data to be used:	Calculation based on MM_{HEAT} and Eff_{HEAT}
Value of data applied for the purpose of calculating expected emission reductions in section B.5	14,331 tCH4/year
Description of measurement methods	Methane destroyed by power generation will be calculated monthly using the following formula:

and procedures to be applied:	
QA/QC procedures to be applied:	The data will be archived electronically and all data will be kept till at least 2 years after the end of the crediting period.
Any comment:	

Data / Parameter:	**CEF_{NMHC}**
Data unit:	tCO2eq/tNMHC
Description:	Carbon emission factor of non-methane hydrocarbons
Source of data to be used:	Periodical gas analyses provided by ZCG
Value of data applied for the purpose of calculating expected emission reductions in section B.5	NMHC should account for less than 1% by volume of extracted coal mine gas and therefore emissions from combustion of NMHC have not been taken into account for the calculation of expected emission reductions (gas analysis provided to validator).
Description of measurement methods and procedures to be applied:	ZCG will take annual gas analysis samples to verify that NMHCs can be

	be excluded.
QA/QC procedures to be applied:	Analyses will be taken at all mines included in the project and the results supervised and signed off by the CDM project manager.
Any comment:	

Data / Parameter:	**PC_{CH4}**
Data unit:	%
Description:	Concentration (in mass) of methane in extracted gas
Source of data to be used:	Measured on a daily basis.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The amount of pure methane is adopted for expected emission reduction calculation.
Description of measurement methods and procedures to be applied:	Methane concentration will be measured on a wet basis by concentration meters, optical and calorific. The data will be archived electronically and all data will be kept till at least 2 years after the end of the crediting period.
QA/QC procedures to be applied:	All meters and sensors will be subject to regular maintenance and calibration according to manufacturer's specifications.
Any comment:	

Data / Parameter:	**PC_{NMHC}**

Data unit:	%
Description:	Non methane hydrocarbons (NMHC) concentration (in mass) in coal mine gas
Source of data to be used:	To be obtained through annual analysis of captured gas. If NMHC concentration is less than 1%, it is not accounted.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not accounted.
Description of measurement methods and procedures to be applied:	Annual measurements of NMHC concentration by concentration meters (optical and calorific) to check out whether it is less than 1% to determine whether NMHC emissions can be excluded from project emission calculation. The data will be archived electronically and all data will be kept till at least 2 years after the end of the crediting period.
QA/QC procedures to be applied:	All meters and sensors will be subject to regular maintenance and calibration according to manufacturer's specifications.
Any comment:	

Data / Parameter:	**r**
Data unit:	%
Description:	Relative proportion of NMHC compared to methane in captured gas
Source of data to be used:	Calculated from PC_{CH4} and PC_{NMHC} : $r = PC_{NMHC} / PC_{CH4}$.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not accounted.
Description of measurement methods and procedures to be applied:	Annual calculation based on annual monitoring of PC_{NMHC} to check out whether r is less than 1% to determine whether NMHC emissions can be excluded from project emission calculation.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**GEN_y**
Data unit:	MWh
Description:	Electricity generated by project
Source of data to be used:	Manufacturer estimate
Value of data applied for the purpose of	39,200 MWh/year

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Electricity flow meters will measure electricity production from gas engines. They will conform to Chinese national standards.
QA/QC procedures to be applied:	Meters will be subject to regular maintenance and calibration according to the manufacturer's specifications.
Any comment:	See details of monitoring plan.

Data / Parameter:	**$HEAT_{ENG}$**
Data unit:	GJ
Description:	Heat generation from gas engines
Source of data to be used:	Manufacturer's specifications.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	38,487 GJ/year
Description of measurement methods and procedures to be applied:	The amount of thermal energy produced will be determined by measuring the following parameters: - Volume of hot water sent to mine facilities (flow meter) - Temperature of water (temperature sensor) These parameters will be directly fed into a data logger which will calculate the energy content of the hot water (in joules).
QA/QC procedures to be applied:	All meters and sensors will be subject to regular maintenance and calibration according to manufacturer's specifications.
Any comment:	To be conservative, it has been assumed that only 30% of available heat from the Vocsidizer will actually be utilized. The above value therefore does not represent the technical potential for heat production. The exact utilization rate depends on the proximity of end users and mine facilities.

Data / Parameter:	**$HEAT_{VOCS}$**
Data unit:	GJ
Description:	Heat generation from Vocsidizer
Source of data to be used:	Manufacturer's specifications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	114,307 GJ/year
Description of measurement methods	The amount of thermal energy produced will be determined by measuring the following parameters:

and procedures to be applied:	- Volume of hot water sent to mine facilities (flow meter) - Temperature of water (temperature sensor) These parameters will be directly fed into a data logger which will calculate the energy content of the hot water (in joules).
QA/QC procedures to be applied:	All meters and sensors will be subject to regular maintenance and calibration according to manufacturer's specifications.
Any comment:	To be conservative, it has been assumed that only 30% of available heat from the Vocsidizer will actually be utilized. The above value therefore does not represent the technical potential for heat production. The exact utilization rate depends on the proximity of end users and mine facilities.

B.7.2 Description of the monitoring plan:

Monitoring equipment installation

The project utilizes two types of equipment for gas utilization: a) gas engines for the combustion of CMM; b) Vocsidizers for the oxidation of VAM. There are therefore two types of setup for the monitoring equipment.

Monitoring equipment will be installed in each mine and the type of setup will depend on the CMM and VAM utilization equipment installed in the mine. Those mines where the same utilization approach (gas engines with power and heat generation and/or Vocsidizer with heat generation) is implemented would adopt the same setup type of monitoring equipment.

This table summarizes for each mine the equipment for CMM and VAM utilization that will be installed.

Table 16: CMM and VAM utilization in each mine

Mine	Gas engines with power and heat generation	Vocsidizers with heat generation
Daping	X	
Peigou	X	X
Chaohua	X	X
Gaocheng	X	X
Lugou		X
Cuimiao	X	
Jinlong		X
Baiping		X
Zhaojiazhai		X

Consequently, the following monitoring equipment will be installed:

- Monitoring equipment for CMM utilization adapted to engines for power and heat generation: installed at Daping, Peigou, Chaohua, Gaocheng and Cuimiao mines.
- Monitoring equipment for VAM utilization adapted to Vocsidizers for heat generation: installed at Peigou, Chaohua, Gaocheng, Lugou, Jinlong, Baiping and Zhaojiazhai mines.

For each of the above-described project sites, a separate agreement will be signed between monitoring equipment supplier ABB Systems Shanghai and ZCG. ZCG will notify ABB of any additional gas utilization equipment that will be installed. This will allow ABB to plan ahead and deliver the monitoring instruments in time so that emission reductions can be measured as soon as the gas utilization equipment is operational on each site.

ZCG and ABB will also sign a comprehensive service agreement that will ensure all instruments are serviced and maintained properly.

Gas engines monitoring equipment to be installed at Daping, Peigou, Chaohua, Gaocheng and Cuimiao mines

The following instruments will be installed at each site at which gas engines utilize CMM (Daping, Peigou, Chaohua, Gaocheng and Cuimiao).

Instrument name	**Parameter measured**
Gas analyzer	CH4 concentration in CMM
Gas flow meter	Flow rate of CMM (through differential pressure)
Temperature transmitter	Temperature of CMM
Pressure Transmitter	Pressure of CMM
Temperature Transmitter	Temperature of hot water from engines
Water Flow Transmitter	Flow rate of hot water
Power Meters	Electricity produced and consumed by engines operation

Vocsidizer monitoring equipment to be installed at Peigou, Chaohua, Gaocheng, Lugou, Jinlong, Baiping and Zhaojiazhai mines

The following instruments will be installed at each site where a Vocsidizer is used to oxidize VAM.

Instrument Name	**Parameter Measured**
Gas Analyzer	CH4 concentration in VAM
Flow meter	Flow rate of VAM (differential pressure)
Temperature Transmitter	Temperature of VAM
Pressure Transmitter	Pressure of VAM

Temperature Transmitter	Temperature of hot water from Vocsidizer
Flow Transmitter	Water Flow Rate
Power Meter	Electricity consumed for Vocsidizer operation

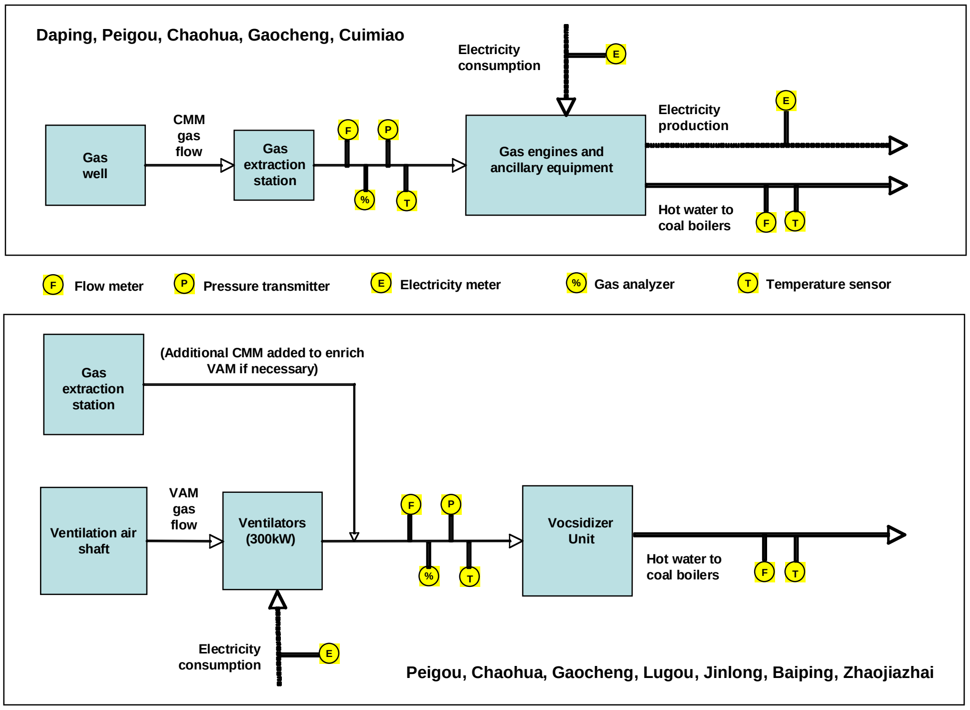


Figure 4: Monitoring diagram for gas engines and Vocsidizers

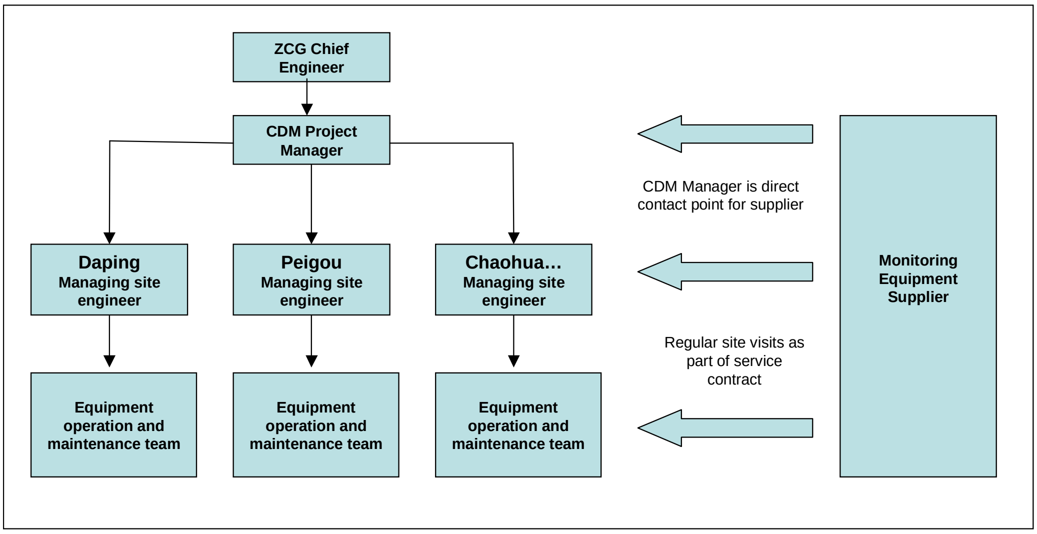
Organization

ZCG has designated a CDM project manager who is in charge of the overall management of the project including the monitoring plan (see contact details in Annex 1). This manager reports directly to ZCG's Chief Engineer. He supervises the managing site engineers of each site where equipment is installed. He is also the direct contact point for the verification DOE and the monitoring equipment supplier.

For each mine, the individual managing site engineer is responsible for the operation and maintenance of the equipment (gas engines and/or Vocsidizers) and is supported by a staff of engineers and workers. As a complete set of monitoring equipment is installed at each equipment site, each managing site engineer will be responsible for the monitoring equipment, the data collection and QA/QC procedures for his/her site.

The equipment supplier will be in frequent contact with the managing site engineer and will conduct periodic visits (see **Quality Control** below). During these visits, there will be regular information exchange and a learning process to ensure that the managing site engineer and his team are familiar with the operation and maintenance of the equipment.

Figure 5: Organizational structure of monitoring team



QA/QC

Each coal mine will adopt the proper monitoring and QA/QC procedures according to its CMM and VAM utilization.

For each mine, specific individuals and QA/QC auditor (the managing site engineer) for project monitoring are appointed. Each managing site engineer is responsible for the training of site's staff working on monitoring. Managing site engineers will be responsible for monitoring equipment operation, maintenance and calibration of the mine they are responsible for. They will check data quality by verifying if there are any values that can be considered to be outside the usual measurement range and by cross-checking all data available. In case inconsistency is detected, the managing site engineer will inform the CDM Project Manager who will take a decision on how to rectify the situation. Managing site engineers will also be in charge of data recording.

The CDM Project Manager is responsible for the training of all the managing site engineers with the technical assistance of the equipment supplier, for project monitoring management and for the QA/QC procedures and the consolidation of all measures. The CDM Project Manager will also check that data are recorded properly in each mine.

Technical services
ZCG will sign a service agreement with the selected equipment supplier. This agreement will guarantee a) that all equipment operates safely and reliably through regular maintenance visits in all mines where monitoring equipment is installed; b) that all equipment is correctly calibrated according to the manufacturer's recommendations; c) that any malfunctioning or damaged equipment can be repaired or replaced quickly.

Data collection and storage

All measured parameters in each mine are sent to a data logger that records data on a continuous basis and computes the required values (such as mass of methane, or energy content of hot water). The records will also indicate the time and date of each data measurement in order to verify any irregularities and double check them with other data such as engine running hours. Records will exist electronically and as paper copies and will be stored for two years after the end of the crediting period as required by ACM0008. Each managing site engineer will be in charge of data records for his/her mine. In case of equipment malfunction, this will be registered by the data logger and will be taken into account in the monitoring report submitted to the relevant DOE. For each monitoring report submitted to the DOE, data will be aggregated from the individual sites under the supervision of the CDM project manager.

Measurements to determine CEF_{NMHC}, PC_{NMHC} and calculate r will be taken annually through manual procedures at all mines included in the project. These gas analyses will be included in the periodic monitoring reports and will be supervised by the CDM project manager and the managing site engineers.

Training

Each managing site engineer and his/her team will receive training on the functioning and maintenance of the site-specific monitoring equipment during the initial installation that will be supervised by the equipment supplier. Specific attention will be given to issues that could affect the CER calculations, such as equipment calibration. Additional information exchange and training will take place during each visit of the supplier's technical team. Any technical questions that arise can be quickly addressed by contacting the supplier, with which there will be regular contact. Furthermore, the CDM consultant will organize a training session with the ZCG CDM manager and his staff to discuss the monitoring plan and the relevant requirements in detail.

Equipment specifications and calibration

All equipment will correspond to Chinese national standards. Data measurement will take place continuously and be transmitted for each mine to the data logger as described above. The equipment will have an accuracy value of no less than ±3%. All instruments have possible measurement ranges that are adequate for the projects, and the specific ranges will be programmed according to project conditions. The most sensitive instrument for calibration is the gas analyzer which will either be self-calibrating, or be calibrated regularly as recommended by the supplier. This will be carried out by the supplier's technicians themselves, or, after sufficient training is received, by ZCG's staff. Other equipment will be calibrated manually according to national standards and the supplier's specifications.

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

Date of completion of the application of the methodology to the project activity: 08/11/2007

Name	Project Participant (Yes/No)
ECO-CARBONE 15, ave de Segur 75007 Paris France Tel: +33 (0)1 53 59 32 58 Fax: +33 (0)1 53 59 94 46 e-mail: michael.pollan@eco-carbone.com	**No**

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:

First gas engines were installed on 01/06/2007.

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

20 years

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

C.2.1. Renewable crediting period

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

>> Not applicable

C.2.1.2. Length of the first crediting period:

>> Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/04/2008

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

An environmental impact assessment was carried out for the project according to the relevant guidelines and was approved by provincial authorities on. Its main conclusions are as follows:

Project construction period

The project's main construction activities involve the construction of the workshop for the generator sets, and equipment installation in these workshops. Possible pollution caused by construction is dust and noise from equipment and material transport. No direct influence on the environment is anticipated, however, as construction will take place on an empty industrial site which is beyond a 200 m radius from any sensitivity points.

Water

The main source of water consumption is cooling water required by gas engines. However, no new water needs to be added to this process as the volume of available and processed coalmine water at each mine is sufficient. A small amount of wastewater will also be produced by mine employees, and will be processed onsite. Dispensed cooling water will be used for irrigation purposes in order to reduce dust. No new pollutants are added to the wastewater by the project.

Local air quality

The combustion of CMM in gas engines produces N2, CO2, and some NOx. NOx is a regulated pollutant, and its production depends largely on the gas combustion temperature. As gas combustion will take place at temperatures below 1,000 C, NOx production is expected to be limited to about 50 mg/Nm3. This is safely below the regulatory limit for coal-fired plants which, according to GB13223-2003, is set at 80 mg/Nm3.

Noise

Noise will be produced mainly from gas engines, generators, exhaust releasers and water pumps. Without any noise protection measures, it is expected to range from 67-85 dB on the project site itself. With noise protection measures (such as mufflers on exhaust pipes and workshop sound insulation), it can be reduced to a level of about 61-75 dB on the project site. Along a 50m radius, noise protection measures are necessary to comply with noise standards of 50dB and 60dB (during day and night respectively). However, as there are no sensitivity points within a 200 m radius (schools, hospitals, residences), the project will not inflict any noise pollution on the surrounding environment.

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

None of the above-identified environmental impacts are considered to be significant. ZCG will take the necessary measures to ensure that noise emissions comply with Chinese regulation.

SECTION E. Stakeholders' comments

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

Stakeholders' comments were collected and compiled in two ways. Firstly, in June 2006 ZCG held two public meetings at Chaohua and Gaocheng Mines respectively. Participants included teachers, mining representatives, resident representatives and environmental officials. During these meetings, ZCG presented an overview of the project design, the nature of coalmine gas, and the concept of the CDM. During the following discussions, participants were invited to ask questions and make comments concerning the project. They were also asked to fill out questionnaires and provide comments or questions in writing if they wished. A total of about 30 people attended these two meetings. Participants were invited to the meeting by telephone.

Secondly, ZCG sent out 100 questionnaires to local residents with a series of questions to be answered concerning the project, as well as space for additional comments. These questionnaires were sent back to ZCG and evaluated as part of its environmental impact assessment.

E.2. Summary of the comments received:

Comments received were almost exclusively positive. All stakeholders making written comments supported the project. Over 60% of those who responded to questionnaires believed the project's main benefits would be to improve the local economy and help to protect the environment. In general, stakeholders perceived the project as having little or no negative impacts on surrounding communities and the environment. Some comments were made concerning worries about the project's possible noise pollution.

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

As mentioned above, comments received were almost all positive. In general, stakeholders present at the meetings organized by ZCG or providing feedback to questionnaires emphasized the project's positive aspects in that it utilizes a resource that was previously regarded as a waste gas. In response to concerns about noise pollution, the project will include measures to minimize the noise level of the installed gas engines. All other potential environmental impacts will be continuously monitored as is specified in the environmental impact assessment commissioned by ZCG.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Middle Name:	

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Represented by:	

Title:	Vice Head of Origination and Corporate Development
Middle Name:	
First Name:	François

Direct FAX:	+44 207 061 5208
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Personal E-Mail:	francois.joubert@edftrading.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was provided for this project activity.

Annex 3

BASELINE INFORMATION

Table 17: ZCG baseline thermal demand

Mine	2004 (GJ)	2005 (GJ)	2006 (GJ)

Peigou	250,800	250,800	250,800
Total	1,149,500	1,149,500	1,149,500

Note: This thermal demand is currently met by coal-fired boilers that are heated with ZCG produced coal. The average thermal demand over the last three years was 1,149,500 GJ. The expected heat output of the project is only at about 10-20% of this consumption, so all heat energy supplied by the project is guaranteed to actually replace coal-based heat.

Table 18: Financial analysis of project

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Revenue (Rmb)																				
Electricity production	8,579,200	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400	17,158,400
Heat production gas engines	940,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800	2,508,800
Heat production Vocsdizer	1,088,640	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480	7,620,480
Costs (Rmb)																				
Capital Expenditure																				
Gas engines and ancillary equipment	(31,582,300)																			
Vocsidizers	(14,000,000)	(84,000,000)																		
Project preparation costs																				
Civil engineering	(5,860,300)																			
Gas engine installation	(33,851,300)																			
Operating Expenditure																				
Gas engine equipment operating costs																				
Water costs	(580,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)	(1,170,000)
Materials	(120,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)
Maintenance and repair	(2,660,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)	(5,320,000)
Salaries and social benefits	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)	(2,400,000)
Other costs	(130,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)	(270,000)
Vocsidizer	(980,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)	(6,860,000)
Project cashflow (Rmb)																				
Net free cash flow (without CERs)	(81,555,260)	(72,962,320)	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680	11,037,680

Rate of return

IRR without CERs	**2.63%**

Key Inputs

Electricity purchasing price (after tax)	Rmb/kWh	0.383
Sales price of heat (after tax)	Rmb/GJ	20
Total gas engine and ancillary equipment cost	Rmb	31,582,300
Cost per Vocsidizer unit	Rmb	14,000,000
Vocsidizer operation costs	%	7.0%
Exchange rate	Rmb/EUR	10
Engine performance	kW	400
Engine heat output	GJ/hour	1.12
Engine operation time	hours/year	7,000
Vocsidizer operation time	hours/year	7,200
Vocsidizer heat output	GJ/hour	7.56

1. Calculation of Operating Margin (OM) of Central China Electricity Grid

Table 19: Electricity generation of the Central China Power Grid in 2003

Province	Power Generation	Power Generation	Self-power consumption rate	Power supply

	(10^8kWh)	(MWh)	(%)	(MWh)
Hunan	295.01	29,501,000		

			4.58	28,149,854
Chongqing	163.41	16,341,000	8.97	14,875,212

Sichuan	327.82	32,782,000	4.41	31,336,314

Source: China Electricity Yearbook 2004

Table 20: Calculation of simple OM emission factor of the Central China Power Grid in 2003

Fuel Type	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Emission Factor	Oxidation rate	Average net	

											net calorific value	CO_2 emissions (tCO_2e)

									(tc/TJ)	**(%)**	**(MJ/t,km3**	**K=G*H*I*J*44/12/10000** **(mass unit)**

Raw coal	Mtons	1427.41	5504.94	2072.44	1646.47	769.47	2430.93	**13851.66**	25.8	100	20908	273,971,540

Coke	Mtons				1.22			**1.22**	25.8	100	28435	32,817

Crude Oil	Mtons		0.5	0.24			1.2	**1.94**	20	100	41816	59,490

Diesel Oil	Mtons	0.52	2.54	0.69	1.21	0.77		**5.73**	20.2	100	42652	181,016

Refinery Gas	Mtons	1.76	6.53		0.66			**8.95**	18.2	100	46055	275,070

Other coking products	Mtons							**0**	25.8	100	28435	0

											Total	276,404,544
Total thermal power supply of the Central China Power grid (MWh)												

	225,987,719
OM of the Central China Power grid (tCO2e/MWh)	**1.2231**

Source: China Electricity Yearbook 2004

Table 21: Electricity generation of the Central China Power Grid in 2004

Province	Power Generation	Power Generation	Self-power consumption rate	Power supply

	(10^8kWh)	(MWh)	(%)	(MWh)
Chongqing	165.2	16,520,000	11.06	14,692,888

Sichuan	346.27	34,627,000	9.41	31,368,599
Total				249,074,186

Source: China Electricity Yearbook 2005

Table 22: Calculation of simple OM emission factor of the Central China Power Grid in 2004

Fuel Type	Unit	Jiangxi	Henan		Hunan				Emission Factor		Average net	

				Hubei		Chongqing	Sichuan	Total		Oxidation rate	net calorific value	CO_2 emissions (tCO_2e)

									(tc/TJ)	(%)	(MJ/t,km3)	K=G*H*I*J*44/12/10000 (mass unit)

		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J*44/12/1000 (volume unit)

Cleaned Coal	Mtons		2.34					**2.34**	25.8	100	26,344	58,316

Coke Oven Gas	10^9m^3			1.68		0.34		**2.02**	12.1	100	16,726	149,900

Crude Oil	Mtons		0.86	0.22				**1.08**	20	100	41,816	33,118

Fuel oil	Mtons	1.09	0.19	9.55	1.38	0.48	1.68	**14.37**	21.1	100	41,816	464,893

Refinery Gas	Mtons	3.52	2.27					**5.79**	18.2	100	46,055	177,950

Other coking products	Mtons							**0**	25.8	100	28,435	0

											Total	345,671,697
OM of the Central China Power grid (tCO2e/MWh)												**1.3878**

Source: China Electricity Yearbook 2005

Table 23: Electricity generation of the Central China Power Grid in 2005

Province	Power Generation	Power Generation	Self-power consumption rate	Power supply

	(10^8kWh)	(MWh)	(%)	(MWh)
Hunan	399	39,900,000	5	37,905,000

Chongqing	175.84	17,584,000	8.05	16,168,488
Sichuan	372.02	37,202,000	4.27	35,613,475

Total				286,203,305

Source: China Electricity Yearbook 2006

Table 24: Calculation of simple OM emission factor of the Central China Power Grid in 2005

Fuel Type	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Emission Factor	Oxidation rate	Average net calorific value	CO_2 emissions (tCO_2e)

									(tc/TJ)	**(%)**	**)**	**K=G*H*I*J*44/12/10000 (mass unit)**

		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	e unit)

Raw coal	Mtons	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	**17827.75**	25.8	100	20,908	352,614,497

Coke	Mtons		25.95		105			**130.95**	25.8	100	28,435	3,522,491

Crude Oil	Mtons		0.82	0.36				**1.18**	20	100	41,816	36,185
Diesel Oil	Mtons	1.3	3.03	2.39	1.39	1.38		**9.49**	20.2	100	42,652	299,798

Fuel oil	Mtons	0.64	0.29	3.15	1.68	0.89	2.22	**8.87**	21.1	100	41,816	286,959

Refinery Gas	Mtons	0.71	3.41	1.76	0.78			**6.66**	18.2	100	46,055	204,689

Other coking products	Mtons				1.5			**1.5**	25.8	100	28,435	40,349

											Total	359,887,488
the Central China Power grid (MWh)												286,203,305

OM of the Central China Power grid (tCO2e/MWh)	**1.2575**

Source: China Electricity Yearbook 2006

$$EF_{OM,y} = \frac{(276,404,544 + 345,671,697 + 359,887,488)}{(225,987,719 + 249,074,186 + 286,203,305)} = 1.2899 tCO_2e / MWh$$

2. Calculation of Build Margin (BM) of Central China Electricity Grid

Table 25: Calculation of coal-fired, oil-fired and gas-fired emission factor

	Power supply efficiency	CO2 emission factor (tC/TJ)	Oxidation rate	Emission Factor (tCO2/MWh)

	A	B	C	D=3.6/A/1000*B*C*44/12
EFCoal,Adv	35.82%	25.8	1	0.9508

EFGas,Adv	47.67%	15.3	1	0.4237

Table 26: Installed Capacity of Central China Power Grid in 2005

Installed capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total

Coal	MW	5,906	26,268	9,526	7,212	3,760	7,496	60,167

Nuclear	MW	0	0	0	0	0	0	0

Source: China Electricity Yearbook 2006

Table 27: Installed Capacity of Central China Power Grid in 2003

Installed capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total

Coal	MW	5,408	17,636	8,173	6,447	3,126	6,104	46,894
Other	MW	0	0	0				

					0	0	0	0
Total	MW	7,715	20,074	15,511	13,050	4,456	18,446	79,251

Source: China Electricity Yearbook 2004

Yearbook 2004

Table 28: Installed Capacity of Central China Power Grid in 2002

Installed capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total

Coal	MW	5,129	15,905	8,148	4,976	3,005	6,142	43,303
Other	MW	0	0	0				

					0	0	0	0
Total	MW	7,326	18,343	15,362	11,111	4,200	17,997	74,338

Source: China Electricity Yearbook 2003

Table 29: Ratio of CO2 emissions among solid fuel, liquid fuel and gas fuel

		Jiangxi	**Henan**	**Hubei**	**Hunan**	**Chongqing**	**Sichuan**	Total	Average Low Calorific Value	Emission Factor (tC/TJ)	Oxidation rate	

	Unit		B	C	D					I	J	4/12/100

Raw coal	Mtons	1869.20	7638.87	2732.15	1712.27	875.4	2999.77	17827.75	20908	25.8	1.00	352,614,497
Cleaned coal	Mtons	0.02	0	0	0	0	0	0.02	26344	25.8	1.00	498

Other washed coal	Mtons	0	138.12	0	0	89.99	0	228.11	8363	25.8	1.00	1,804,669

Sub-total												**357,982,504**

Gasoline	Mtons	0	0.02	0	0	0.02	0	0.04	43070	18.9	1.00	1,194

Fuel oil	Mtons	0.64	0.29	3.15	1.68	0.89	2.22	8.87	41816	21.1	1.00	286,959

Natural gas	10^7m3	0	0	0	0	0	30	30	38931	15.3	1.00	655,209

Other coke gas	10^7m3	0	102	0	0	31.2	0	133.2	5227	12.1	1.00	308,897

Sub-total												**1,280,848**

$\lambda_{Coal} = 99.47\%;\ \lambda_{Oil} = 0.17\%;\ \lambda_{Gas} = 0.36\%$

$$\boxed{EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} \times \lambda_{Gas} \times EF_{Gas,Adv} = 0.9486}$$

Table 30: Calculation of BM of Central China Electricity Grid

	Installed capacity in 2002	Installed capacity in 2003	Installed capacity in 2005	New capacity additions 2002-2005	Share of capacity additions

	A	B	C	D=C-A	
(MW)	0	0	24	24	0.10%

Total (MW)	74,338	79,251	98,596	24,259	100.00%
Share of installed capacity in 2005	75.40%	80.38%	100.00%		

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Adv,Thermal} \qquad \textbf{(20)}$$

EF_{BM} = 0.9486 x 69.52% = **0.6594 tCO2e/MWh**

3. Calculation of combined margin emission factor of China Central Electricity Grid

$\mathbf{EF_{ELEC}}$ = 0.5 x **1.2899** + 0.5 x **0.6594** = **0.9747 tCO2e/MWh**

Annex 4

MONITORING INFORMATION

No additional information. See monitoring plan above.