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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

Pingdingshan Coal (Group) Co., Ltd. Methane Utilization Project, Henan Province, China

Version 2.9
Completed on: 03/06/2008

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A.2. Description of the project activity:

Pingdingshan Coal (Group) Co., Ltd. (PCG) is a state-owned industry group located in Henan Province, Central China. It operates a total of 31 mineshafts, and produces approximately 32 million tons of coal a year. During its mining activities, coalmine methane (CMM) is released and needs to be discharged in order to comply with Chinese mining safety regulations. About 30% of gas is released in the form of coalmine methane (CMM), which is drained directly from PCG's coal seams. About 70% is released in the form of ventilation air methane (VAM), and is vented through the mines' ventilation shafts.

The project includes 5 mines 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 38 gas engines will be installed at the following mines belonging to PCG: Mine 4, Mine 8, Mine 10, Mine 11, Mine 12. Total installed capacity will be 19 MW. The power produced will be used for PCG's own consumption, replacing electricity that would otherwise be purchased from the Central China Electricity Grid. Waste heat from the engines will also be utilized to supply hot water to nearby mining facilities. Secondly, four units of a newly developed methane oxidation technology (known as the *Vocsidizer*) will be installed at Mine 8 to destroy ventilation air methane (VAM) 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: Methane utilization and energy output of project (at full capacity)

CMM utilization (m3 CH4/year)	31,584,416
VAM utilization (m3 CH4/year)	12,000,000
Electricity production (MWh/year)	109,440
Heat production (GJ/year)	282,768

Total emission reductions over a ten-year crediting period are estimated at **6,137,982 tCO2e**.

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 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)	Pingdingshan Coal (Group) Co., Ltd. (public)	No
United Kingdom	Climate Change Capital Carbon Fund II S.à r.l.	No
United Kingdom	Climate Change Capital Carbon Managed Account 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:

Pingdingshan

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

PCG is located near Pingdingshan City, in the central part of China. Its mining area, which covers about 2,400 km^2, is located in the coalfields of Pingdingshan, Ruzhou, and Yuzhou.

Figure 1: Henan Province and Pingdingshan

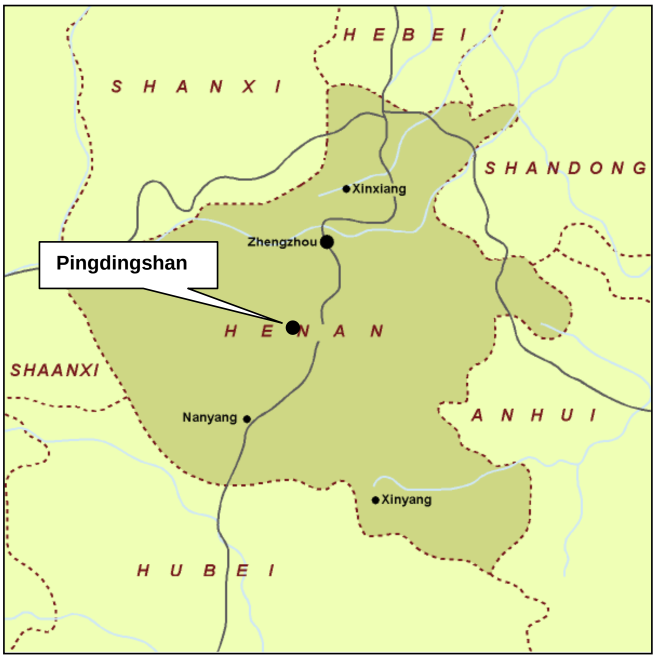
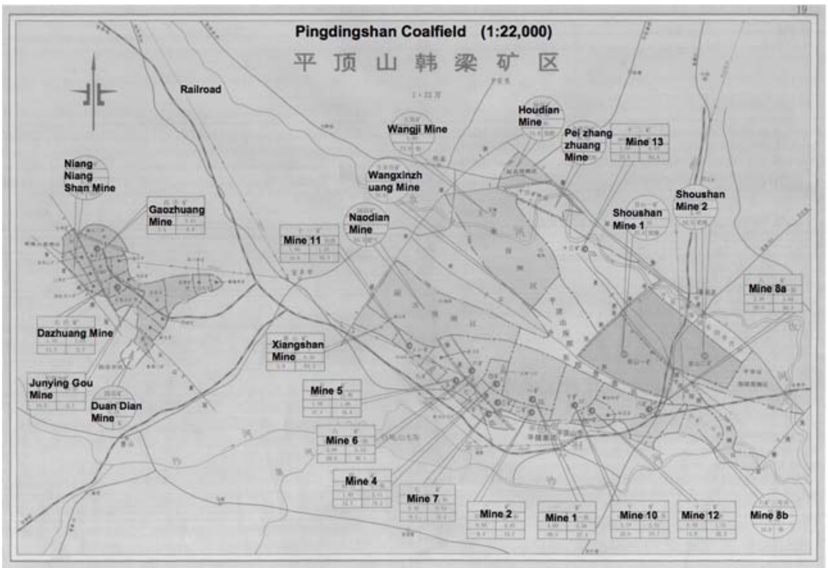


Figure 2: Map of Pingdingshan Coalfield



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 70-85% for electricity production (350-425kW). Other ancillary equipment associated with the gas engines includes cooling water towers, water pumps and heat exchangers.

Vocsidizers: Up to four Vocsidizer modules will be installed at one of PCG's mineshafts.[1] 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

[1] Based on a preliminary site assessment, Mine 8 is the most promising site for the installation of the four Vocsidizer units. However, it is possible that other sites within the already defined project boundaries may be chosen for installation if their conditions are more favourable. Choosing another location would not affect the estimated CERs or other aspects of this PDD.

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 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

Mine	Equipment installed
Mine 4	8 x 500 kW gas engines
Mine 8	12 x 500 kW gas engines Up to 4 Vocsidizer units
Mine 10	8 x 500 kW gas engines
Mine 11	4 x 500 kW gas engines
Mine 12	6 x 500 kW gas engines

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 demonstration 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.
- Throughout the project's preparation, international mining experts have conducted visits to PCG 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. The CER buyer has also financed a technical audit of the mines in order to assist PCG in improving its CMM extraction techniques.

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

The chosen crediting period is 10 years.

Table 3: Estimated Emission Reductions throughout crediting period

Years	Annual estimation of emission reductions in tCO2e
2008	**264,611**
2009	**575,146**
2010	**610,841**
2011	**646,536**
2012	**646,536**
2013	**646,536**
2014	**646,536**
2015	**646,536**
2016	**646,536**
2017	**646,536**
2018	**161,634**
Total estimated reductions (tCO2e)	**6,137,982**
Annual average of emission reductions over the crediting period (tCO2e)	**613,798**

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:

The following tables demonstrate that methodology ACM0008 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. PCG 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 should either be used or destroyed, and cannot be vented.	All of the captured CMM is used to generate 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	Excluded for simplification. This is conservative.
		N2O	Excluded	Excluded for simplification. This is conservative.
	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 currently account for less than 1% of volume in extracted gas (gas analysis provided to validator). However, 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

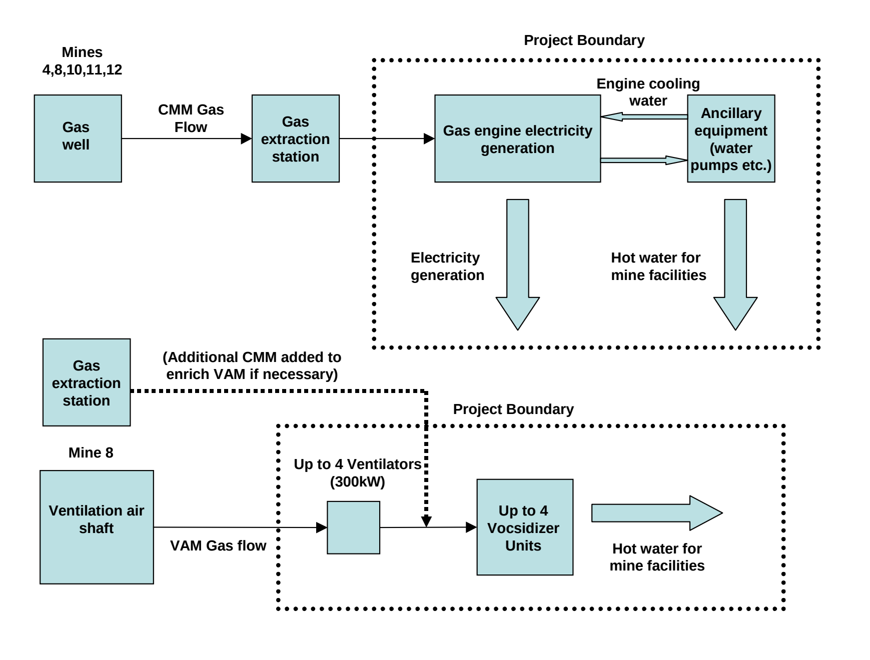

Figure 3: Project Boundaries

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:

Identification of baseline scenario

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 PCG's coal seam (0.0019 millidarcy) is not at all suitable for this type of gas extraction.[2] As a result, PCG has no intention to pursue efforts to extract CBM from its mines.

At PCG'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.) are currently being 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 share between CMM and VAM extracted from PCG's mines is as follows:

Table 7: Relative shares of CMM and VAM in PCG's mines (2006)

Mine	VAM (m3 CH4/yr)	CMM (m3 CH4/yr)	VAM %	CMM %
Mine 4	30,565,177	5,125,651	85.60%	14.40%
Mine 8	15,068,834	12,814,128	54.00%	46.00%
Mine 10	31,221,018	15,231,888	67.20%	32.80%
Mine 11	15,202,875	1,740,787	89.70%	10.30%
Mine 12	10,241,631	4,206,902	70.90%	29.10%
Total	**102,299,535**	**39,119,356**	**72.34%**	**27.66%**

Step 1b. Options for extracted CBM and CMM treatment

i. CMM Venting
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 7.5% of total methane extracted from PCG's mines would be utilized in option ii in the form of VAM, and about 20% 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 PCG-owned and operated captive coal power plants.
3. Heat generation from coal boilers.
4. Electricity production using captured methane.

[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

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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). PCG'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).

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 low-concentration 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 December 16, 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

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

[4] Evidence of this is that in addition to the present PCG project, projects developed by the following coal mine groups that use the same Shengdong technology have obtained both DRC and NDRC approval at the time of writing: Zhengzhou Coal (Group) Co., Ltd., Hebi Coal Industry (Group) Co., Ltd., and Yima Coal Industry (Group) Co., Ltd.

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 feasibly 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 with the relative shares of CMM and VAM as shown in Table 7.

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. PCG currently operates three small to medium-sized coal power plants of 12, 18 and 50MW capacity. The group's electricity demand is met through a combination of grid purchases (69%) and captive coal power (31%). Heat demand is met by using onsite coal boilers fed with PCG-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 4 such units would be installed. Depending on the methane concentration of the VAM, these four units could produce approximately 10% of PCG'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. PCG'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. Its concentration is likely to range from about 10-25% and would require the installation of special safety equipment as proposed by Shengdong. A total of 38 x 500kW engines are installed, utilizing approximately 52% of available extracted CMM. Estimated electricity production would be about 109,440 MWh per year. This power would be used to meet PCG's own needs, and account for about 6% of the group's annual 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 17% of PCG'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 PCG's own consumption (showers, kitchens etc.). PCG could theoretically meet 100% of its heat requirements by using 53 million m3 CH_4/year, accounting for about 95% 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 their distance to the mines and the costs of laying pipelines. Additional equipment required would be gas tanks, gas pumps and other ancillary equipment. PCG'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 10% of total extracted VAM in four *Vocsidizer* units, producing around 103,680 GJ/year of usable heat. A set of 38 x 500kW gas engines would utilize about 52% of available extracted CMM for electricity production (109,440 MWh/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 permission from the relevant safety authorities, creating additional barriers to its implementation.[7] In addition, an important technical barrier would prevent PCG from flaring extracted CMM. Flaring of CMM is generally considered to be possible only when methane concentrations are above 25%. At PCG's mineshafts, however, the methane concentration is generally too low, ranging from 10-25% most of the time. As a result, flaring is not a technically suitable option at PCG and this scenario can be eliminated.

Scenario IV (electricity generation from CMM):

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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

[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

Technological barriers: PCG 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 PCG's CMM (ranging from 10-25% 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, PCG 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.

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 PCG's extracted CMM are generally below 25% and fluctuate strongly. This makes the gas unreliable and unsuitable as a cooking fuel. PCG has therefore in the past chosen not to provide its mineworkers with CMM but to subsidize LPG instead. 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.

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[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.

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.

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]

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[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.

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.

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] Finally, PCG itself has indicated that given the project risks (new technologies, need to secure safe and reliable methane supply etc.), it would not accept to carry out the project if its return were below 15%.[18]

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

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

Table 8: Cost and Revenue Assumptions for Project Investment Analysis

Parameter	**Unit**	
Total investment	Rmb	255 million
Among which: equipment cost	Rmb	169 million
Annual operating costs	Rmb/year	14.9 million
Electricity cost (after tax)	Rmb/kWh	0.383
Heat cost (after tax)	Rmb/GJ	20
Gas price (of CMM)	Rmb/m3	0

Table 9: Results of Investment Analysis[19]

	38 gas engines and 4 Vocsidizers
Project IRR without CERs	7.40%
Project IRR with CERs	27.59%

[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

[18] Information obtained from PCG CDM project manager in August 2006.

[19] Although the project incorporates five different mines, the financial return is only calculated for the project as a whole. All mines belong to and are operated by PCG, 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.

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

The analysis is based on the feasibility report and financial analysis completed by PCG. 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 27.59%, which is significantly above the hurdle rate. It should also be noted that the analysis is conservative because it 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 10: Results of Sensitivity Analysis

Parameters	-10%	-5%	0	5%	10%
Investment	9.03	8.18	7.40	6.67	5.98
Operational costs	8.14	7.77	7.40	7.03	6.66
Electricity tariff	5.36	6.4	7.40	8.37	9.32
Heat price	7.12	7.26	7.40	7.54	7.68
Gas engine operating hours	5.16	6.30	7.40	8.46	9.49

The table above summarizes the results of the sensitivity analysis carried out for the project. The most sensitive parameter is the gas engine operating hours, which is assumed to be 7,200 hours/year. This is already towards the upper end of what the engine manufacturer, Shengdong, has indicated was possible. A 10% increase in the operating hours would make almost 8,000 hours/year, which is very unlikely to occur, in view of Shengdong's previous experience with its technology at other coal mine sites (where engines have run between 6,800 and 7,200 hours/year). 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.

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.[20] Low coal permeability prevents methane trapped in the coal seam from easily

[20] 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

migrating through the coal deposits. Onsite visits to the four major coal groups in Henan showed that coal permeability was comparatively low[21] (i.e. far below 1mD):

Table 11: Coal permeability at major mine groups in Henan Province[22]

Mine group	Coal permeability (mD)
Pingdingshan Coal (Group) Co., Ltd.	0.0019
Zhengzhou Coal (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%.[23] This demonstrates that other coal groups in the province face the same challenges as PCG 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.[24]

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.

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 PCG 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.

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

[21] 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

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

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

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

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 (%)

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

$$MD_{HEAT} = MM_{HEAT} \times Eff_{HEAT} \qquad \textbf{(5)}$$

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)

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

PE_{UM}: Emissions from un-combusted methane

$$PE_{UM} = GWP_{CH4} \times \sum_i MM_i \times (1 - Eff_i) \quad \textbf{(6)}$$

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 (%)

<u>2. Baseline emissions</u>

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

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

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:

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

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)

<u>Note</u> 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

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

Where:

$PBE_{Use,y}$	Potential total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO_2e)
GEN_y	Electricity generated by project activity in year y (MWh)
EF_{ELEC}	Emissions factor of electricity (Central China Electricity Grid) replaced by project (tCO_2/MWh)
$HEAT_y$	Heat generation by project activity in year y (GJ)
EF_{HEAT}	Emissions factor for heat production replaced by project activity (tCO_2/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:

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

Where:

$EF_{OM,y}$	Emission factor of the grid's operating margin (tCO_2e/MWh)
$EF_{BM,y}$	Emission factor of the grid's build margin (tCO_2e/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, and therefore the simple OM method is used. The Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

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

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:

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

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:

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

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.[25] 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:

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

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

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

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:	Revised 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:	**$EF_{CO2,i}$**
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:	**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 CMM over a heated ceramic bed. Every few minutes, the direction of the flow of CMM 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:	**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:	**r**
Data unit:	%
Description:	Relative proportion of NMHC compared to methane (PC_{NMHC} / PC_{CH4})

Source of data used:	PCG measurements
Value applied:	Less than 1%
Justification of the choice of data or description of measurement methods and procedures actually applied:	As per ACM0008
Any comment:	Percentage of NMHC in gas analysis is below 1% and is therefore considered to be negligible as per ACM0008. Value will be monitored annually as described in monitoring plan below.

Data / Parameter:	$\mathbf{EF_{OM,y}}$
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:	$\mathbf{EF_{BM,y}}$
Data unit:	tCO2/MWh
Description:	Build Margin (BM) of Central China Electricity Grid
Source of data used:	*China Electricity Yearbooks 2003-2006*
Value applied:	0.6954
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:	$\mathbf{EF_{HEAT}}$
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	Based on $\mathbf{EF_{CO2,I}}$ of 25.8 tC/TJ from IPCC.

measurement methods 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

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

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

Table 12: Energy requirements for methane capture and utilization[26]

Mine	Vocsidizers (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)
Mine 4[27]							
Mine 8	1,200	135.0	30.0	1.5	33.0	33.0	2.4
Mine 10		90.0	20.0	1.0	22.0	22.0	1.6
Mine 11		45.0	10.0	0.5	11.0	11.0	0.8
Mine 12		67.5	15.0	0.8	16.5	16.5	1.2
Total	**1,200**	**337.5**	**75.0**	**3.8**	**82.5**	**82.5**	**6.0**

Operating hours of gas engine ancillary equipment: 7,200 hours/year
Operating hours of Vocsidizer ventilators: 8,000 hours/year
EF_{ELEC}: 0.9747 tCO2e/MWh

Vocsidizer electricity consumption
= (1,200 kW x 8,000 hrs)/1000 = 9,600 MWh/year

Gas engine ancillary equipment electricity consumption:
= [(337.5 + 75 + 3.8 +82.5 + 82.5 + 6) x 7,200 hrs]/1000 = 4,228 MWh/year

$CONS_{ELEC,PJ}$ = 9,600 + 4,228 = 13,828 MWh/year

[26] 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.

[27] Mine 4 is likely to share this ancillary equipment with another site.

PE_{ME}: 13,828 x 0.9747 = **13,478 tCO2e/year** (difference in value due to rounding)

PE_{MD}: Project emissions from methane destroyed

Operating hours of gas engines:	7,200 hours/year
Methane destruction per gas engine:	115.44 m3 CH4/engine/hour
Number of gas engines installed:	38
Operating hours of Vocsidizer:	8,000 hours/year
Methane destruction per Vocsidizer unit:	375 m3 CH4/Vocsidizer/hour
Number of Vocsidizer units installed:	4
Density of methane:	0.67 kg/m3
Eff_{ELEC}:	0.995
Eff_{HEAT}:	0.97
CEF_{CH4}:	2.75

MM_{ELEC} = 38 x 7,200 x 115.44 x 0.67/1000 = 21,162 tCH4/year

MM_{HEAT} = 4 x 8,000 x 375 x 0.67/1000 = 8,040 tCH4/year

MD_{ELEC} = 21,162 x 0.995 = 21,056 tCH4/year

MD_{HEAT} = 8,040 x 0.97 = 7,799 tCH4/year

PE_{MD}= (21,056 + 7,799) x 2.75 = **79,350 tCO2e/year** (difference in value due to rounding)

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

PE_{UM} = (21,056 x [1-0.995] + 8,040 x [1-0.97]) x 21 = **7,287 tCO2e/year**

Total Project Emissions = 13,478 + 79,350 + 7,287 = 100,115 tCO2e/year

2. Baseline Emissions

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \quad \textbf{(18)}$$

$BE_{MD,y}$: 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:	21,162 tCH4/year
Methane emissions avoided by Vocsidizer:	8,040 tCH4/year
$CMM_{PJi,y}$ (total methane emissions avoided by project activity):	29,202 tCH4/year
GWP_{CH4}:	21 tCO2e/tCH4

$BE_{MR,y}$ = 29,202 x 21 = **613,233 tCO2e/year** (differences in value due to rounding)

$BE_{Use,y}$: Baseline emissions from the production of power and heat[28]

Gas engine estimated performance:	0.4 MW
Gas engine waste heat generation:	0.65 GJ/hour
Operating hours of gas engines:	7,200 hours/year
Vocsidizer heat generation:	3.24 GJ/hour
Operating hours of Vocsidizers:	8,000 hours/year
EF_{ELEC}:	0.9747 tCO2e/MWh
EF_{HEAT}:	0.095 tCO2e/GJ

GEN_y (Electricity generated by project):
= 38 x 0.4 x 7,200 = 109,440 MWh/year

$HEAT_{ENG}$ (Heat generated by gas engines):
= 38 x 0.65 x 7,200 = 179,088 GJ/year (difference in value due to rounding)

$HEAT_{VOCS}$ (Heat generated by Vocsidizers):
= 4 x 3.24 x 8,000 = 103,680 GJ/year

$BE_{Use,y}$ = (109,440 x 0.9747) + (179,088 + 103,680) x 0.095 = **133,418 tCO2e/year** (differences in value due to rounding)

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Total baseline emissions = 0 + 613,233 + 133,418 = 746,651 tCO2e/year

3. Leakage

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

4. Emission reductions

$$ER_y = BE_y - PE_y - LE_y \qquad \textbf{(19)}$$

ERy = 746,651 – 100,115 – 0 = 646,536 tCO2e/year

Table 13: Summary of Project Emission Reductions

[28] Actual heat output from gas engines and Vocsidizers is likely to be higher, but a heat utilization rate of 50% has been conservatively assumed for both technologies in case facilities in the vicinity of the equipment sites do not require the total heat output.

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

Table 14: Total Emission Reductions

Year	Estimation of project activity emissions (tCO2e)	Estimation of baseline emissions (tCO2e)	Estimation of leakage (tCO2e)	**Estimation of overall emission reductions (tCO2e)**
2008	39,260	303,871	0	**264,611**
2009	82,181	657,327	0	**575,146**
2010	91,148	701,989	0	**610,841**
2011	100,115	746,651	0	**646,536**
2012	100,115	746,651	0	**646,536**
2013	100,115	746,651	0	**646,536**
2014	100,115	746,651	0	**646,536**

	Equipment installation		**Project Emissions (tCO2e)**			**Baseline Emissions (tCO2e)**				**Leakage (tCO2e)**	**Emission Reductions (tCO2e)**
								$BE_{Use,y}$			
Year	Gas engines	Vocsidizers	$PE_{ME,y}$	$PE_{MD,y}$	$PE_{UM,y}$	$BE_{MD,y}$	$BE_{MR,y}$	Electricity	Heat	$LE_{,y}$	$ER_{,y}$
2007	20		-	-	-	-	-	-	-	-	-
2008	18	1	6,460	31,247	1,553	0	240,165	54,270	9,437	0	264,611
2009		1	8,800	68,627	4,755	0	528,813	106,668	21,846	0	575,146
2010		1	11,139	73,988	6,021	0	571,023	106,668	24,298	0	610,841
2011		1	13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2012			13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2013			13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2014			13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2015			13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2016			13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2017			13,478	79,350	7,287	0	613,233	106,668	26,750	0	646,536
2018			3,369	19,838	7,287	0	613,233	106,668	26,750	1	161,634

2015	100,115	746,651	0	**646,536**
2016	100,115	746,651	0	**646,536**
2017	100,115	746,651	0	**646,536**
2018	25,029	186,663	0	**161,634**
Total (tCO2e)	913,395	6,889,743	0	**6,137,982**

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 12).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	13,828 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	21,162 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:	**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	8,040 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:	**r**
Data unit:	%
Description:	Relative proportion of NMHC compared to methane (PC_{NMHC} / PC_{CH4})
Source of data to be used:	Periodical gas analyses provided by PCG
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Less than 1% and therefore not applicable (gas analysis provided to validator).
Description of measurement methods and procedures to be applied:	A gas sample of extracted CMM will be taken once a year and sent to a professional laboratory for testing using gas chromatography techniques. A copy of the latest test results will be included in each monitoring report.
QA/QC procedures to be applied:	Analyses will be taken at all mines included in the project and the results signed off by the CDM project manager to ensure regular testing.
Any comment:	

Data / Parameter:	**GEN_y**
Data unit:	MWh
Description:	Electricity generated by project
Source of data to be	Manufacturer estimate

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	109,440 MWh/year
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	179,088 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 50% 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	103,680 GJ/year

calculating expected emission reductions in section B.5	
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 50% 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.

Mine	Gas engines with power and heat generation	Vocsidizers with heat generation
Mine 4	X	
Mine 8	X	X
Mine 10	X	
Mine 11	X	
Mine 12	X	

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Consequently, the following monitoring equipment will be installed:

- Monitoring equipment for CMM utilization adapted to engines for power and heat generation: installed in all the 5 mines.
- Monitoring equipment for VAM utilization adapted to Vocsidizers for heat generation: installed only in Mine 8.

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For each of the above-described project sites, a separate agreement will be signed between monitoring equipment supplier ABB Systems Shanghai and PCG. PCG 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.

PCG 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 in all mines

The following instruments will be installed in all sites.

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 in mine 8

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

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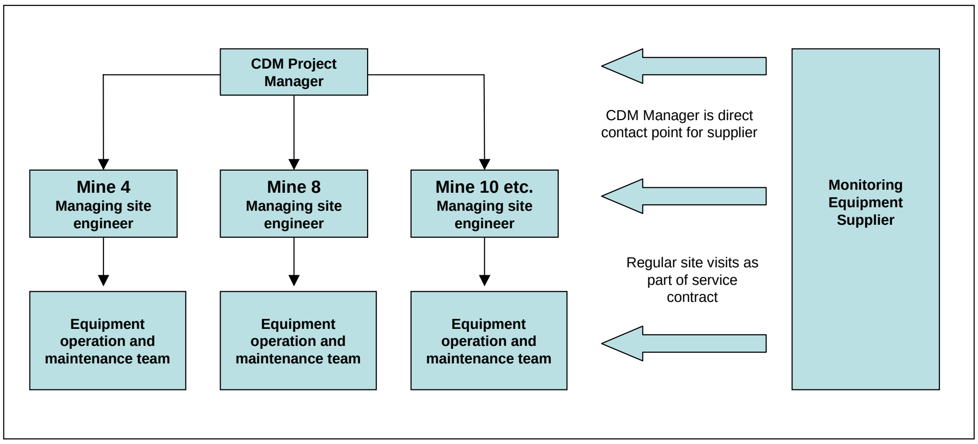

Organization

PCG 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 PCG'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

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Figure 4: Organizational structure of monitoring team¶

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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

PCG 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 engineers 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 PCG 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

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Figure 5: Monitoring diagram for gas engines and Vocsidizers¶
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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 PCG'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: 25/10/2007

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:

The first equipment was installed on 01/09/2005.

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 analysis was carried out as is required by Chinese law. The report was approved by provincial authorities [29] and its main findings 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. The main environmental impacts are considered to be dust, noise and wastewater. Dust may be produced from digging, exposed soil and vehicle transport and a dry climate will increase dust production. Noise will stem from machinery used for workshop construction and equipment installation, such as cranes, bulldozers, welding and cement mixing. Expected noise pollution is about 80-95dB. Some wastewater is expected to be produced during project construction.

Water

The main source of water consumption is cooling water required by gas engines, for which wastewater from PCG's mines will be reused. Dispensed cooling water will be used for irrigation purposes in order to reduce dust pollution on the project site. No new pollutants are added to the wastewater by the project. A small amount of wastewater will be produced by mine employees, and will be processed onsite. Some engine oil will be needed for the running of the gas engines, but this waste output will be processed and collected.

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.

[29] Copies of the environmental impact assessment and relevant approval documents provided to validator.

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 67-95 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 61-67 dB on the project site.

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

The environmental impact assessment cited above concludes that there are no significant environmental impacts of the project. Both air pollution and wastewater release fall within Chinese-approved norms. The main environmental impact of the project is noise. The report recommends noise protection measures which PCG will follow. However, there are no sensitivity points within a reasonable radius of the project, so even the impact of noise if not considered to be significant.

SECTION E. Stakeholders' comments

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

PCG convened a public meeting of relevant stakeholders at its offices on September 28, 2006. This meeting included among others the following participants: PCG engineers, PCG CDM project manager, representatives of the PCG mines concerned by the project, representative of local villages, representative of local government, representative of the local district commissariat, representative of local police, representative of local fire and emergency services. The local stakeholders were invited by contacting the above-mentioned offices (such as local commissariat, local police, local village government etc.) by telephone in advance of the meeting.

The meeting began with a general presentation of the project by the CDM project manager. He discussed the current level of CMM emissions by PCG into the atmosphere, its coal production and total gas stock. He highlighted the fact that as PCG produces coal from deeper seams, the volume of CMM that needs to be drained for safety purposes also increases. The different methods of utilizing CMM were then discussed. Following this presentation, the meeting participants were asked to provide comments and questions concerning the project.

E.2. Summary of the comments received:

All comments made during the meeting were in support of the project. Participants stated that they appreciated the public input phase because it showed that local opinion was important. Most emphasized the importance of the project's combined impact on reducing pollution and developing the local economy through more efficient use of resources. No adverse impacts on the local population were noted. One participant stated that the investment for the project seemed to be rather high, but given its important goals, he supported it. At the end of the meeting, the participants unanimously expressed their support for the project.

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

As mentioned above, no negative comments were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Climate Change Capital Carbon Fund II S.à r.l.
Street/P.O.Box:	c/o The Investment Manager Climate Change Capital 3 More London Riverside
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E-Mail:	aaldridge@c-c-capital.com
URL:	www.climatechangecapital.com
Represented by:	
Title:	
Salutation:	Mr.
Last Name:	Aldridge
Middle Name:	
First Name:	Andrew
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Mobile:	
Direct FAX:	As above
Direct tel:	As above
Personal E-Mail:	As above

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Represented by:	
Title:	
Salutation:	Mr.

Last Name:	Aldridge
Middle Name:	
First Name:	Andrew
Department:	
Mobile:	
Direct FAX:	As above
Direct tel:	As above
Personal E-Mail:	As above

Organization:	**Pingdingshan Coal (Group) Co., Ltd**.
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City:	Pingdingshan
State/Region:	Henan Province
Postfix/ZIP:	467000
Country:	China
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Direct tel:	+86 375 27 23 487 (0)
Personal E-Mail:	lihong6689@126.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was provided for this project activity.

Annex 3

BASELINE INFORMATION

Table 15: PCG baseline thermal demand

	2004 (GJ)	2005 (GJ)	2006 (GJ)
Mine 4	418,000	418,000	418,000
Mine 8	627,000	627,000	627,000
Mine 10	418,000	418,000	418,000
Mine 11	313,500	313,500	313,500
Mine 12	313,500	313,500	209,000
Total	2,090,000	2,090,000	1,985,500

Note: This thermal demand is currently met by coal-fired boilers that are heated with PCG produced coal. The average thermal demand over the last three years was 2,055,167 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 16: Financial analysis of project

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Revenue (Rmb)										
Electricity production	4,136,400	12,409,200	22,750,200	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800
Heat production gas engines	377,028	1,131,084	2,073,655	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767
Heat production Vocsdizer		518,400	1,036,800	1,555,200	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600
Costs (Rmb)										
Capital Expenditure										
Gas engines and ancillary equipment	(54,230,850)	(54,230,850)								
Vocsidizers		(15,078,000)	(15,078,000)	(15,078,000)	(15,078,000)					
Project preparation costs										
Civil engineering	(12,732,150)	(12,732,150)								
Gas engine installation	(19,298,900)	(19,298,900)								
Other costs	(10,994,400)	(10,994,400)								
Operating Expenditure										
Gas engines and ancillary equipment										
Water	(915,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)
Materials	(115,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)
Maintenance and repair	(2,335,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)
Wages and social benefits	(1,720,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)
Other costs	(1,305,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)
Vocsidizers	0	(1,055,460)	(2,110,920)	(3,166,380)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)
Net free cash flow without CERs (Rmb)	(99,132,872)	(112,111,076)	(4,108,265)	13,408,387	12,871,327	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Revenue (Rmb)										
Electricity production	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800	39,295,800
Heat production gas engines	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767	3,581,767
Heat production Vocsdizer	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600	2,073,600
Costs (Rmb)										
Capital Expenditure										
Gas engines and ancillary equipment										
Vocsidizers										
Project preparation costs										
Civil engineering										
Gas engine installation										
Other costs										
Operating Expenditure										
Gas engines and ancillary equipment										
Water	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)	(1,830,000)
Materials	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)	(230,000)
Maintenance and repair	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)	(4,670,000)
Wages and social benefits	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)	(3,440,000)
Other costs	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)	(2,610,000)
Vocsidizers	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)	(4,221,840)
Net free cash flow without CERs (Rmb)	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327	27,949,327

Rate of return

IRR without CERs	**7.40%**

Key Inputs

Electricity purchasing price (after tax)	Rmb/kWh	0.383
Sales price of heat (after tax)	Rmb/GJ	20
Total engine and ancillary equipment cost	Rmb	108,461,700
Cost per Vocsidizer unit	Rmb	15,078,000
Vocsidizer operation costs	%	7.0%
Exchange rate	Rmb/EUR	10.77
Gas engine operation time	hours/year	7200
Gas engine performance	kW	375
Gas engine heat generation	GJ/hr	0.65
Vocsidizer operation time	hrs/yr	8,000
Vocsidizer gas utilization	m3 CH4/hr	375
Vocsidizer heat generation	GJ/hr	3.2

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

Table 17: 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)
Jiangxi	271.65	27,165,000	6.43	25,418,291
Henan	955.18	95,518,000	7.68	88,182,218
Hubei	395.32	39,532,000	3.81	38,025,831
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
Total				225,987,719

Source: China Electricity Yearbook 2004

Table 18: 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 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)
Raw coal	Mtons	1427.41	5504.94	2072.44	1646.47	769.47	2430.93	**13851.66**	25.8	100	20908	273,971,540
Cleaned Coal	Mtons							**0**	25.8	100	26344	0
Other Washed	Mtons	2.03	39.63			106.12		**147.78**	25.8	100	8363	1,169,146

Coal												
Coke	Mtons				1.22			**1.22**	25.8	100	28435	32,817
Coke Oven Gas	$10^9 m^3$			0.93				**0.93**	12.1	100	16726	69,013
Other Coke Gas	$10^9 m^3$							**0**	12.1	100	5227	0
Crude Oil	Mtons		0.5	0.24			1.2	**1.94**	20	100	41816	59,490
Gasoline	Mtons							**0**	18.9	100	43070	0
Diesel Oil	Mtons	0.52	2.54	0.69	1.21	0.77		**5.73**	20.2	100	42652	181,016
Fuel oil	Mtons	0.42	0.25	2.17	0.54	0.28	1.2	**4.86**	21.1	100	41816	157,229
LPG	Mtons							**0**	17.2	100	50179	0
Refinery Gas	Mtons	1.76	6.53		0.66			**8.95**	18.2	100	46055	275,070
Natural gas	$10^9 m^3$					0.04	2.2	**2.24**	15.3	100	38931	489,223
Other petroleum products	Mtons							**0**	20	100	38369	0
Other coking products	Mtons							**0**	25.8	100	28435	0
Other energy	Mtons standard coal		11.04			16.2		**27.24**	0	100	0	0
											Total	276,404,544
Total emissions of Central China Power Grid (tCO2e)												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 19: 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)
Jiangxi	301.27	30,127,000	7.04	28,006,059
Henan	1093.52	109,352,000	8.19	100,396,071
Hubei	430.34	43,034,000	6.58	40,202,363
Hunan	371.86	37,186,000	7.47	34,408,206
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 20: Calculation of simple OM emission factor of the Central China Power Grid in 2004

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）	（%）	（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)
Raw coal	Mtons	1863.8	6948.5	2510.5	2197.9	875.5	2747.9	**17144.1**	25.8	100	20,908	339,092,605
Cleaned Coal	Mtons		2.34					**2.34**	25.8	100	26,344	58,316
Other Washed Coal	Mtons	48.93	104.22			89.72		**242.87**	25.8	100	8,363	1,921,441
Coke	Mtons		109.61					**109.61**	25.8	100	28,435	2,948,455
Coke Oven Gas	10^9m^3			1.68		0.34		**2.02**	12.1	100	16,726	149,900

Other Coke Gas	10^9m^3					2.61		**2.61**	12.1	100	5,227	60,527
Crude Oil	Mtons		0.86	0.22				**1.08**	20	100	41,816	33,118
Gasoline	Mtons		0.06			0.01		**0.07**	18.9	100	43,070	2,089
Diesel Oil	Mtons	0.02	3.86	1.7	1.72	1.14		**8.44**	20.2	100	42,652	266,627
Fuel oil	Mtons	1.09	0.19	9.55	1.38	0.48	1.68	**14.37**	21.1	100	41,816	464,893
LPG	Mtons							**0**	17.2	100	50,179	0
Refinery Gas	Mtons	3.52	2.27					**5.79**	18.2	100	46,055	177,950
Natural gas	$10^9 m^3$						2.27	**2.27**	15.3	100	38,931	495,775
Other petroleum products	Mtons							**0**	20	100	38,369	0
Other coking products	Mtons							**0**	25.8	100	28,435	0
Other energy	Mtons standard coal		16.92		15.2	20.95		**53.07**	0	100	0	0
											Total	345,671,697
Total emissions of Central China Power Grid (tCO2e)												345,671,697
Total thermal power supply of the Central China Power grid (MWh)												249,074,186
OM of the Central China Power grid (tCO2e/MWh)												**1.3878**

Source: China Electricity Yearbook 2005

Table 21: 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)
Jiangxi	300	30,000,000	6.48	28,056,000
Henan	1315.9	131,590,000	7.32	121,957,612
Hubei	477	47,700,000	2.51	46,502,730
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 22: 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）	（%）	（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)
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
Cleaned Coal	Mtons	0.02						**0.02**	25.8	100	26,344	498
Other Washed Coal	Mtons		138.12			89.99		**228.11**	25.8	100	8,363	1,804,669
Coke	Mtons		25.95		105			**130.95**	25.8	100	28,435	3,522,491

Coke Oven Gas	10^9m^3			1.15		0.36		**1.51**	12.1	100	16,726	112,054
Other Coke Gas	10^9m^3		10.2			3.12		**13.32**	12.1	100	5,227	308,897
Crude Oil	Mtons		0.82	0.36				**1.18**	20	100	41,816	36,185
Gasoline	Mtons		0.02			0.02		**0.04**	18.9	100	43,070	1,194
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
LPG	Mtons							**0**	17.2	100	50,179	0
Refinery Gas	Mtons	0.71	3.41	1.76	0.78			**6.66**	18.2	100	46,055	204,689
Natural gas	10^9m^3						3	**3**	15.3	100	38,931	655,209
Other petroleum products	Mtons							**0**	20	100	38,369	0
Other coking products	Mtons				1.5			**1.5**	25.8	100	28,435	40,349
Other energy	Mtons standard coal		2.88		1.74	32.8		**37.42**	0	100	0	0
											Total	359,887,488
Total emissions of Central China Power Grid (tCO2e)												359,887,488
Total thermal power supply of 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 23: 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
EFOil,Adv	47.67%	21.1	1	0.5843

Table 24: 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
Hydro	MW	3,019	2,540	8,089	7,905	1,893	14,960	38,405
Nuclear	MW	0	0	0	0	0	0	0
Other	MW	0	0	0	0	24	0	24
Total	MW	8,925	28,808	17,615	15,117	5,676	22,456	98,596

Source: China Electricity Yearbook 2006

Table 25: 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
Hydro	MW	2,307	2,438	7,337	6,603	1,330	12,342	32,357
Nuclear	MW	0	0	0	0	0	0	0

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

Table 26: 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
Hydro	MW	2,197	2,438	7,214	6,135	1,196	11,855	31,035
Nuclear	MW	0	0	0	0	0	0	0
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 27: 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	CO2 emissions (tCO2)
Fuel Type	Unit	A	B	C	D	E	F	G=A+…+F	H	I	J	K=G*H*I*J*44/12/100
Raw coal	Mtons	1869.29	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
Coke	Mtons	0	25.95	0	106.5	0	0	132.45	28435	25.8	1.00	3,562,840
Sub-total												**357,982,504**
Crude oil	Mtons	0	0.82	0.36	0	0	0	1.18	41816	20	1.00	36,185

Gasoline	Mtons	0	0.02	0	0	0.02	0	0.04	43070	18.9	1.00	1,194
Kerosene	Mtons	0	0	0	0	0	0	0	43070	19.6	1.00	0
Diesel oil	Mtons	1.3	3.03	2.39	1.39	1.38	0	9.49	42652	20.2	1.00	299,798
Fuel oil	Mtons	0.64	0.29	3.15	1.68	0.89	2.22	8.87	41816	21.1	1.00	286,959
Other petroleum products	Mtons	0	0	0	0	0	0	0	38369	20	1.00	0
Sub-total												**624,136**
Natural gas	10^7m3	0	0	0	0	0	30	30	38931	15.3	1.00	655,209
Coke oven gas	10^7m3	0	0	11.5	0	3.6	0	15.1	16726	12.1	1.00	112,054
Other coke gas	10^7m3	0	102	0	0	31.2	0	133.2	5227	12.1	1.00	308,897
LPG	Mtons	0	0	0	0	0	0	0	50179	17.2	1.00	0
Refinery gas	Mtons	0.71	3.41	1.76	0.78	0	0	6.66	46055	18.2	1.00	204,689
Sub-total												**1,280,848**
Total												**359,887,488**

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

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

Table 28: 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	

Coal (MW)	43,303	46,894	60,167	16,864	69.52%
Hydro (MW)	31,035	32,357	38,405	7,371	30.38%
Nuclear (MW)	0	0	0	0	0.00%
Wind (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%		

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

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

<u>3. Calculation of combined margin emission factor of China Central Electricity Grid</u>

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.