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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Project title: Tianjin Shuangkou Landfill Gas Recovery and Gas Utilization Project
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A.2. Description of the project activity:

The project site is Shuangkou landfill, located in Tianjin Municipality of China. It was the first modern sanitary landfill in Tianjin, designed and constructed in accordance with national standards, including impermeable liners and leachate collection and treatment systems.

The Shuangkou landfill occupies an area of 60 hectares and is approximately 35 kilometres away from Tianjin downtown. It was designed with total waste disposal capability of 8.5 million cubic meters, or 7.39 million metric tons. The facility was constructed in 1999 and became opertional in April 2001 to receive an average of 800~1000 tons household waste per day. By the end of year 2006 more than 1.6 million tons of household waste has been landfilled. The waste mainly comes from four districts (Hongqiao, Hebei, Xiqing and Beichen) directly and two districts (Heping and Nankai) via Panlou transfer station.

Developed by the Tianjin Clean Energy and Environmental Engineering Co., Ltd. (hereafter referred to as TCEE), the main objectives of this project are to:

- Collect landfill gas (LFG), which primarily consists of methane (50%) and other gases (50%), such as carbon dioxide and additional gases including Non-methane organic compounds.
- Generate electricity by installing LFG collection system, electricity generation system and flaring system on site.

The generators will combust the methane in the LFG to produce electricity for sale to the North China Power Grid (“NCPG”). Excess LFG, as well as all gas collected during periods when electricity is not generated, will be flared. The state-of-the-art technology such as gas collection system, generating and flaring systems will be adopted by the project participant.

As a result, this project will reduce greenhouse gas emissions generated from the landfill, including power generation offsets, by a total of approximately 1,558,228 tonnes of carbon dioxide equivalents (tCO_2e) during the 10-year crediting period, from 2008 to 2017. The project will also produce a total of 218,509 MWh electricity during this period of time, 95% of which will be sent to the grid while the remaining 5% will be used on-site ex ante.

Implementation of this project will not only bring local and national environmental benefits, but also showcase a CDM project for LFG recovery and electricity generation in Tianjin Municipality. The project will successfully promote the sustainable development in the following aspects:

・**Greenhouse gas emission reduction**

Without the project, methane, which has the Global Warming Potential of 21 times than that of carbon dioxide (CO_2) based on the IPCC default value, and is the main content of LFG produced from the landfill, will continue to emit through several installed gas venting wells and the landfill surface to the atmosphere without any treatment or recovery. With the project activities, the methane in LFG will be recovered and utilized so that direct emission will be reduced, resulting in a positive impact on global climate.

• **Landfill safety**

If the methane concentration in the air rises up to 5~15% by volume within the confined space in a building, there is the risk of explosion is very high. In China, sometimes landfill explosion happen due to unsuccessful venting of landfill gas. At present, several venting pipes and wells have been installed in order to avoid the accumulation of LFG in the waste layer and to minimize the risk of explosion at Shuangkou landfill site.

• **Energy potential**

Methane is an ideal clean fuel. As each cubic meter of methane generates about 36000kJ of heat, LFG recovery and utilization will contribute greatly to the energy supply for Tianjin.

• **Creation of employment**

The project will be designed, constructed and operated using local resources, supported by international experts. Consequently, employment opportunities will be created during both the project construction and operation period.

• **Demonstration**

Up to now, many developing countries, like Brazil, South Africa and Costa Rica, have accumulated experience on recovery and utilization of landfill gas as CDM projects. China is also making great efforts to promote LFG utilization projects. One of them, Nanjing Tianjingwa landfill site, succeeded in registering as a CDM project in December 2005. With overseas and domestic experiences, Shuangkou Landfill Gas Recovery and Gas Utilization Project is expected to proceed successfully, aiming at improving landfill gas utilization, saving energy and protecting the environment. It will be the first CDM project carried out in Tianjin and it plays a demonstrative role for future CDM projects development in Tianjin. An additional four main landfills are operating in Tianjin.

A.3. Project participants:

Name of Party involved(*) ((Host) indicates a host Party)	Private and/or public entity(ies) project participants(*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (Host)	Tianjin Clean Energy and Environmental Engineering Co., Ltd.	No
Spain	International Bank for Reconstruction and Development ("World Bank") as Trustee of the Spanish Carbon Fund	No

The participants involved in this project are:

• **Tianjin Clean Energy and Environmental Engineering Co., Ltd. (TCEE)**
Shuangkou landfill is under the control of the Tianjin Solid Waste Treatment Centre, which is a division under the Tianjin Environmental Sanitation Commission. TCEE is a newly formed company under the Tianjin Construction Commission, and authorized jointly by Construction Commission and Environmental Sanitation Commission to implement Shuangkou landfill gas recovery and utilization project as the project developer and operator, and as the project emission reductions seller.

• **The Spanish Carbon Fund**
The Spanish Carbon Fund (SCF) is the carbon buyer of this project. International Bank for Reconstruction and Development ("World Bank"), as Trustee of the Spanish Carbon Fund, will sign an Emission Reduction Procurement Agreement with the project developer, TCEE.

The Spanish Carbon Fund (SCF) was created in 2005. With a capital base of US$202.7 million, the SCF will purchase greenhouse gas emission reductions from projects developed under the Kyoto Protocol to mitigate climate change. The SCF will promote renewable energy and energy efficiency projects in developing countries and countries with economies in transition.

Consulting company for the proposed project is:

• **Shanghai JEC Consultant Co., Ltd.**
Shanghai JEC is a Chinese & Japanese Joint Venture which specializes in developing municipal solid waste management projects and CDM projects. Shanghai JEC is mainly involved in the preparation of the PDD for this project, and is not a project participant.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

People's Republic of China

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

Municipality of Tianjin

A.4.1.3. City/Town/Community etc:

Shuangkou town, Bei Chen District, Tianjin Municipality

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

The project is located at Shuangkou landfill site in China's metropolis of Tianjin. Situated between 38.57-40.25 north latitude and 116.71-118.67 east longitude, Tianjin is by the Bohai Gulf and in the eastern part of North China Plain. Flat Land covers 94.2% of land area, and between 2.2 to 50 meters above sea level.

Tianjin has a coastline of 113.4 kilometres long. Covering a jurisdiction area of 11,305 square kilometres, 186 kilometres from north to south and 101 kilometres from east to west, and with a population of more than 10.2 million (data of year 2004), it enjoys the semi-humid continental monsoon climate of warm temperate zone.

Shuangkou landfill is located in the Shuangkou town, west of Beichen District. There are several villages in the vicinity of the landfill, among which Shuangkou village is the closest, located 1.2 km to the east, and Anguang village is 2km to the south. See below for the project location.

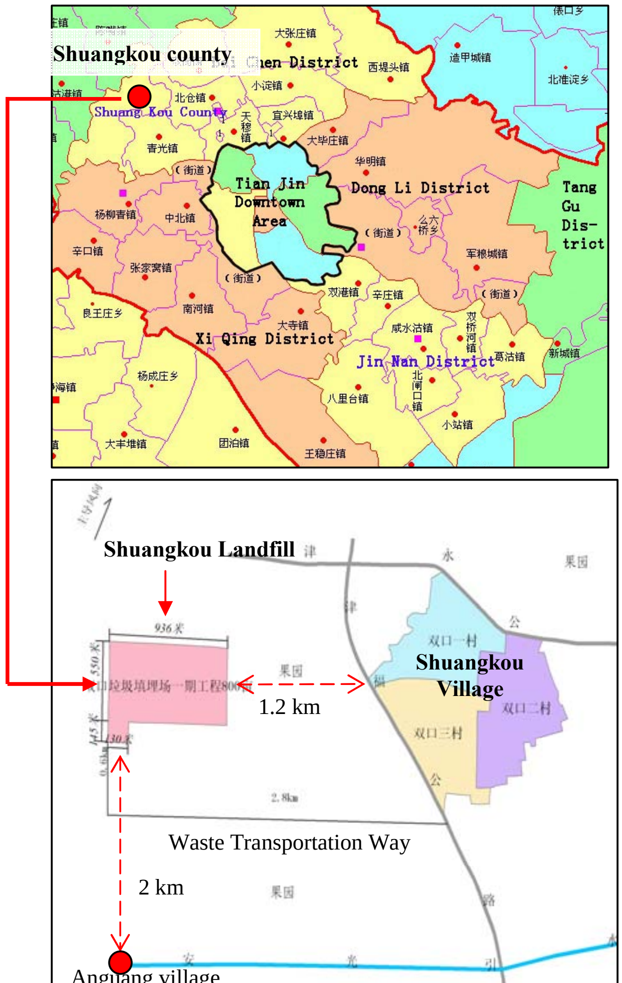


Fig.1 Map of Project Location – Shuangkou Landfill Site

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

Sectoral scope 1: energy industries (renewable-/non-renewable sources)
Sectoral scope 13: waste handling and disposal

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

Background:

Tianjin Shuangkou sanitary landfill started construction in the year 1999 and commenced operation in April 2001. The site was designed to receive 2,700 tons of municipal solid waste per day while currently average input is 800~1000 tons per day. It mainly accepts waste from four districts: Hongqiao, Heibei, Xiqing and Beichen, as well as a portion of waste from Heping district and Nankai district from Panlou transfer station. Up to now, more than 1.6 million tons of wastes have been landfilled at the site. It is estimated that it will have a daily waste input of 1300 tons from the year 2007 till the end of its service life.

The projected depth of waste, after reaching the final contour, will be approximately 34 metres with 32 metres above grade and 2 metres below grade. Total design capacity is 8.5 million cubic metres. At an approximate density of 0.87 ton per cubic metre, about 7.39 million metric tons of waste can be landfilled.

The project activities involve the reconstruction of the landfill and set-up of LFG recovery systems in its working cells, including such systems as LFG collection, pre-treatment, electricity generation and grid connection, flaring, monitoring and protection system, data recording and archiving.

In China, the technology to use the landfill gas to produce the electricity or heat is at its infancy. Those existing landfills with gas utilization system generally use foreign technology, especially the pre-treatment equipment, gas generator, flares, etc. The proposed project will apply the state-of-the-art technology from overseas to make sure that the emission reductions from the project are real, measurable and qualified. Moreover, the generators and auxiliary facilities are planned to be installed in different stages based on the available LFG flow so that the most recent modern and suitable technology will be employed accordingly during the project crediting period.

- **Landfill covering**

In order to collect more landfill gas, the waste layers will be covered with more soil.

- **Gas collection system**

At present, a total of 42 vertical gas venting wells are installed at the site in a rectangle form. The interval between two wells is 99 metres in long side and 88 metres in short side. These wells were constructed in 1000mm diameter with Φ200mm HDPE pipes inside. They will be raised as waste is filling up. The proposed project will install a gas collection network with additional wells where appropriate and connect each wellhead to lateral piping, which transports the gas to a main collection header.

- **Gas pretreatment system**

Prior to electricity generation and flaring, LFG must be pre-treated to remove its impurities and moisture, etc., to prevent corrosion in the generators and flaring system. The pre-treatment consists of: 1) separation of leachate condensation, 2) filtration, dewatering and removing of solid impurities and moisture and 3) drying and pressurization.

- **Electricity generation and grid connection system**

The electricity generated with LFG will be sold to the NCPG. The electricity generators will be installed in different stages of the project. Deutz, the generator with good reputation all over the world, is proposed to be used in the early stage of this project.

- **Flaring system**

The LFG not used for electricity generation will be flared. Once methane converts into carbon dioxide, the greenhouse effect caused by LFG will be reduced substantially. The main works include the installation of enclosed auto-ignition flare platforms.

- **Monitoring and protection system**

The monitoring and protection of the proposed project will be firmly based on the monitoring methodologies ACM0001 (ver.05) and AMS I.D. (ver.10). This project provides monitoring and protection facilities for landfill gas pre-treatment, power generation and public grid connection.

The technology used in the project, will be the state of the art technology. High standard technology and monitoring equipment will come from abroad and must meet international standards, including monitoring, maintenance and calibration. Landfill gas collection and utilization is a new aspect in the operation of Chinese landfills, but well known and well developed in developed countries. It is unlikely that the standard of the proposed technology will change during the crediting period. Due to the successively installation, the project developer is able to realize substantial changes.

The personnel involved in the operation and monitoring will receive a comprehensive training on equipment, maintenance and monitoring from the equipment supplier.

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

Years	Annual estimation of Emission reductions in tonnes of CO_2e
2008	62,801
2009	80,278
2010	96,725
2011	133,222
2012	156,733
2013	181,873
2014	195,950
2015	206,970
2016	217,143
2017	226,533
Total estimated reductions (tonnes of CO_2 e)	1,558,228
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**155,823**

A.4.5. Public funding of the project activity:

No public funding is available for the proposed 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:

- ACM0001 Consolidated baseline and monitoring methodology for landfill gas project activities (version 05, December 2006).

- AMS-I.D.Grid connected renewable electricity generation (version 10, December 2006).
- Tool for demonstration and assessment of additionality (version 03, February 2007).
- Methodological Tool to determine project emissions from flaring gases containing methane (December 2006).

Above methodologies are available at
http://cdm.unfccc.int/methodologies/Pamethodologies/approved.html

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

The project meets all the applicability criteria as set out in the methodologies.

ACM0001 is applicable to the following situations in regards to LFG treatment activities where:
a) The captured gas is flared; or
b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources; or
c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy from other sources.

As previously described, this project is based on two complementary activities, as follows:
• Collection and combustion of LFG, thus converting its methane content into CO_2, reducing its greenhouse gas effect; and
• Generation and supply of electricity to the regional grid, thus displacing a certain amount of fossil fuels used for electricity generation.

The project activity meets situation a) and c) above and is therefore applicable to ACM0001.

Furthermore, ACM0001 (version 05) requires the latest version of the *Tool for the demonstration and assessment of additionality* and the latest version of the *Tool to determine project emissions from flaring gases containing Methane* be used in the baseline analysis.

ACM0001 also mentioned that a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one, including ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable", shall be used. If the capacity of electricity generated is less than 15MW, and/or energy displaced is less than 54TJ(15GWh), small-scale methodologies can be used.

Because the maximum generation capacity of this project in the initial years of the project will be about 3.75MW and grow to more than 5 MW in the latter years of the project, both of which will be much smaller than 15MW, simplified methodologies for small-scale projects will be used to calculate reductions for displacing electricity generation from other sources. Under the baseline scenario, the North China Power Grid which covers Beijing, Tianjin, Hebei, Shanxi, Shandong, Western Mongolia autonomous region is selected to calculate the baseline emissions.

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

The following Fig.2 describes the project boundaries comprising all possible elements of the landfill gas collection, flaring and electricity generation systems, in conformity with latest methodologies ACM0001 and AMS I.D. Both approved methodologies state that the project boundary is the site of the project activity where the gas is captured and destroyed/used.

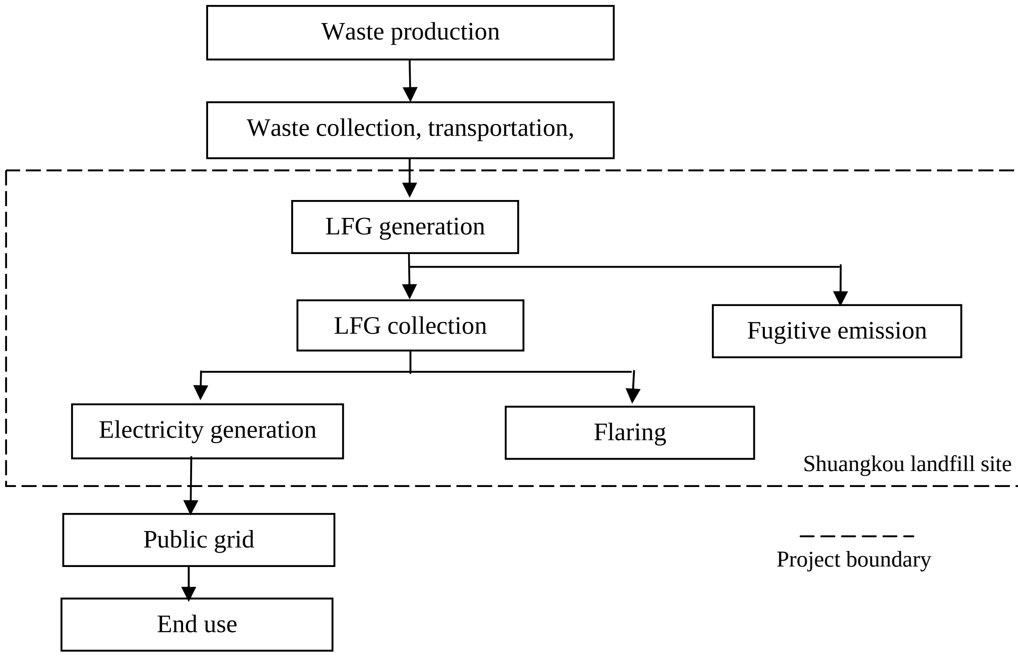


Fig.2 Boundary of Tianjin Shuangkou LFG recovery and utilization project

The project boundary is chosen with consideration of not only the geographical boundaries, but also the competence boundaries of the project. This is because the influence the project owner has changes the impacts of the project.

The project does not include waste production, collection and waste transportation to the landfill, because the project owner is not responsible for these areas. The same for the public grid, the public grid and usage by the end user is not in the project boundaries, but the transmission line from the landfill site to the public grid is included. From the transmission line no emissions are to be expected. Furthermore, construction and operation of the transmission line will not result in significant environmental impacts. At this time, it is has not been determined whether the existing transmission line connecting the Shuangkou landfill and the municipal grid will be able to accommodate the future export of electricity from the project. While the transmission corridor already exists, minor land acquisition may become necessary to enhance the capacity of the existing poles. The need for land acquisition will be determined at the time of negotiation of the Power Purchase Agreement with the Power Bureau in 2007. Any land acquisition will be carried out in compliance with the World Bank's safeguard policies on resettlement.

To determine the overall baseline including the electricity generation component and the emission factor of the regional power system, the direct project boundaries will be extended and will include the boundaries of the NCPG. The spatial extent is the indirect project boundary of the project.

	Source	Gas	Included?	Justification / Explanation

Baseline	From waste degradation	CO_2	No	As CO_2 is biogenic in nature and has been previously sequestered from the atmosphere
		CH_4	Yes	Main source of greenhouse gas emissions in baseline
		N_2O	No	Negligible in effect
	From North China Power Grid	CO_2	Yes	Major source of baseline scenario
		CH_4	No	Excluded for simplification. The mission resource is assumed to be very small.
		N_2O	No	Excluded for simplification. The mission resource is assumed to be very small.
Project Activity	On-site fuel consumption due to project activity	CO_2	Yes	May be an emission source and depends on the final generator design in all stages of the project
		CH_4	Yes	May be an emission source and depends on the final generator design in all stages of the project
		N_2O	Yes	May be an emission source and depends on the final generator design in all stages of the project
	From flaring of landfill gas	CO_2	No	As CO_2 is biogenic in nature and has been previously sequestered from the atmosphere
		CH_4	Yes	Methane emitted at times when flare is not lit is subtracted from ER
		N_2O	No	Negligible in effect
	From combustion of LFG in generators	CO_2	No	As CO_2 is biogenic in nature and has been previously sequestered from the atmosphere
		CH_4	Yes	Methane emitted at times when generators are not operating are subtracted from ER
		N_2O	No	Negligible in effect
	On-site electricity consumption due to the project activity	CO_2	Yes	Project-related emissions are subtracted from ER
		CH_4	No	Negligible in effect
		N_2O	No	Negligible in effect

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

For the proposed project, its alternatives are as follows:

Alternative 1: Collecting LFG to generate electricity while excess LFG being flared, but not as a CDM project;
Alternative 2: Collecting and flaring LFG only;
Alternative 3: LFG emitting directly, as business-as-usual

If Shuangkou LFG, after being collected, is sent to the generators for electricity production for the NCPG, the project participant can gain tariff revenues. But if not as a CDM project, the financial internal rate of return ("IRR") of the proposed project cannot reach the benchmark rate of power industry in China (please see B.5). Therefore, Alternative 1 is not the baseline scenario of the project.

Shuangkou landfill fully met the national and local standards and regulations during construction and has been in compliance since its operation. LFG from the landfill has directly been released to the atmosphere, although in recent years, the Chinese government has encouraged conversion of LFG to a clean fuel for utilization. Without CDM, under the scenario of flaring LFG could not be implemented in China because it needs large investment and no additional revenue can be provided. Meanwhile, with consideration of the CDM revenue, the Chinese government does not encourage flaring-only projects according to the relevant China's regulation.

In addition, Annex 3 of EB22 Report clarifies as follows:

> *7(a) Only national and/or sectoral policies or regulations under paragraph 6(a) that have been implemented before adoption of the Kyoto Protocol by the COP (decision 1/CP.3, 11 December 1997) shall be taken into account when developing a baseline scenario. If such national and/or sectoral policies were implemented since the adoption of the Kyoto Protocol, the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place.*

The *Standard for pollution control on the landfill site for domestic waste (GB16889-1997)*, which encourages the use of landfill gas, was in effect as the date of 1st January 1998. Therefore, it falls into the above 7 (a) category and should not be taken into consideration as a baseline scenario. As a result, Alternative 2 is not regarded as the baseline of the project.

Hence, the only realistic and reliable baseline of the proposed project is Alternative 3, LFG emitting directly. The baseline scenario in the Shuangkou case is passive venting of landfill to the atmosphere. The existing venting wells at the Shuangkou landfill are a safety requirement specified by Chinese laws for reducing the risk of explosions. The well design was approved by the local government taken into account of the requirements for the regulations at that time. None of these regulations require LFG collection other than for safety reasons.

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

The determination of project scenario additionality is conducted by using the *Tool for the demonstration and assessment of additionality* (version 03, February 2007) .

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

Sub-step 1a. Define alternatives to the project activity:

Alternative 1: Collecting LFG to generate electricity while excess LFG being flared, but not as a CDM project;
Alternative 2: Collecting and flaring LFG only;
Alternative 3: LFG emitting directly, as business-as-usual

Sub-step 1b. Consistency with mandatory laws and regulations:

The baseline scenario, or the proposed project scenario, must meet the regulatory requirements of the Chinese government. Shuangkou landfill was constructed in 1999 and it met all the requirements in the regulations. The applicable regulations were:

- *Technical code for municipal solid waste sanitary landfill (CJJ17-1988).*
- *Standard for pollution control on the landfill site for domestic waste (GB16889-1997).*

When Shuangkou landfill was constructed in the year of 1999, the applicable guideline was CJJ17-1988,. This guideline did not mandate either the flaring nor utilization of LFG. Therefore, the current operation of Shuangkou landfill is in compliance with the applicable Chinese guideline. Promulgated in 2004, *Technical code for municipal solid waste sanitary landfill (CJJ17-2004)*, which further addresses the collection and flaring of LFG, is not applicable to the Shuangkou landfill. In the absence of the CDM, the proposed project would not be implemented so that LFG would continue to be emitted to the atmosphere without flaring or utilization.

In China, legislation on landfill gas came forth many years ago and has been viewed as guidelines rather than mandatory regulations. As a result, these guidelines are not enforced even today. Another guideline, the *Standard for pollution control on the landfill site for domestic waste (GB16889-1997)* encourages the collection and use of landfill gas. Nonetheless, almost all landfills that started operation after 1997 do not collect or flare/use LFG. Even if it is interpreted as a requirement rather than a guideline, the law is not enforced. Common practice as described in Step 4 demonstrates that landfills in the region, regardless of whether they covered by the law or not, do not capture and flare or utilize their LFG. Furthermore, as stated in B.4, Annex 3 of EB22 Report clarified that the regulations implemented after the adoption of the Kyoto Protocol need not be taken account in developing a baseline scenario.

Shuangkou landfill fully met the national and local standards and regulations during construction and has been in compliance since its operation. LFG from the landfill has been directly released to the atmosphere, although in recent years, the Chinese government has encouraged the use of LFG to a clean fuel. Without CDM, the flaring LFG would not be implemented in China because the large investment needed for which no additional revenue would be provided. Meanwhile, the Chinese government does not encourage flaring-only projects.

As a result, Alternative 1 and 2 are not suitable alternatives to the proposed project and eliminated.

<u>Step 2: Investment analysis</u>

Sub-step 2a. Determine appropriate analysis method

The project will have proceeds from power sales as well as from emission reduction credits, so Option I stated in *Tool for the Demonstration and Assessment of Additionality* (version 03) is not applicable.

Further, Option II is based on the comparison of returns of the project investment with the investment required for an alternative to the project. In this case, the alternative to the CDM project activity is simply not to install flaring and generation equipment at the site, as business-as-usual scenario. Therefore it does not involve investment of comparable scale to the project.

As a result, Option III must be used, where the returns of the investment in the project activity is compared to benchmark returns that are available to any investors in the country. Here, the benchmark analysis is selected to be conducted as follows.

Sub-step 2b.- OptionⅢ. Apply benchmark analysis

With reference to the *Economical Assessment and Parameters for Construction Projects 3rd edition*, published by China Planning Press in 2006, the financial benchmark for the rate of return for Chinese power industries, including waste-to-energy projects is at 8% in China. Therefore, we choose 8% as the benchmark.

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

If without CERs revenue taken into consideration, the financial situation of the project is as below.

Table B.5.-1 Financial situation of the project, without CERs revenue

No	Variables	Unit	Value	Remark
1	Total investment	million CNY	38.72	
2	Project lifetime	Year	10	
3	Income from electricity sales	million CNY	103.8	Tariff (with VAT): 0.50 CNY/kWh
4	Value Added Tax rate	%	17	
5	City Construction & Maintenance Tax rate	%	7	
6	Educational Surcharge rate	%	3	
7	Levied VAT and other tax	million CNY	1.36	
8	O&M costs	million CNY	56.38	
9	Gross profit	million CNY	9.86	
10	Income tax rate	%	33	
11	Income tax	million CNY	5.79	
12	Net profit	million CNY	3.89	
13	NPV（before income tax）	million CNY	Negative	
14	IRR of total investment（before income tax）	%	3.2	

Assuming that the unit price of CER is US$10[1], the result of financial analysis for the proposed project is shown in the table below. The calculated IRR value of the project without CERs would be 3.2%, below the benchmark rate 8%. Thus without CERs revenue, it is evident that this project faces substantial financial hurdles and would not be implemented.

[1] As of January 2007, the price and conditions have not yet been finalized. Note that this is the assumed price for the sake of financial analysis.

Table B.5.-3 IRRs of the project

	IRR (%)
Without CERs	3.2
With CERs	17.9

Sub-step 2d. Sensitivity analysis

A sensitivity analysis was conducted by altering the parameters: electricity output, investment and operation & maintenance costs. These parameters were selected as being most likely to fluctuate over time. Financial analysis was performed by altering each of these parameters by 10%, and by assessing what the impact on the project IRR would be, as shown in the figure below.

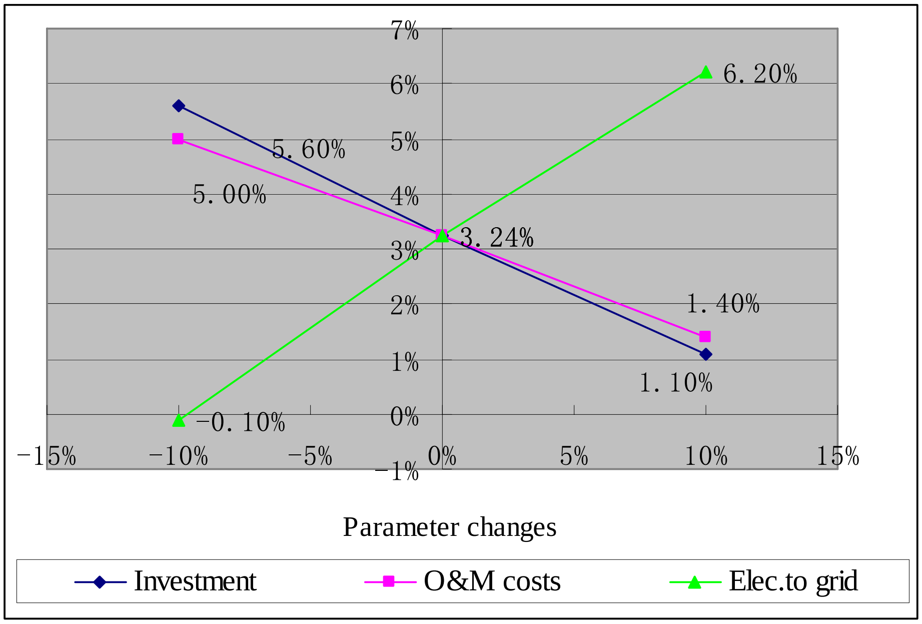


Fig. 3 Project Sensitivity Analysis

Fig.3 shows that if there is an increase in the electricity output or a decrease in the investment and O&M cost by 10%, respectively, the project IRR would still be below the benchmark rate 8%.

The above sensitivity analysis provides the valid argument that the financial attractiveness of the proposed project is robust to reasonable variations in the critical assumptions, and consistently supports that if without CER revenue the proposed project is not financially attractive.

Step 3. Barrier analysis

Technical barriers

In China, for a long time, LFG has always been emitted directly to the atmosphere. Except Hangzhou Tianzilin landfill which was installed with foreign technologies for LFG collection and electricity generation in 1997, most other landfills have neither LFG collection nor LFG utilization facilities for two reasons: China has not developed its technology in this area and the state-of-the-art LFG collection and utilization technologies from aboard are not affordable to many landfill operators. According to ERM's survey, currently less than 5% of recognisable landfill sites in China have LFG collection and flaring schemes and even less have gas utilization facilities[2]. Technical barrier is the key reason why most landfill operators, including Shuangkou landfill owner in China choose to emit their LFG directly.

Step 4. Common Practise Analysis

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

The traditional and common solid waste disposal method in China is to simply deposit the waste on a designated (unused) area of land. When undertaken in an uncontrolled way, as is the case in many cities, the result is an "open dump". Open dumps give rise to a number of potential health and environmental problems including the spread of disease by flies, rats and other vectors, pollution of surface waters and, as the waste is frequently set on the fire, air pollution.

Where municipal authorities (mainly in the cities) have developed sizable landfills, most of them vent methane directly to the atmosphere. At present it is estimated that less than 5% of sizable landfill sites in China have landfill gas collection and flaring schemes and even less have gas utilization facilities. Most landfills are considered inadequate based on "modern" landfill standards: no leachate collection system, inappropriate or no cover system, limited or no compaction, no gas control system, and no waste screening systems in place.

According to the *National Action Plan for Recovery and Utilization of Landfill Gas (December 2001),* it stated that:
"At present, in China the municipal refuse is disposed of using traditional landfill technology, without consideration of recovery and utilization of landfill gas. Almost all landfills do not have landfill gas recovery systems, except a few newly built landfills, and the landfill gas is emitted to the atmosphere openly……About 10 sanitary landfills have been set up in a few cities. However, there was no landfill gas recovery system in these sanitary landfills. In 1997, the first system of landfill gas recovery and utilization in China was built is Hangzhou Tianziling landfill, Zhejiang province, and the landfill gas is utilized for power generation. However, there is no mechanism and policy to guide the whole country to have landfill gas recovery and utilization systems. Therefore, it is still a blank paper for landfill management to establish landfill gas recovery and utilization systems. "

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

Currently Tianjin has 5 landfills in operation, including Shuangkou landfill. All of them have no gas recovery and utilization system, while just venting gas to the atmosphere through wells instead. These landfills are listed below:

Table B.5.-5 Main MSW landfills in Tianjin

Name of landfill	Operation start	Designed capacity (metric tons per day)	Current Status
Dahanzhuang landfill	2004	1000	No collection, flaring, recovery

[2] CDM Umbrella Guidelines for MSW in China, by ERM, June 2004

Hangu landfill	2002	700	No collection, flaring, recovery
Dagang landfill	2003	400	No collection, flaring, recovery
Jixian county landfill	2005	200	No collection, flaring, recovery

Consequently, the proposed project to be implemented in Tianjin Shuangkou landfill site is clearly additional in terms of common practices of landfill gas management in China.

Fully recognizing the serious problem of global warming, especially caused by methane from landfills, Tianjin Construction Commission authorized Tianjin Clean Energy and Environmental Engineering Co, Ltd. is the project developer seeking to recover and utilize the landfill gas from Shuangkou landfill, while taking CDM into consideration. On the contrary, without CDM, LFG from Shuangkou landfill will continue emitting as it usually does because there is neither legislative regulation requiring nor financial support allowing TCEE to collect and utilize the LFG from the landfill.

Further, as analyzed above (Step 2c), if the developer could be able to sell emission reduction credits derived from the project, the additional revenue generated by carbon sales would be adequate for the project to proceed.

Therefore, only the proposed project is approved and registered as a CDM activity, it can proceed with its implementation plan and the emission reductions will be generated as expected. Otherwise, the project cannot be implemented.

In sum, based on above analysis the proposed project, Tianjin Shuangkou Landfill Gas Recovery and Utilization Project is additional to the current baseline scenario.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The project activity extracts landfill gas and combusts it in a flare or in the gas engines for electricity generation. The baseline scenario is the total atmospheric release of LFG.
The emission reductions will be calculated as follows according to ACM0001 (ver.05):

Step 1: Calculating the emission reductions generated by the proposed project

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} - ET_y * CEF_{thermal,y} \quad (1)$$

Where,

ER_y = Emission reduction in tonnes of CO_2 equivalents (tCO_2e);
$MD_{project,y}$ = Amount of methane that would be destroyed/combusted during the year, in, tonnes of methane (tCH_4);
$MD_{reg,y}$ = Amount of methane that would have been destroyed/combusted during the year in the absence of the project, in, tones of methane (tCH_4);
GWP_{CH4} = Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4;
EL_y = Net quantity of electricity exported during year y, in megawatt hours (MWh);
$CEF_{electricity,y}$ = CO_2 emissions intensity of the electricity displaced, in tCO_2e/MWh;
ET_y = Incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil fuel use during project, for energy requirement on site under project activity during

the year y, in TJ. In this project, 5% of the power generated at the landfill site will be used by the landfill gas extraction system and generation system itself, so the value of ET_y is 0;

$CEF_{thermal,y}$ = CO_2 emissions intensity of the fuel used to generate thermal/mechanical energy, in tCO_2e/TJ, which for this project is irrelevant since ET_y is 0.

$$\mathbf{Ely = EL_{EX,LFG} - EL_{IMP}} \qquad \mathbf{(2)}$$

Where,

$EL_{EX,LFG}$ = net quantity of electricity exported during year, y, produced using landfill gas, in MWh

EL_{IMP} = net incremental electricity imported, defined as difference of project imports less any imports of electricity, less any imports of electricity in the baseline, to meet the project requirements, in MWh.

The project emission reductions are estimated ex ante for the credit period, by projecting the future GHG emissions of the landfill.

The methane that would be destroyed in baseline is calculated as follows.

$$\mathbf{MD_{reg,y} = MD_{project,y} * AF} \qquad \mathbf{(3)}$$

Where:

AF = Adjustment Factor

In the ACM0001, it provides the guidance on how to estimate AF, while the proposed project is none of the cases mentioned. Moreover, there is neither contractual requirement for this project nor local and national mandatory regulations which are applicable to Shuangkou landfill for the destruction of certain amount of methane from landfill, therefore, AF is zero and will be monitoring during the crediting period.

LFG captured will be flared and used to generate electricity. Thus, the following equation is used to calculate the project emission reductions.

$$\mathbf{MD_{project,y} = MD_{flared,y} + MD_{electricity,y}} \qquad \mathbf{(4)}$$

Where:

$$\mathbf{MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})} \qquad \mathbf{(5)}$$

$LFG_{flare,y}$ = quantity of LFG fed to the flare during the year, m^3
$w_{CH4,y}$ = average methane fraction of the LFG as measured during the year, m^3CH_4/m^3LFG
D_{CH4} = methane density, tCH_4/m^3CH_4
$PE_{flare,y}$ = the project emissions from flaring of the residual gas stream in year y, tCO_2e

The proposed project will install enclosed flaring system. According to *Methodological Tool to determine project emissions from flaring gases containing methane*, option (a) for enclosed flares is selected to determine the flare efficiency of the project.

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

$$\mathbf{MD_{electricity,y} = LFG_{electricity,y} * w_{CH4} * D_{CH4}} \qquad \mathbf{(6)}$$

$LFG_{electricity,y}$ = quantity of LFG fed into electricity generator, m^3

$$\mathbf{MD_{total,y} = LFG_{total,y} * w_{CH4} * D_{CH4}} \quad \textbf{(7)}$$

$LFG_{total,y}$ = total quantity of LFG generated, m^3

Step 2: Calculating the emission in the baseline scenario

ACM0001 requires that a project proponent provides an ex ante estimate of emissions reductions. So the generation of methane ($CH_{4,emission,y}$) is estimated with the following methane generation model, First Order Decay Model from the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*:

$$\mathbf{CH_{4,gen,t} = \Sigma_x [(A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet Lo(x)) \bullet e^{-k(t-x)}]} \quad \textbf{(8)}$$

$CH_{4,gen,t}$ = the quantity of methane generated from waste in year t, ton/yr
A = $(1-e^{-k})/k$; normalisation factor which corrects the summation
k = methane generation rate constant (1/yr)
$MSW_x(x)$ = total municipal solid waste (MSW) generated in year x (Gg/yr)
$MSW_F(x)$ = fraction of MSW disposed at solid waste disposal site in year x
Lo(x) = methane generation potential (Gg CH_4/Gg waste)
MCF(x) = methane correction factor in year x (fraction)
DOC(x) = Degradable organic carbon (DOC) in year x (fraction) (Gg C/Gg waste)
DOC_F = fraction of DOC dissimilated
F = fraction by volume of CH_4 in landfill gas
x = years for which input data should be added
t = year of inventory
where,

$$\mathbf{Lo(x) = MCF(x) * DOC(x) * DOC_F * F * 16/12} \quad \textbf{(9)}$$

$$\mathbf{CH_{4,\ emissn,t} = [\ CH_{4,gen,t} - R(t)] * (1-OX)} \quad \textbf{(10)}$$

$CH_{4,\ emissn,t}$ = emissions in the baseline scenario (Gg/yr)
R(t) = recovered methane in inventory year t (Gg/yr).
The value of the proposed project is zero.
OX = oxidation factor (fraction)

Step 3: Calculating emission factor of North China Power Grid in the baseline scenario

The electricity generated by the project activity will be transferred to the NCPG. The generation capacity installed will be 3.75MW during the crediting period. Shuangkou project electricity system will be connected with the Tianjin Electricity System, which is interconnected with the NCPG. From the China Electric Power Yearbook and China Energy Statistical Yearbook data are public available to calculate the Emission Factor of the NCPG. The default values for the calculation of calorific values for fuel types and fuel oxidation came from the *IPCC GHG Gas Inventory Reference Manual* and the *IPCC Good Practise Guidance and Uncertainty Management in Greenhouse Gas Inventories*[3]. Moreover, the Chinese DNA published emission factor of NCPG on its website[4] which is also available.

[3] http://www.ipccnggip.iges.or.jp (1996 and 2000 respectively)
[4] http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=1235

According to AMS.I.D.(ver.10), we choose Option (a) under paragraph 10 to demonstrate the emission in baseline scenario, which says "A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restriction to use the Simple OM and the Average OM calculations must be considered."

EF_y is calculated using the weighted average emissions of the operating margin factor and the build margin factor. The calculation was done according to the ACM0002 methodology and followed the 3 steps described in the methodology.

(1) Calculate the Operating Margin Emission Factor ($EF_{OM,y}$)

The Calculation followed (a) the Simple OM method.

According to the methodology the preferred method to calculate the operating Margin Emission factor should be option c) the Dispatch data analysis OM. Unfortunately, not enough dispatch data are available from the NCPG. Detailed data of dispatch of NCPG and the power plants are not public available and handled as confidential business information. This is also the reason why method b) Simple adjusted OM is not applicable and cannot be calculated. The fourth choice, Method d), the average emission rate method, can only be used where low-cost/must run resources constitute more than 50% of the total grid generation. As seen in Table B.6.1-1 below, the low-cost/must run resources in the power generation was very low in the last four years where data are available. Therefore, method d) is also not applicable.

Table B.6.1. –1: Percentage of resources in the overall power generation of NCPG (in %)[5]

Year	Hydro	Thermal	Others
2004	0.66	99.29	0.05
2003	1.17	98.77	0.06
2002	1.21	98.73	0.06
2001	1.16	98.79	0.05
2000	1.56	98.39	0.05

Hence, method a) Simple OM is applicable and is used to calculate the Operating Margin.

In accordance with ACM0002, the Simple OM emission factor ($EF_{OM,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, excluding those low-operating cost and must-run power plants. $EF_{OM,y}$ is calculated as follows:

$$EF_{OM,y}\left(tCO_2 / MWh\right) = \frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}} \qquad (11)$$

Where:

$F_{i,j,y}$ = Amount of fuel *i* consumed by relevant power sources *j* in year 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;

[5] China Electric Power Yearbook 2001-2005

$COEF_{i,j}$ = CO_2 emission coefficient of fuel *i* (tCO_2/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by the relevant power sources j and the percent oxidation of the fuel in year y;
$GEN_{j,y}$ = Electricity delivered to the grid by source *j*, MWh.

The Emission Coefficient $COEF_{i,y,j}$ is obtained from the following equation:

$$COEF = NCV_i * EF_{CO2,i} * OXID_i \quad (12)$$

Where
NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i,
$OXID_i$ is the oxidation factor of fuel i
$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel i

A complete list of fuel used, consumption and the emission factors can be found in Annex 3.

The Operating Margin Emission Factor ($EF_{OM,y}$) is calculated according to above equation and data of the NCPG in 2002-2004. Detailed Calculation and data see Annex 3.
$EF_{OM,y}$ = 1.0585 tCO_2e/MWh

.
(2) Calculation of the Build Margin Emission Factor ($EF_{BM,y}$)
The build margin Emission factor ($EF_{BM,y}$) is calculated according to following equation:

$$EF_{BM,y}\left(tCO_2 / MWh\right) = \frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_{m} GEN_{m,y}} \quad (13)$$

where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ is analogous to variables used in equation (11).

The Build Margin emission factor will be calculated according to Option 1, ex ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m 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 (in MWh) and that have been built most recently. Due to the fact, that single plant data are not public available, aggregated power plant capacity additions that leads to 20 % system generation were taken into account.

For calculating the $EF_{BM,}$ the capacity additions during years 2002 to 2004 were taken into account. The calculation was done according to recommendations and guidance from the Chinese DNA. Detailed explanation and calculation can be found in Annex 3.
$EF_{BM,y}$ = 0.9066 tCO_2e/MWh

(3) Calculation of the Baseline Emission Factor (EF_y)
EF_y is calculated as the weighted average of the Operating Margin emission factor and the Build Margin emission factor, where the weights w_{OM} and w_{BM} by default, are 50 %.

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y} \quad (14)$$

This leads to an emission factor of **0.9826 tCO_2e/MWh**.

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

There are no data available at validation besides the baseline data, which are not monitored throughout the crediting period but that are determined only once and thus remains fixed throughout the crediting period and are available when validation is undertaken. All project data will be monitored throughout the crediting period.

Data / Parameter:	**Quantity of solid waste to Shuangkou landfill site**
Data unit:	ton
Description:	MSW landfilled or to be landfilled during 2004~2018
Source of data used:	Records from landfill operator and landfill design documents
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data from 2004~2006 are recorded by Shuangkou landfill operator on the basis of daily receipt of the solid waste; data from 2007 till the end of the landfill lifetime are assumptions according to the design plans and the city planning.
Any comment:	The data of waste input from 2004~2006 can be provided by the project participant.

Year	Waste (ton)
2004	272,000
2005	333,000
2006	395,876
2007	470,000
2008	470,000
2009	470,000
2010	470,000
2011	470,000
2012	470,000
2013	470,000
2014	470,000
2015	470,000
2016	470,000
2017	470,000
2018	470,000
Total	6,640,876

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost Shuangkou landfill has daily soil cover, thus OX = 0.1.
Any comment:	According to IPCC Good Practice, in developing countries such as China with less elaborate management practices, the average value is probably closer to zero. For the conservativeness, 0.1 is used for this project.

Data / Parameter:	**DOC**
Data unit:	-
Description:	Fraction of degradable organic carbon in the waste
Source of data used:	CDM Umbrella Guidelines for MSW in China, The World Bank, prepared by ERM, final Report, 2004
Value applied:	0.130
Justification of the choice of data or description of measurement methods and procedures actually applied :	DOC is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream, such as paper and textiles, garden waste, park waste or other non-food organic putrescibles, food waste, and wood or straw. So far, the specific composition of waste filled in Shuangkou landfill site is not available, therefore the DOC value of the project is referred to the data in Shanghai, which is also a municipality directly under the Central Government as Tianjin.
Any comment:	-

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can compose
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.77
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Guidelines provide 0.77 as the default value for DOC_f.
Any comment:	-

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane Correction Factor
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	1.0
Justification of the choice of data or description of measurement methods	1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste. All three cases apply to Shuangkou landfill.

and procedures actually applied :	
Any comment:	-

Data / Parameter:	**k**
Data unit:	-
Description:	Decay rate for the waste
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories; Turning a Liability Into an Asset; A Landfill Gas-to-Energy Project Development Handbook, EPA 1995
Value applied:	0.08
Justification of the choice of data or description of measurement methods and procedures actually applied :	Climate data for the location of Shuangkou landfill: Mean Annual Temperature: 11.7 ^{o}C Annual precipitation: 600 mm Potential evapotransportation: 1032 mm According to the climate data, Shuangkou landfill is in Boreal/Temperate wet zone. For determine the k-value, the approach for mixed waste was used, with mainly food waste and rapidly degrading waste.
Any comment:	Considering leachate re-circulation into the landfill.

Data / Parameter:	**$F_{i,y}$**
Data unit:	mass or volume
Description:	Amount of each fossil fuel consumed by each power source /plant to NCPG
Source of data used:	China Energy Statistical Yearbook 2000~2006
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	China Energy Statistical Yearbook is an official and authoritative publication.
Any comment:	Official data

Data / Parameter:	**NVC_i**
Data unit:	TJ/mass or TJ/volume
Description:	Net calorific value (energy content) per mass or volume unit of fuel i
Source of data used:	China Energy Statistical Yearbook 2005
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	Using China's specific values as required by the ACM0002, version 6.
Any comment:	This datum is used for calculating CO_2 emission coefficient of fuel i, COEF = $NCV_i*EF_{CO2}*OXID$

Data / Parameter:	**EF_{CO2}**

Data unit:	tC/TJ
Description:	CO_2 emission factor per unit of energy of fuel i
Source of data used:	Revised 1996 IPCC Guidelines for default values
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	Using default values as required by the ACM0002, version 6.
Any comment:	This datum is used for calculating CO_2 emission coefficient of fuel i, COEF = $NCV_i*EF_{CO2}*OXID_i$

Data / Parameter:	**$OXID_i$**
Data unit:	%
Description:	Oxidation factor of fuel i
Source of data used:	Revised 1996 IPCC Guidelines for default values
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	Using default values as required by the ACM0002, version 6.
Any comment:	This datum is used for calculating CO_2 emission coefficient of fuel i, COEF = $NCV_i*EF_{CO2}*OXID$

Data / Parameter:	**$GEN_{i/k/n,y}$**
Data unit:	MWh/a
Description:	Electricity generation of each power source/ plant j, k or n
Source of data used:	China Electric Power Yearbook 2000~2005
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	China Electric Power Yearbook is an official and authoritative publication.
Any comment:	Official data

Data / Parameter:	**$NVC_{i,IMP}$**
Data unit:	TJ/mass or TJ/volume
Description:	Net calorific value (energy content) per mass or volume unit of fuel i consumed to produce electricity imports to the NCPG
Source of data used:	China Energy Statistical Yearbook 2005
Value applied:	See Annex 3 for specific values
Justification of the choice of data or	Using China's specific values as required by the ACM0002, version 6.

description of measurement methods and procedures actually applied :	
Any comment:	This datum is used for calculating CO_2 emission coefficient of fuel i, COEF = NCV_i*EF_{CO2}*OXID

Data / Parameter:	**$EF_{CO2,i,IMP}$**
Data unit:	tC/TJ
Description:	CO_2 emission factor per unit of energy of fuel i consumed to produce electricity imports to the NCPG
Source of data used:	Revised 1996 IPCC Guidelines for default values
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	Using default values as required by the ACM0002, version 6.
Any comment:	This datum is used for calculating CO_2 emission coefficient of fuel i, COEF = NCV_i*EF_{CO2}*$OXID_i$

Data / Parameter:	**$OXID_{i,IMP}$**
Data unit:	%
Description:	Oxidation factor of fuel i consumed to produce electricity imports to the NCPG
Source of data used:	Revised 1996 IPCC Guidelines for default values
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	Using default values as required by the ACM0002, version 6.
Any comment:	This datum is used for calculating CO_2 emission coefficient of fuel i, COEF = NCV_i*EF_{CO2}*OXID

Data / Parameter:	**$GEN_{i/k/n,y, IMP}$**
Data unit:	kWh
Description:	Electricity imports to the project electricity system
Source of data used:	China Electric Power Yearbook 2000~2005
Value applied:	See Annex 3 for specific values
Justification of the choice of data or description of measurement methods and procedures actually applied :	China Electric Power Yearbook is an official and authoritative publication.
Any comment:	Official data

Data / Parameter:	**Regulatory requirements relating to landfill gas projects**
Data unit:	Test
Description:	**Regulatory requirements relating to landfill gas projects**
Source of data to be used:	National laws, standards, requirements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	• *Technical code for municipal solid waste sanitary landfill (CJJ17-1988)* • *Standard for pollution control on the landfill site for domestic waste (GB16889-1997)*
Description of measurement methods and procedures to be applied:	The project chose the fixed 10-year crediting period. Therefore, the regulatory requirements relating to landfill gas project in China is checked and evaluated, and won't be monitored during the vintage years of the project.
QA/QC procedures to be applied:	In compliance with the design documents, which have already been approved by the relevant authorities for construction of Shuangkou landfill.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

According to ACM0001, the following variables will be used to estimate the baseline emissions and the emission reductions by implementing the proposed project.

Table B.6.3.-1 Variables to determine the baseline emissions and the emission reductions of the project

Description	**Value**	**Unit**	**Comments**
Amount of waste landfilled till now	1,000,876	ton	2004-2006
Estimated amount of waste landfilled in the future	5,640,000	ton	2007-2018, end of landfill life
LFG collection efficiency	45~60	%	From Feasibility Study
Lo	84	m^3/ton waste	Project developer's calculation
Methane fraction in the LFG	50	%	For ex ante estimation, later monitored
Generation efficiency	30	%	
Flare/combustion efficiency	90	%	For ex ante estimation, later monitored
Baseline emission factor of the NCPG	0.9826	tCO_2/MWh	Ex ante

Major risk of uncertainties

The following assumptions and uncertainties must be taken into account because they affect LFG generation, and they are difficult to be predicted and are not in the control of the project developer.

Data uncertainties include:

- Waste quantity and composition.
- Quantity of methane generated.
- Landfill gas collection efficiency.

The project developer tried to be conservative in all the estimations. The waste quantity was calculated based on official data. The quantity of methane is site specific and is a function of controllable and uncontrollable factors like temperature, moisture content, atmospheric conditions, availability of nutrients, waste moisture content, leachate pH conditions, waste density, waste characteristics, organic content, porosity, intermediate cover materials used, temperature, depth of wastes, grading and contour and landfill operation conditions. Therefore, to reduce the uncertainties of these factors, Shuangkou landfill operators took the very conservative way to calculate the emission reductions.

Following the formula (1) ~ (14), the baseline emissions and the emission reductions from the project are shown below.

(1) Baseline emissions from Shuangkou landfill site

Year	Methane generated from Shuangkou landfill (ton CH_4)	Collection efficiency (%)	Collected methane from Shuangkou landfill (ton CH_4)
	A	B	C=A*B
2008	5,697	45	2,564
2009	7,268	48	3,488
2010	8,717	50	4,359
2011	10,056	55	5,531
2012	11,291	60	6,775
2013	12,431	60	7,459
2014	13,484	60	8,090
2015	14,456	60	8,673
2016	15,353	60	9,212
2017	16,181	60	9,709
Total	114,933		65,859

(2) Emission reductions from the proposed project

a) Methane destroyed in generators and flare

Year	Methane combustion by power generation (ton CH_4)	Methane combustion by flaring (ton CH_4)	Methane destroyed by the project (ton CH_4)	Direct emission reductions by methane combustion (tCO_2e)
	D	E	F=D+E	G=F*21
2008	2,387	159	2,546	53,466
2009	2,387	991	3,378	70,944
2010	2,387	1,775	4,161	87,391
2011	4,774	681	5,455	114,552
2012	4,774	1,801	6,574	138,064
2013	6,805	589	7,393	155,261
2014	7,161	837	7,997	167,946
2015	7,161	1,361	8,522	178,966
2016	7,161	1,846	9,007	189,139

2017	7,161	2,293	9,454	198,529
Total	52,157	12,332	64,488	1,354,257

b) Emission reductions by displacing equivalent electricity from NCPG

5% of the power generated by the project is considered for on-site use, such as by the landfill gas extraction system (pumps) and the generation system itself. The rest, 95% of the power, will be connected to the NCPG. The emission factor of NCPG is calculated as 0.9826 tCO_2e/MWh.

Year	Generation capacity (kW)	Electricity output (kWh)	Power supplied to the grid (kWh)	Grid electricity displacement emission reductions (tCO_2e)
	H	I	J=I*0.95	K=J*EF
2008	1,250	10,000,000	9,500,000	9,335
2009	1,250	10,000,000	9,500,000	9,335
2010	1,250	10,000,000	9,500,000	9,335
2011	2,500	20,000,000	19,000,000	18,669
2012	2,500	20,000,000	19,000,000	18,669
2013	3,750	28,508,584	27,083,155	26,612
2014	3,750	30,000,000	28,500,000	28,004
2015	3,750	30,000,000	28,500,000	28,004
2016	3,750	30,000,000	28,500,000	28,004
2017	3,750	30,000,000	28,500,000	28,004
Total		218,508,584	207,583,155	203,971

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

Based on the tables in B.6.3, the proposed project will generate a total amount of emission reductions during 10-year crediting period shown below.

Year	Estimation of project activity emission reductions (tonnes of CO_2e)	Estimation of baseline emission reductions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
	L=G+K	M=L*AF	N	P=L-M-N
2008	62,801	0	0	62,801
2009	80,278	0	0	80,278
2010	96,725	0	0	96,725
2011	133,222	0	0	133,222
2012	156,733	0	0	156,733
2013	181,873	0	0	181,873
2014	195,950	0	0	195,950
2015	206,970	0	0	206,970
2016	217,143	0	0	217,143
2017	226,533	0	0	226,533

Total	1,558,228	**0**	**0**	1,558,228

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$LFG_{total,y}$**
Data unit:	m^3
Description:	Total amount of landfill gas captured in year y
Source of data to be used:	On site measurement by gas flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	Data measured by continuous flow meter and aggregated monthly and yearly, 100% of the data are to be monitored and all data will be archived electronically
QA/QC procedures to be applied:	Flow meter will be subject to regular maintenance and testing regime, in accordance with the manufacturer's recommendations, to ensure accuracy
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Year	total collected LFG flow（m^3）
2008	7,153,137
2009	9,733,307
2010	12,161,345
2011	15,431,166
2012	18,902,136
2013	20,811,267
2014	22,573,616
2015	24,200,470
2016	25,702,245
2017	27,088,559
Total	183,757,248

Data / Parameter:	**$LFG_{electricity,y}$**
Data unit:	m^3
Description:	Amount of landfill gas to generators in year y
Source of data to be used:	On site measurement by gas flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)

Year	LFG to the generators（m^3）
2008	6,660,000
2009	6,660,000
2010	6,660,000
2011	13,320,000
2012	13,320,000
2013	18,986,717
2014	19,980,000
2015	19,980,000

	2016 — 19,980,000 2017 — 19,980,000 Total — 145,526,717
Description of measurement methods and procedures to be applied:	Data measured by continuous flow meter and aggregated monthly and yearly, 100% of the data are to be monitored and all data will be archived electronically
QA/QC procedures to be applied:	Flow meter will be subject to regular maintenance and testing regime, in accordance with the manufacturer's recommendations, to ensure accuracy
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Data / Parameter:	**LFG** $_{\textbf{flared,y}}$ (or $FV_{RG,h}$)
Data unit:	m^3 (or m^3/h)
Description:	Total amount of landfill gas to flares in dry basis at normal conditions, in year y (or in hour h)
Source of data to be used:	On site measurement by gas flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	see table below
Description of measurement methods and procedures to be applied:	Data measured by continuous flow meter and aggregated monthly and yearly, 100% of the data are to be monitored and all data will be archived electronically. For calculating flare efficiency (FE), the project participants shall ensure that the same basis (dry or wet) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) , when the residual gas temperature exceeds 60℃.
QA/QC procedures to be applied:	Flow meter will be subject to regular maintenance and calibrated testing regime, in accordance with the manufacturer's recommendations, to ensure accuracy
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Year	LFG to the flares（m^3）
2008	493,137
2009	3,073,307
2010	5,501,345
2011	2,111,166
2012	5,582,136
2013	1,824,549
2014	2,593,616
2015	4,220,470
2016	5,722,245
2017	7,108,559
Total	38,230,531

Data / Parameter:	$\mathbf{w}_{\mathbf{CH4,y}}$
Data unit:	m^3 CH_4/m^3 LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	On site measurement
Value of data applied for the purpose of calculating expected	50 %

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Continuously measured with continuous gas quality analyser, 100% of all data are measured and archived electronically
QA/QC procedures to be applied:	The gas analyser will be subject to a regular maintenance and testing regime, in accordance with the manufacturer's recommendations, to ensure accuracy
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Data / Parameter:	**T**
Data unit:	^{o}C
Description:	Temperature of the landfill gas
Source of data to be used:	On site measurement by gas flow meter that automatically measure the temperature and pressure of the gas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The temperature is zero degree centigrade under normal conditions.
Description of measurement methods and procedures to be applied:	Measured to determine the density of methane. The measurement will be done automatically and continuously by a gas flow meter, expressing LFG volumes in normalized cubic meters. All data will be archived electronically
QA/QC procedures to be applied:	Flow meter will be subject to regular maintenance and testing regime, in accordance with the manufacturer's recommendations, to ensure accuracy
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Data / Parameter:	**P**
Data unit:	Pa
Description:	Pressure of LFG
Source of data to be used:	On site measurement by gas flow meter that automatically measure the temperature and pressure of the gas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The pressure is 101,325 Pa under normal conditions.
Description of measurement methods and procedures to be applied:	Measured to determine the density of methane. The measurement will be done automatically and continuously by a gas flow meter, expressing LFG volumes in normalized cubic meters. All data will be archived electronically
QA/QC procedures to be applied:	Flow meter will be subject to regular maintenance and testing regime, in accordance with the manufacturer's recommendations, to ensure accuracy
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Data / Parameter:	$\mathbf{T_{flare}}$
Data unit:	^{o}C

Description:	Temperature in the exhaust gas of the enclosed flare
Source of data to be used:	Continuous on site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Assumed above 500 ^{o}C
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by the Type N thermocouple. A temperature above 500^{o}C indicates that a significant amount of gases are still being burnt and the flare is operating.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year to ensure accuracy
Any comment:	An excessive high temperature at the sampling point (above 700^{o}C) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow

Data / Parameter:	**$fv_{i,h}$**
Data unit:	
Description:	Volumetric fraction of component i in the residual gas in the hour h where i = CH_4, CO, CO_2, O_2, H_2, N_2
Source of data to be used:	Continuous gas analyser on site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50% CH_4, and the rest is assumed as nitrogen.
Description of measurement methods and procedures to be applied:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60^{o}C
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with the standard certified gas.
Any comment:	This data will be monitored continuously on site.

Data / Parameter:	**$EL_{EX, LFG,y}$**
Data unit:	MWh
Description:	Total amount of electricity exported out of the direct project boundary
Source of data to be used:	On site measurements and cross check through electricity sales receipts
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)

Year	Electricity to the NCPG (MWh)
2008	9,500
2009	9,500
2010	9,500

	2011: 19,000 2012: 19,000 2013: 27,083 2014: 28,500 2015: 28,500 2016: 28,500 2017: 28,500 Total: 207,583
Description of measurement methods and procedures to be applied:	On site electricity meters, continuously, 100% of data are monitored and are cross checked with receipts from the Power Supplier Company
QA/QC procedures to be applied:	Electricity meter will be calibrated regularly according to the manufacturer's requirements. Measurement results will be cross-checked with the quantity of invoices from the grid operator to insure consistency
Any comment:	These data are ex-ante estimated and will be monitored ex post.

Data / Parameter:	**EL_{IMP}**
Data unit:	MWh
Description:	Total amount of electricity imported/used for on-site purposes to meet project requirement
Source of data to be used:	On site measurements and cross check through electricity invoices if electricity is coming from outside the boundaries
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0, because the project will apply electricity generated for on-site use
Description of measurement methods and procedures to be applied:	On site electricity meters, continuously, 100% of data are monitored and are cross checked with invoices from the Power Supplier Company, if possible
QA/QC procedures to be applied:	Electricity meter will be calibrated regularly according to the manufacturer's requirements. Measurement results will be cross-checked with the quantity of invoices from the grid operator to insure consistency
Any comment:	Required to determine CO_2-emissions from the use of electricity from use of electricity from use of electricity or other energy carriers to operate the project activity. The records of any electricity imported in the baseline too should be recorded at the start of the project.

Data / Parameter:	**Operating hours**
Data unit:	Hours
Description:	Operating hours of the energy plant/generators
Source of data to be used:	On site measurement
Value of data applied for the purpose of calculating expected	8000

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	On site measurement of the operating hours of the generators, 100% of all data are measured and archived electronically, recording frequency will be annually
QA/QC procedures to be applied:	The meter will be calibrated regularly according to manufacturer's regulations
Any comment:	This is monitored to ensure methane destruction is claimed for methane used in generator when it is operational.

Data / Parameter:	**Flare operation parameters**
Data unit:	-
Description:	Manufacturer's specification of flare, such as temperature, flow rate of residual gas at the inlet of the flare
Source of data to be used:	On site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Assumed that all flare operation parameters meet the manufacturer's specifications, hence, the flare efficiency of the enclosed flared to be applied by the project is 90% for calculating the emission reductions.
Description of measurement methods and procedures to be applied:	Continuously
QA/QC procedures to be applied:	The operating conditions will be measured according to the manufacturer's specification.
Any comment:	All parameters such as temperature, flow rate of residual gas at the inlet of the flare, etc. will be monitored to see if they meet the manufacturer's requirements.

All data monitored and measured will be archived during credit period and two years after.

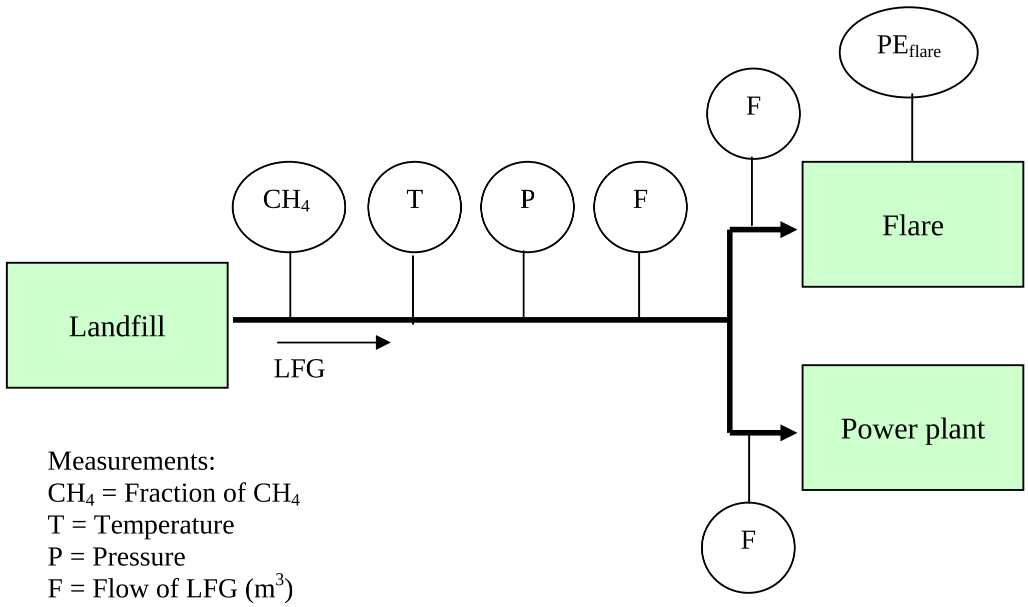
B.7.2 Description of the monitoring plan:

TCEE, as the project developer described will select a Professional Company (PC) specializing in the municipal solid waste management to invest in, construct and operate the proposed project. TCEE is responsible for supervising the project implementation, performance, and the monitoring activities to be conducted by the professional company.

The selected PC will invest in, construct and operate the proposed project and is also responsible for all monitoring activities to assure that all activities are consistent with the Monitoring Plan. The PC will handle the monitoring under the supervision of TCEE.

PC will monitor the project in compliance with the latest ACM0001 and AMS.I.D Monitoring Methodologies.

1. Monitoring plan



Measurements:
CH_4 = Fraction of CH_4
T = Temperature
P = Pressure
F = Flow of LFG (m^3)
PE_{flare} = Project emissions from flaring of the residual gas stream

Figure 4: Monitoring Plan of the project

- The amount of landfill gas generated (in m^3, using a continuous flow meter), where the total quantity ($LFG_{total,y}$) as well as the quantities fed to the flare ($LFG_{flare,y}$), to the power plant ($LFG_{electricity,y}$) are measured continuously.
- The fraction of methane in the landfill gas ($w_{CH4,y}$) should be measured with a continuous analyzer or, alternatively, with periodical measurements, at a 95% confidence level, using calibrated portable gas meters and taking a statistically valid number of samples and accordingly the amount of landfill gas from $LFG_{total,y}$, $LFG_{flare,y}$ and $LFG_{electricity,y}$ shall be monitored in the same frequency. The continuous methane analyzer should be preferred option because the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions. Methane fraction of the landfill gas to be measured on wet basis.
- The parameters used for determine the project emissions from flaring of the residual gas stream in year y (PEflare,y) should be monitored as per the “Tool to determine project emissions from flaring gases containing Methane”.
- Temperature (T) and pressure (P) of the landfill gas are required to determine the density of methane in the landfill gas.
- The quantities of fossil fuels required to operate the landfill gas project, including the pumping equipment for the collection system and energy required to transport heat, should be monitored. In projects where landfill gas is captured in the baseline too should be recorded.
- The quantity of electricity imported, in the baseline and the project situation, to meet the requirements of the project activity, if any.
- The quantity of electricity exported out of the project boundary, generated from landfill gas, if any.
- The operating hours of the energy plant.

2. Monitoring Management

(1) CDM Monitoring Manager
One competent manager, will be designated by the professional company and approved by TCEE, will be responsible for this monitoring plan and supervise the collected data. He/She will report monthly to both the professional company and the Management Board (MB) of TCEE about project performance and data. He/She will inform the PC and MB immediately as soon as he/she detects non-conformance in the performance to the mentioned regulations, problems in the performance (e.g. flow meters not working, data not correct). The CDM Manager will be the main contact person for the verifiers, Chinese DNA, World Bank, as well as Tianjin related authorities, during the crediting period.

(2) CDM Project Team
Tianjin Shuangkou LFG CDM project team will gather, at least monthly, to discuss the performance of the CDM project. Member of the CDM Project Team includes CDM Manager, the MB of TCEE, the chief engineer of the Shuangkou landfill. The meeting of the CDM project team can be part of regular meetings, but meeting minutes are recorded as required. In case of non-conformance, each members of the team can call in for a CDM project team meeting.

(3) Training
For all employees, involved in the CDM project, a Training Plan will be created. The Training Plan gives an overview, what kind of training is necessary and the time schedule of the training, including a signature of trainer, after the training was carried out. The CDM manager should ensure that for the crediting period, only trained and skilled people work in the CDM project. The training content depends of the trainees' background and in which way they are involved in the collection/utilization process and CDM process. Depending on their task, they should get a comprehensive knowledge with regard to the general and technical aspects of the projects.
The technology supplier will provide instructions and training to the personnel on instalment, operation, maintenance and calibration of monitoring equipment.

(4) Internal inspection
Frequently the monitoring plan including all defined procedures, reports, data, and personnel will be inspected internally to ensure the monitoring activities. Especially in the beginning of the crediting period, these Internal Inspections should take place, to guarantee the monitoring procedures.

3. Quality control and quality assurance procedures

The PC will establish a quality management system, which ensures the quality and accuracy of the measured data, including corrective measures in case of non-conformity. The quality management system will include:

(1) Gas field monitoring records
- Daily readings of all field meters will be filled out in paper worksheets and filed consequently. All data collected will also be entered in electronic worksheets and stored in computer immediately and in discs periodically.
- Periodic controls of the LFG field monitoring records will be carried out to check any deviations from the estimated ERs following the guidelines for LFG plant operation and monitoring for correction or future references.
- Periodic reports to evaluate performance and assist with performance management will be elaborated.

(2) Monitoring data evaluation

- Following the main criteria such as use and strict adherence to recognised standard methods, use of non-standard methods only after approved validation, use of standard reporting forms including process measures as well as emission data, etc. to guarantee the data reliable and accurate.
- A procedure will be developed to define the responsibility of how critical data parameters and possible adjustment or uncertainties will be evaluated and performed.

(3) Equipment calibration and maintenance
- Flow meters, gas analyzers, other critical CDM project equipment will be subject to regular maintenance and testing according to the technical specifications from the manufactures to ensure accuracy and good performance.
- Calibration of equipment will be conducted periodically according to their technical specifications.

(4) Corrective actions
- Actions to correct deviations from the Monitoring Plan and the guidelines for LFG plant operation and monitoring will be implemented as these deviations are observed either by the operator or during internal audits.
- Except periodic meeting, additional technical meetings among the operator, the MB of the developer will be held, if necessary, in order to define the corrective actions to be carried out.
- Corrective actions are also set down in case of equipment or systems malfunction or breakdown.

(5) Site audits
- CDM Project Team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the Monitoring Plan and the guideline for LFG plant operation and monitoring.

(6) Documents storage
- List of monitoring equipment (flow meters, gas analyzers, thermometers, etc.), including their numbers, names, manufacturers, specifications, use requirements, etc.
- Calibration lists and reports, including equipment or parts calibrated, date, method and procedures of calibration, their precision after these procedures, personnel, devices needed, etc.
- Maintenance lists and reports, including equipment or parts maintained, date, method and procedures of maintenance, their performance after these procedures, personnel, devices needed, etc.
- Operational manual of the proposed project
- Meeting minutes of CDM project team meeting
- Non-conformance reports
- Worksheets, monthly and yearly
- Training plan
- Internal audit/inspection reports, including personnel, time, findings, corrective actions, follow-up inspections
- Annual monitoring review

(7) Emergency preparedness for unintended emissions
- In case of equipment malfunction or breakdown, the timely corrective actions will be carried out to minimize the unintended emissions.
- Working staffs will be trained to appropriately cope with the emergent situations. They can effectively judge the abnormal situation and make prompt response such as fixing malfunctioned equipment, recording and reporting to the Management in time.

- The plant operator has to inspect frequently, at least once per week all methane-containing parts of the plant (on the surface). All findings have to be documented. In cases leakages will be found, the leakages have to be reduced and repaired according to the plant operators manual and manufacturer recommendations.

4. Verification

The verification is the focal point of the CDM project and all the documents have to be in place, archived and accumulated in a final Monitoring review, which will be submitted to the DOE, who is verifying the CDM project during the credit period. The CDM-Manager should work closely with the verifier and answer all questions raised by the DOE for emission reduction verification.

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: 01/03/2007

Name of responsible persons/entity:

Company Name: Shanghai JEC Environmental Consultant Co., Ltd.
Address: 1748 Xinzha Road, Shanghai, China
Zip Code: 200040
Tel: +86-21-62172233
Fax: +86-21-62715179

Ms. Ou Yuanyang oyy@shjec.cn
Ms. Beatrix Etzkorn bea@shjec.cn

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:

01/01/2008

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

11 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:

01/01/2008

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

According to the procedures for applying for a construction project in China, an Environmental Impact Assessment (EIA) is a must. The objective of the EIA is to identify the effects of the project activities on both the environmental and socio-economic aspects of the community located near Shuangkou landfill, and to provide proper measures and procedures to mitigate its possible negative impacts.

At the time of this PDD submission, the EIA for the Shuangkou LFG recovery and utilization project has been approved dated Oct.20, 2006.

Based on the national technical code for landfill construction (CJJ17-1988), Shuangkou landfill has not installed LFG collection and recovery system. Currently, the existing landfill phases have a negative impact on the environment, especially on the aspects of groundwater pollution (leachate), air pollution and odour (LFG emissions), and littering.

Through uncontrolled emitting of LFG, uncontrolled gas accumulation in the solid waste disposal body, gas explosions and fire were common problems on the old landfill site, and were not only harmful to the environment, but also for the health of workers. In order to collect landfill gas as much as possible, the proposed project will retrofit the landfill with more soil cover and build the side dikes. Thus, through the side dikes the leaching will also be minimized. The littering of old waste will completely disappear and through the landfill gas collection the air pollution in terms of odor and hazardous components will be reduced to minimum.

In particular, the proposed project will minimize leachate problems. At present, the leachate produced at the Shuangkou landfill is collected through perforated pipes installed at the bottom of each waste disposal cell and then circulated back to these cells. The proposed project will include collecting the leachate separated by condensing from the extracted LFG, then discharging to the adjusting tank for pre-treatment prior to being circulated to the landfill.

The proposed project will bring environmental benefits globally and locally. From the Shuangkou landfill project:

- ◇ Reducing the uncontrolled discharging of LFG, (including methane, carbon dioxide and more than 150 trace components)
- ◇ No contact of waste with open air meaning no contamination nor risk to public health
- ◇ Reducing the odor nuisance
- ◇ Reducing vermin
- ◇ Reducing spreading of litter.
- ◇ Production of electrical power
- ◇ CER revenue from the project can be used for improving the landfill operation and maintenance

On the other side, LFG generators produce emissions, depending on the type of generator, operation and maintenance. Flaring can generate trace amounts of organic and toxic emissions. Compared with the environmental impact without the project, these emissions are minimal, and they will be minimized and controlled by high standards in monitoring and maintenance measurements.

Combustion of LFG produces air contaminants such as SO_2 and NO_X. NO_X is a mixture of NO, NO_2, N_2O. N_2O is another kind of greenhouse gas in the Kyoto Protocol. In the proposed project the NO_X emissions can be reduced by careful control of the combustion process, the techniques being those which essentially limit the oxygen availability to the fuel and/or lower the peak flame temperature. According to the project EIA analysis and the power generator manufacturer's specification of emission standards, theNO_X expected to be emitted will be much lower than the Chinese standards on pollutants emission limits to the atmosphere (GB3095-1996). Thus, NO_X emissions can be neglected, while complying with the methodology ACM0001.

There are 3 villages near the Shuangkou landfill. The closest village is 1.2 kilometres from the landfill, which meets the national standard that a municipal solid waste sanitary landfill must be built at least 500 meters away from the residential area. As a result, the proposed project complies with the national standard, and is expected to improve the local environmental quality.

The proposed project meets all requirements in line with the host country's regulations of environmental protection and has great positive impacts both on the environment and social conditions.

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:

No significant negative environmental impacts are expected to result from the project activity. On the contrary, the project will upgrade the local waste management practice to a higher standard and will lead to a significant reduction in local pollution along with a significant reduction in GHG emissions as described above.

Before the EIA report was approved on Oct.20, 2006, it was publicly available at *www.tjcac.gov.cn* on the purpose of collecting the public comments on the proposed project. Now, for further information about the EIA, please contact the project participants (see Annex 1).

SECTION E. Stakeholders' comments

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

According to China's Environmental Impact Assessment Law, before starting a construction project, an EIA report of the project must be conducted by an organization with the qualification from the Chinese government. Under this Law the construction projects will be assessed in three categories.

- Category A: the project has the great environmental impact;
- Category B: the project has the medium environmental impact;
- Category C: the project has little impact on the environment.

According to the Law, only category A projects need public involvement and comments, through questionnaires handout, hearing, etc. which are stipulated in the SEPA Interim Measures For EIA Public Involvement in effect on March 18, 2006.

The proposed project falls into category B, which has no mandatory requirement for the public consultation. But according to the World Bank's general procedures as the carbon emission reduction buyers, the World Bank will evaluate the project based on its safeguard policies and require the project developer preparing the Environmental Management Plan (EMP), and soliciting stakeholder comments and involvement.

Therefore, for strictly following the CDM procedures, the project developer conducted public consultation in the following manner.

The survey of stakeholder comments is mainly in the form of handing out questionnaires (see the below for the form), together with interview. The survey covered most Shuangkou area, in particular those located in Shuangkou town where the electricity generation plant is, and lasted for 1 month. During this survey six residents living near the landfill site were selected as the representative interviewees for their comments on the project.

Spot Check Questionnaires for the Public on the Environment Impact Assessment of Tianjin Shuangkou LFG Recovery & Utilization Project

Name		Gender		Age	
Education		Vocation		Post Title	
Served company and living address					
Contact No.		Whether living in Shuangkou county			

Dear everybody,

Tianjin Shuangkou MSW sanitary landfill site is located at Shuangkou village, Beichen district, tianjin city, with a total capacity of 9 million cubic meters, a daily handling capacity of 2700 tons and a service life of 15 years. The landfill site has been in operation since 2001 and accepted the MSW from Tianjin city. Till now, already 1.5 million tons of MSW has been landfilled there. In order to reduce greenhouse effect and the negative impact caused by LFG emission on air quality and environment quality, Tianjin Clean Energy Environmental Engineering Co., Ltd. will invest RMB 19 million Yuan for this project.

The project is Shuangkou Landfill Gas Recovery & Utilization Project, which collects LFG, the gas generated during the anaerobic decomposition of the household waste in landfill site, and utilize LFG for electricity generation. The proposed power plant will be located at the existing Shuangkou sanitary landfill, no need to occupy other land. The plant mainly consists of LFG collection system, compression system and power generation system, etc. The power generated by the collected LFG is expected to be 177,000 kilowatt. During the project crediting period, the GHG emission reductions are estimated to reach 7,290,000 tons of carbon dioxide equivalents, and consequently, the project will make a great contribution to the social and environmental benefit.

Q.1. How do you think of the impact on your living quality from Shuangkou landfill site?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

Q.2. How do you think of the impact on air quality and environment quality from Shuangkou landfill gas?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

Q.3. How do you think this project's influence on the improvement of living quality?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

Q.4. How do you think this project's influence on the improvement of air quality and environment quality?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

Q.5. How do you think this project's influence on the economic development of Shuangkou country?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

Q.6. What do you think of the project?
□ extremely for □ for □ against □ extremely against □ of no concern

Other opinions and suggestions	

Thank you very much for your participancy!

Signature: Date:

Note: Except the blanks for name, address and vocation which should be filled out in details, please mark "√" in those concerned items to show your attitude towards each question. If you choose "others", please give your explanations as well.

Besides, you can also leave your words on attached paper to illustrate other situation. In case of any questions, please do not hesitate to present them to our staff.

E.2. Summary of the comments received:

The result of this survey shows that he majority of the stakeholder representatives have the same view on most of the questions. The summary of questionnaire results is as follows:

Questions raised in the questionnaire	Investigation result（%）				
	great	average	Small	no impact	others
Q.1. How do you think of the impact on your living quality from Shuangkou landfill site?			33.3	66.7	
Q.2. How do you think of the impact on air quality and environment quality from Shuangkou landfill gas?			100		
Q.3. How do you think this project' s influence on the improvement of living quality?		66.7	33.3		
Q.4. How do you think this project' s influence on the improvement of air quality and environment quality?	100				
Q.5. How do you think this project' s influence on the economic development of Shuangkou country?		50	50		
Q.6. What do you think of the project?	Extremely for	For	Against	Extremely against	Of no concern
	66.7	33.3			
Other options and suggestions	None				

The summary shows that all the interviewees are for the implementation of this project. It is convinced that the project will effectively improve the air quality and environment quality within the surrounding area, which is consistent with the result of environment impact assessment.
During this time, no comments and requests other than described above arose.

Besides, during the preparation of the environmental impact assessment and its follow-up evaluation meeting, the other stakeholders, especially the relevant local authorities got to know this project by the project developer and other sources. They showed their great support to the project.

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

The residents and local authorities are all very supportive of the proposed project. Therefore, there is no need to modify the project based on the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Developer

Organization:	Tianjin Clean Energy and Environmental Engineering Co.,Ltd.
Street/P.O.Box:	7/F, 209 Xinhua Road, Heping District,
Building:	
City:	Tianjin
State/Region:	Municipality of Tianjin
Postfix/ZIP:	300040
Country:	China
Telephone:	+86-22-23191560
FAX:	+86-22-23120978
E-Mail:	
URL:	
Represented by:	
Title:	General Manager
Salutation:	Mr.
Last Name:	Qi
Middle Name:	
First Name:	Wenjie
Department:	
Mobile:	
Direct FAX:	+86-22-23120978
Direct tel:	+86-22-23191560
Personal E-Mail:	tjpmo@public.tpt.tj.cn

Carbon Buyer

Organization:	International Bank for Reconstruction and Development ("World Bank") as Trustee of the Spanish Carbon Fund
Street/P.O.Box:	1818 H Street, N.W.
Building:	
City:	
State/Region:	Washington D.C.
Postfix/ZIP:	20433
Country:	United States of America
Telephone:	+1 202 473 0836
FAX:	+1 202 522 7432
E-Mail:	ibrd-carbonfinance@worldbank.org
URL:	www.carbonfinance.org
Represented by:	
Title:	Director
Salutation:	Ms.
Last Name:	Joelle
Middle Name:	
First Name:	Chassard
Department:	Carbon Finance Unit
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public fund for this project.

Annex 3

BASELINE INFORMATION

Chinese DNA has already published the emission factor of North China Power Grid at its web site, http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=1235. The data of NCPG are shown as follows.

Emission factor of North China Power Grid[6,7,8,9]

I. Operation Margin

Data of fuel consumed and electricity generation& supply by the NCPG during the year of 2002~2004, which is most recently available

Year 2002 - Fuel consumed

Fuel type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Subtotal	Emission factor (tc/TJ)	Oxidation (%)	LHV (MJ/t,km3)	CO_2 emission (tCO_2e) K=G*H*I*J*44/12/10000 (Weight)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J*44/12/1000 (Volumn)
Raw coal	10^4 tn	691.84	1052.74	4988.01	4037.39	3218	5162.86	**19150.84**	25.8	98	20908	371208174.5
Cleaned coal	10^4 tn						80.71	**80.71**	25.8	98	26344	1971179.968
Other washed coal	10^4 tn	3.43		65.2	135.56		106.32	**310.51**	25.8	98	8363	2407436.829
Coke oven	10^4 tn							**0**	29.5	98	28435	0
Coke oven gas	10^8 m^3	0.17	1.71		0.75	0.16	0.04	**2.83**	13	99.5	16726	224500.0238
Other gas	10^8 m^3	15.82		7.34		10.35		**33.51**	13	99.5	5227	830739.3673
Crude oil	10^4 tn						14.98	**14.98**	20	99	41816	454769.0717
Gasoline	10^4 tn						0.65	**0.65**	18.9	99	43070	19206.87269
Diesel oil	10^4 tn	0.26	2.35	4.12		1.6	10.02	**18.35**	20.2	99	42652	573896.3513
Fuel oil	10^4 tn	13.94	0.04	1.22		0.42	20.33	**35.95**	21.1	99	41816	1151411.233
PLG	10^4 tn							**0**	17.2	99.5	50179	0
Refinery gas	10^4 tn			0.27				**0.27**	18.2	99.5	46055	8256.698951
Natural gas	10^8 m^3		0.55			0.02		**0.57**	15.3	99.5	38931	123867.2104
Other petroleum products	10^4 tn							**0**	20	99	38369	0
Other coking products	10^4 tn							**0**	25.8	98	28435	0
Other energy	10^4 tce					1.1	15.92	**17.02**	0	0	0	0
											Subtotal	378973438.1

[6] China Energy Statistical Yearbook 2000~2006
[7] China Electric Power Yearbook 2002~2005
[8] Revised IPCC 1996
[9] http://cdm.ccchina.gov.cn/web/index.asp

Year 2002 – Electricity generation and supply

Name	Generation (MWh)	On-site use (%)	Power supply (MWh)
Beijing	17,886,000	7.95	16464063
Tianjin	27,263,000	7.08	25332779.6
Hebei	100,970,000	6.72	94184816
Shanxi	82,256,000	7.98	75691971.2
Inner Mongolia	51,382,000	7.93	47307407.4
Shandong	124,162,000	6.79	115731400.2
Total			374712437.4

Year 2003 – Fuel consumed

Fuel type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Subtotal	Emission factor (tc/TJ)	Oxidation (%)	LHV (MJ/t,km3)	CO_2 emission (tCO_2e) K=G*H*I*J*44/12/10000 (Weight)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J*44/12/1000 (Volumn)
Raw coal	10^4 tn	714.73	1052.74	5482.64	4528.51	3949.32	6808	**22535.94**	25.8	98	20908	436822883.4
Cleaned coal	10^4 tn						9.41	**9.41**	25.8	98	26344	229820.3878
Other washed coal	10^4 tn	6.31		67.28	208.21		450.9	**732.7**	25.8	98	8363	5680747.688
Coke oven	10^4 tn					2.8		**2.8**	29.5	98	28435	84397.73393
Coke oven gas	10^8 m^3	0.24	1.71		0.9	0.21	0.02	**3.08**	13	99.5	16726	244332.1814
Other gas	10^8 m^3	16.92		10.63		10.32	1.56	**39.43**	13	99.5	5227	977500.8431
Crude oil	10^4 tn						29.68	**29.68**	20	99	41816	901037.7869
Gasoline	10^4 tn						0.01	**0.01**	18.9	99	43070	295.490349
Diesel oil	10^4 tn	0.29	1.35	4		2.91	5.4	**13.95**	20.2	99	42652	436286.327
Fuel oil	10^4 tn	13.95	0.02	1.11		0.65	10.07	**25.8**	21.1	99	41816	826325.7251
PLG	10^4 tn							**0**	17.2	99.5	50179	0
Refinery gas	10^4 tn			0.27			0.83	**1.1**	18.2	99.5	46055	33638.40313
Natural gas	10^8 m^3		0.5				1.08	**1.58**	15.3	99.5	38931	343351.2148
Other petroleum products	10^4 tn							**0**	20	99	38369	0
Other coking products	10^4 tn							**0**	25.8	98	28435	0
Other energy	10^4 tce	9.83					39.21	**49.04**	0	0	0	0
											Subtotal	446580617.2

Year 2003 – Electricity generation and supply

Name	Generation (MWh)	On-site use (%)	Power supply (MWh)
Beijing	18,608,000	7.52	17,208,678
Tianjin	32,191,000	6.79	30,005,231
Hebei	108,261,000	6.5	101,224,035
Shanxi	93,962,000	7.69	86,736,322
Inner Mongolia	65,106,000	7.66	60,118,880
Shandong	139,547,000	6.79	130,071,759
Total			425,364,906

Year 2004 – Fuel consumed

Fuel type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Subtotal	Emission factor	Oxidation	LHV	CO_2 emission（tCO_2e）
									（tc/TJ）	（%）	（MJ/t,km3）	K=G*H*I*J*44/12/10000（Weight）
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J*44/12/1000 (Volumn)
Raw coal	10^4 tn	823.09	1410	6299.8	5213.2	4932.2	8550	**27228.29**	25.8	98	20908	527776527.1
Cleaned coal	10^4 tn						40	**40**	25.8	98	26344	976919.8208
Other washed coal	10^4 tn	6.48		101.04	354.17		284.22	**745.91**	25.8	98	8363	5783167.065
Coke oven	10^4 tn					0.22		**0.22**	29.5	98	28435	6631.250523
Coke oven gas	10^8 m^3	0.55		0.54	5.32	0.4	8.73	**15.54**	13	99.5	16726	1232766.915
Other gas	10^8 m^3	17.74		24.25	8.2	16.47	1.41	**68.07**	13	99.5	5227	1687509.064
Crude oil	10^4 tn							**0**	20	99	41816	0
Diesel oil	10^4 tn	0.39	0.84	4.66				**5.89**	20.2	99	42652	184209.7825
Fuel oil	10^4 tn	14.66		0.16				**14.82**	21.1	99	41816	474656.87
PLG	10^4 tn							**0**	17.2	99.5	50179	0
Refinery gas	10^4 tn		0.55	1.42				**1.97**	18.2	99.5	46055	60243.32197
Natural gas	10^8 m^3		0.37		0.19			**0.56**	15.3	99.5	38931	121694.1015
Other petroleum product	10^4 tn							**0**	20	99	38369	0
Other coking products	10^4 tn							**0**	25.8	98	28435	0
Other energy	10^4 tce	9.41		34.64	109.73	4.48		**158.26**	0	0	0	0
											小计	538304325.3

Year 2004 – Electricity generation and supply

Name	Generation （MWh)	On-site use （%）	Power supply （MWh)
Beijing	18,579,000	7.94	17,103,827
Tianjin	33,952,000	6.35	31,796,048
Hebei	124,970,000	6.5	116,846,950
Shanxi	104,926,000	7.7	96,846,698
Inner Mongolia	80,427,000	7.17	74,660,384
Shandong	163,918,000	7.32	151,919,202
Total			489,173,110

Furthermore, North China Power Grid imported electricity from Northeast China Power Grid (“NECPG”) in the past three years. The following table shows the imported quantity and the emission factors of Northeast China Power Grid.

	2002	2003	2004
Imported quantity (MWh)	2905200	4244380	4514550
Emission factor of NECPG (tCO_2e/MWh)	1.03025	1.09603	1.22042
Imported emissions from NECPG (tCO_2e)	2993082	4651968	5509647
Total emissions (tCO_2e)	381966513	451232602	543813992
Total power supply (MWh)	377617637	429609286	493687660

II. **Build Margin**

Fuel consumption and emission on the NCPG in 2004

Fuel type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Subtotal	Emission factor	Oxidation	LHV		CO_2 emission（tCO_2e） K=G*H*I*J*44/12/100
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J		
Raw coal	10^4 tn	823.09	1410.00	6299.80	5213.20	4932.20	8550.00	**27228.29**	25.8	0.98	20908	kJ/kg	527,776,527
Cleaned coal	10^4 tn	0	0	0	0	0	40	**40**	25.8	0.98	26344	kJ/kg	976,920
Other washed coal	10^4 tn	6.48	0	101.04	354.17	0	284.22	**745.91**	25.8	0.98	8363	kJ/kg	5,783,167
Coke oven	10^4 tn	0	0	0	0	0.22	0	**0.22**	29.5	0.98	28435	kJ/kg	6,631
Sub-Total													**534,543,245**
Crude oil	10^4 tn	0	0	0	0	0	0	**0**	20.0	0.99	41816	kJ/kg	-
Gasoline	10^4 tn	0	0	0	0	0	0	**0**	18.9	0.99	43070	kJ/kg	-
Kerosene	10^4 tn	0	0	0	0	0	0	**0**	19.6	0.99	43070	kJ/kg	-
Diesel oil	10^4 tn	0.39	0.84	4.66	0	0	0	**5.89**	20.2	0.99	42652	kJ/kg	184,210
Fuel oil	10^4 tn	14.66	0	0.16	0	0	0	**14.82**	21.1	0.99	41816	kJ/kg	474,657
Other petroleum products	10^4 tn	0	0	0	0	0	0	**0**	20	0.99	38369	kJ/kg	-
Sub-Total													**658,867**
Natural gas	10^9 m^3	0	3.7	0	1.9	0	0	**5.6**	15.3	0.995	38931	kJ/m^3	121,694
Coke oven gas	10^9 m^3	5.5	0	5.4	53.2	4.0	87.3	**155.4**	13.0	0.995	16726	kJ/m^3	1,232,767
Other gas	10^9 m^3	177.4	0	242.5	82.0	164.7	14.1	**680.7**	13.0	0.995	5227	kJ/m^3	1,687,509
PLG	10^4 tn	0	0	0	0	0	0	**0**	17.2	0.995	50179	kJ/m^3	-
Refinery gas	10^4 tn	0	0.55	1.42	0	0	0	**1.97**	18.2	0.995	46055	kJ/m^3	60,243
Sub-Total													**3,102,213**
Total													**538,304,325**

Additional capacity during the 2001~2004 on the NCPG

Year 2001 – Capacity installation

No.	Area	Capacity (MW)				
		Total	Hydro	Thermal	Nuclear	Other
		72,071.8	3,224.0	68,791.2	0.0	56.6
1	Beijing	4,470.6	1,058.1	3,412.5	0.0	0.0
2	Tianjin	5,637.0	5.0	5,632.0	0.0	0.0
3	Hebei	17,227.4	742.6	16,474.9	0.0	9.9
4	Shanxi	14,211.7	795.9	13,415.8	0.0	0.0
5	Inner Mongolia	9,511.2	566.2	8,898.3	0.0	46.7
6	Shandong	21,013.9	56.2	20,957.7	0.0	0.0

Year 2003 – Capacity installation

No.	Area	Capacity (MW)				
		Total	Hydro	Thermal	Nuclear	Other
		87,362.7	3,215.2	53,512.2	0.0	90.1
1	Beijing	4,405.6	1,058.1	3,347.5	0.0	0.0
2	Tianjin	6,013.5	5.0	6,008.5	0.0	0.0
3	Hebei	18,476.5	764.3	17,698.7	0.0	13.5
4	Shanxi	15,831.5	795.7	15,035.8	0.0	0.0
5	Inner Mongolia	12,090.4	592.1	11,421.7	0.0	76.6
6	Shandong	30,545.2	50.8	30,494.4	0.0	0.0

Year 2004 – Capacity installation

No.	Area	Capacity (MW)				
		Total	Hydro	Thermal	Nuclear	Other
		96,983.3	3,250.7	93,594.9	0.0	137.7
1	Beijing	4,514.4	1,055.9	3,458.5	0.0	0.0
2	Tianjin	6,013.5	5.0	6,008.5	0.0	0.0

3	Hebei	20,730.0	783.8	19,932.7	0.0	13.5
4	Shanxi	18,480.6	787.3	17,693.3	0.0	0.0
5	Inner Mongolia	14,321.2	567.9	13,641.5	0.0	111.8
6	Shandong	32,923.6	50.8	32,860.4	0.0	12.4

Therefore, the Build Margin of North China Power Grid is calculated in the table below:

Capacity		2001	2002	2004	additional capacity 2001-2004	Share in the additional capacity
		A	B	C	D=C-A	
Thermal	(MW)	68791.3	75607.6	93594.9	24803.6	99.57%
Hydro	(MW)	3224	3257.6	3250.7	26.7	0.11%
Nuclear	(MW)	0	0	0	0	0.00%
Other	(MW)	56.6	90.1	137.7	81.1	0.33%
Total	(MW)	72071.9	78955.3	96983.3	24911.4	100.00%
Share in the capacity of 2004		74.31%	81.41%	100.00%		

Taking the default value of weights W_{OM} and W_{BM}, 50% respectively, the emission factor of North China Power Grid is calculated as follows. For more details please refer to ***http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=1235***, on which all data are published by Chinese DNA.

	OM (tCO_2/MWh)	**BM (tCO_2/MWh)**	**EF (tCO_2/MWh)**
North China Power Grid	**1.0585**	**0.9066**	**0.9826**

Annex 4

MONITORING INFORMATION

Please refer to the section B.7 of this document for monitoring information.