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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Controlled combustion of municipal solid waste (MSW) and energy generation in Linyi City, Shandong, China (the Project activity or the Project)
(Version 4.0, 10/02/2009)

A.2. Description of the project activity:

The Project activity involves the controlled combustion of municipal solid waste (MSW) to generate electricity and heat in Linyi City, Shandong Province, China. Linyi City disposes of its MSW at the Linyi Landfill Site, a managed anaerobic solid waste disposal site. Under the Project activity, Linyi National Environmental New Energy Co., Ltd., installed two waste-combustion fluidized-bed boilers with rated steam capacities of 75t/hour, and each able to deal with 400t/day of MSW. The MSW combusted in the Project would have been disposed of at the Linyi Landfill Site for MSW Sanitation Treatment, which was built in 1999, and is capable of dealing with 900 tons/day of MSW over its projected 22-year lifespan. The Linyi Landfill Site does not currently have a gas capture system installed, as it is not required by the Chinese regulatory authorities.[1] Furthermore, disposing of all MSW at landfill is acceptable according to the waste disposal guidelines.

The waste will be co-combusted with coal in order to ensure complete firing of the waste in two circularized fluidized bed boilers that were constructed under the project activity. Steam produced by the boilers feeds into a 25MW steam turbine-generator and steam containing excess thermal energy will be exported via a pipeline to customers in a nearby wood-processing industrial park. The electricity produced by the Project activity will displace electricity generated by power plants connected to the regional North China Grid. The nearby industrial park currently meets its thermal energy needs through on-site coal-fired boilers, and would continue to do so in the absence of a supply of thermal energy from the Project activity.

When fully operational, the Project is expected to generate a total of 168,300MWh/yr of electricity and to be providing customers at the industrial park with 912,000GJ/year of energy. Parasitic use of electricity is expected to be approximately 22%, therefore, the total electricity exported to the North China Power Grid is estimated as 131,274MWh/yr. The Project activity will be brought up to full operational capacity in a number of stages as time is required to complete testing and bring equipment fully online. The first year sees only one boiler in operation, with the second boiler coming online from the second year. Furthermore, for the export of thermal energy the Project proponent will have to develop the necessary infrastructure and is expecting to have to overcome technical difficulties; therefore, the implementation of this part of the Project has been planned in four stages: 0% of full capacity (i.e. 0% of 912,000GJ) in the first year, 33% in the second year, 66% in the third year and 100% from the fourth year onwards.

The project achieves GHG emission reductions by avoiding CH_4 emissions that would have occurred as a result of landfilling of the MSW. It also leads to emission reductions through the

[1] Landfill Technology Codes for MSW, enforced on January 15, 1999, Chinese regulation reference no. CJJ17-88

displacement of grid electricity and of thermal energy currently produced by coal-fired boilers at a nearby industrial park.

Total emission reductions over the 7-year crediting period are expected to be in the region of 580,000 tCO_2e.

The project contributes to sustainable development in the local area in a number of ways:
Avoided MSW dumping: In the absence of the Project activity the MSW would be landfilled and left to decay in anaerobic conditions, resulting in the release of methane, a potent GHG, and putrid odours.
This project creates a significant number of jobs for local people for the construction, operation and maintenance stages. These staff will receive comprehensive training as necessary in the technology to be used by the Project activity.
Renewable energy production, reducing consumption of fossil fuels: The Project will lead to lower emissions of SO_x and NO_x as the activity reduces the use of fossil fuels used in electricity generation. This also contributes to national goals of greater energy security as it reduces the country's need to rely on imports of fossil fuels.

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 a project participant (Yes/ No)
China (host)	**Linyi National Environmental New Energy Co., Ltd(**)**	No
Portugal	**LUSO Carbon Fund**	No
(*) In accordance with the CDM modalities and procedures, at the time of making the PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required. (**) A private entity 60% owned by China National Environmental Protection Corporation, and 40% owned by Eden Investment Co., Ltd. (Hong Kong). The CDM aspects of the Project will be managed by staff at CECIC Blue-Sky Investment Consulting & Manage ment Co., Ltd, a subsidiary of China National Environmental Protection Corporation.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

China

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

Shandong Province

A.4.1.3. City/Town/Community etc:

Hengyuan, Linyi City

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

Linyi City, situated in the southeast of Shandong Province in P.R. China, covering an area of 409km^2, and with a population of 10 million, is the largest administrative division in the province. The Project activity is located in the northwest of Linyi City. The co-ordinates of the site are: 118º13`46″E, and 35º06`37″N. To the east of the Project site is the Jinghu highway, to the south is the Jucai road, and to the west is an industrial park.

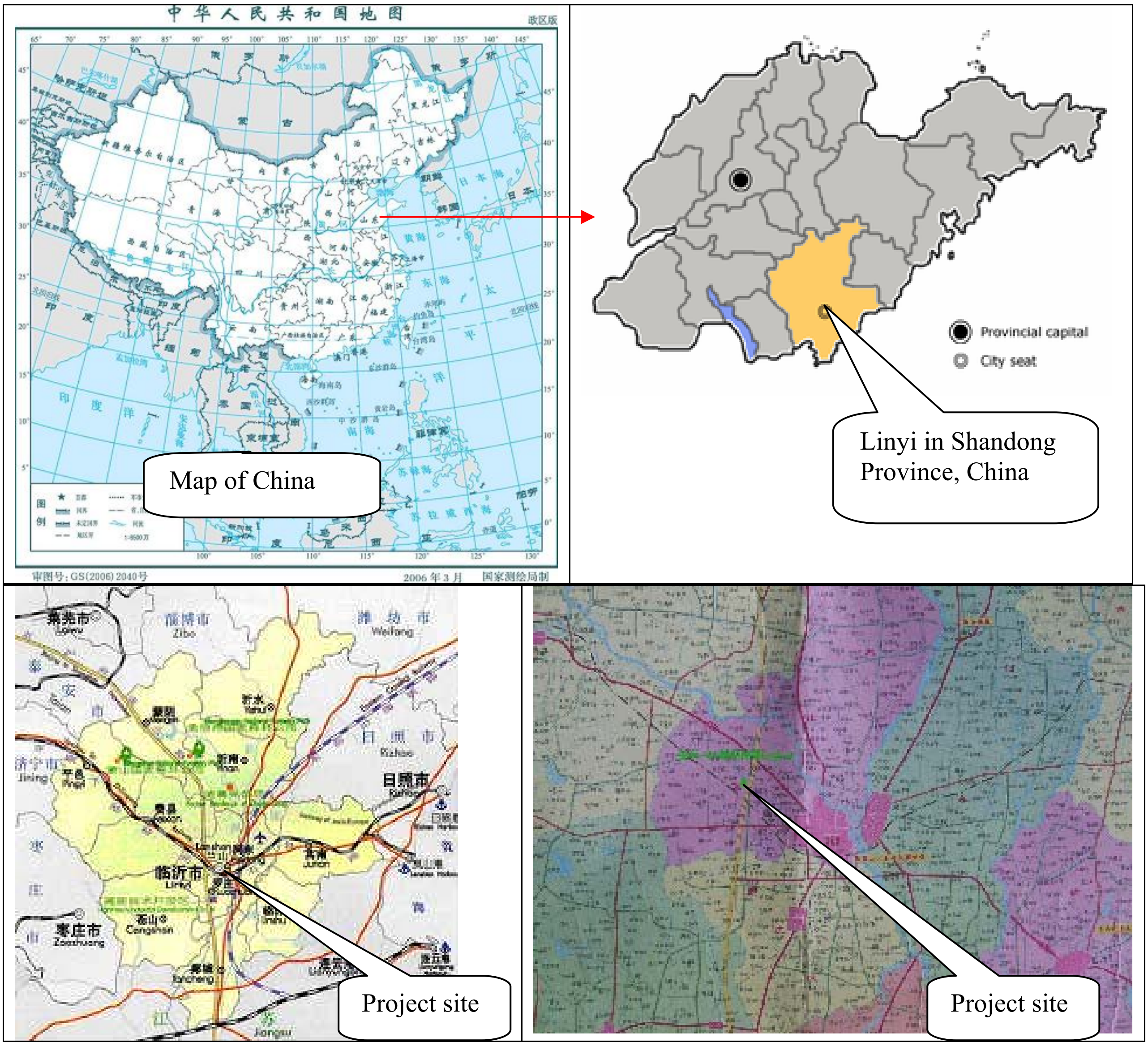

Figure 1. Location of site of Project activity

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

The Project comes under the following category:
Sectoral Scope 1: Energy industry
Sectoral Scope 13: Waste handling and disposal

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

The Project is a greenfield project that involves the construction of an MSW incineration plant. The plant will utilize MSW that would previously have disposed of at landfill, and will generate electricity to displace grid-generated electricity and thermal energy to displace that produced in small coal-fired boilers.

The Project plant will employ two waste-combustion fluid-bed boilers with rated steam capacities of 75t/hour, and each able to deal with 400t/day of MSW. The steam produced by the boilers will feed into a 25MW steam turbine-generator co-designed by the Chinese Academy of Science and Zhonglian Environmental Protection Co., Ltd. The boilers will be supplied by Wuxi Huaguang Boiler Plant, a boiler supplier with some of the most advanced domestically produced technology. The plant has been designed to have an operational lifetime of approximately 22 years. By combusting the waste, the plant will be able to provide the service of municipal solid waste disposal. The level of service provided will be equivalent to the service provided by the landfill site at which disposal of MSW was handled in the baseline scenario.

Under the Project Activity the MSW is weighed with a weighbridge upon entry to the site, and then transported to a holding facility. From the holding facility, the MSW is fed into the boiler using ceiling-mounted cranes. Coal will be fed into the boiler using a conveyor-belt system in which weighing apparatus is installed. During full operation, the plant is expected to handle approximately 800 tonnes of MSW per day and one quarter of that amount of coal will be co-combusted to ensure complete combustion.

Total electricity generation and on-site consumption are monitored by meters in the power distribution room of the facility. The main electricity meter to be used for measuring exports is located in the meter room of Linyi Transformation Substation. A back-up meter is located in the central control building of the Project site. Annual electricity generation is expected to be approximately 168,300 MWh/year

The main flow meter for thermal energy will be installed with temperature and pressure meters in the main thermal energy supply pipe on-site. Each thermal energy user will also have flow, temperature and pressure monitored at the inlet connection for the respective facilities. Project company staff will record data on the user-inlet meters daily and the data will be aggregated monthly to provide the basis for calculating payments for thermal energy use. Thermal energy exports are to be in the form of steam and are expected to be in the region of 912,000GJ/year.

Turbine (1 set)

Data Item	**Value**
Model	C25-4.9/0.98
Rated steam pressure inflow	4.9 (4.60~5.10) MPa(a)
Rated power	**25 MW**

Maximum power	30 MW
Rated steam extraction pressure	0.98 MPa(a)/300ºC
Steam extraction pressure (scope)	0.785~1.275 MPa(a)
Rated steam extraction volume	70 t/h
Maximum steam extraction volume	130 t/h
Steam flow pressure in rated operating mode	4.194 KPa(a)
Steam consumption in rated operating mode (guarantee value)	6.17 kg/kw.h
Heat consumption in rated operating mode (guarantee value)	8949 kJ/kw.h
Steam flow pressure in condensing operating mode	4.194~4.334 KPa(a)
Steam consumption in condensing operating mode (guarantee value)	4.113 kg/kw.h
Heat consumption in condensing operating mode (guarantee value)	11165 kJ/kw.h
Temperature of fed-in water	153ºC
Rated rotation speed	3000 r/min

Generator (1 set)

Data Item	**Value**
Model	QFW-30-2
Rated voltage	10.5KV
Rated flow	2062A
Rated power	30MW
Power factor	0.8
Rated rotation speed	3000r/min
Frequency	50Hz
States	3
Efficiency	97.4%
Maximum working pressure	0.196 MPa
Temperature of fed-in water	≤ 33ºC
Temperature of air used for cooling	≤ 40ºC
Noise (1 meter from the equipment)	≤ 90dB(A)

CFB boilers (2 sets)

Data Item	**Value**
Model	UG-75/5.29-MT
MSW disposal capacity	**400t/d**
Maximum capacity	**500t/d**
Rated steam capacity	**75t/h**
Flue gas temperature	150ºC
Rated steam temperature	485ºC
Efficiency	81%
Rated steam pressure	5.29MPa
Combustion mode	CFB

Temperature of fed-in water	150ºC
Height of operation layer	7m
Coal	0~10mm
Load range	50~110%
Temperature of air used for cooling	30ºC
Boiler installation	Semi-outdoor

Pollution control equipment and measures, flue gas filtration and other waste disposal

MSW will be mixed with coal in a 4:1 ratio by weight. The boilers are designed to allow combustion at 860ºC, which will improve the efficiency of MSW combustion, destroy organic pollutants, and limit the production of toxic substances such as dioxins.

The flue gas of this system contains SO_2 and HCl, therefore, an MHGT gas-filtering system will be installed to remove more than 90% of the SO_2, more than 95% of the HCl, and more than 99% of the particulate matter, thereby meeting the Chinese MSW Combustion Pollution Control Code. In addition to this, activated carbon will be used to extract dioxins and heavy metals, and bag filters will be used to remove particulate matter.

Sewage and residue will be treated in order to bring it to within national standards before release into the municipal sewage system.

Leachate from the MSW waiting to be incinerated will be collected and added to the boilers by means of sewage pumps. The energy required to power the pumps will be included in the energy balance of the plant.

An automatic control system (DCS), comprising of a control system, operation system, engineering system, communication network, remote I/O, and spot meters, will be installed to monitor particulate matter, SO_2, HCl, NO_x, O_2, CO, and CO_2 emissions in the flue gas in order to ensure they meet national standards.

The National Emissions Index limits are shown in the following table:

Pollutant	***Emission intensity (mg/m^3, unless otherwise stated)***	
	Predicted emission value	***National limit***
SO_2	*160*	*260*
HCl	*30*	*75*
Flue gas particulate matter	*40*	*80*
Dioxin	*0.1ng/m^3*	*1ng/m^3 (TEQ)*

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

Years	Annual estimation of emission reductions in tonnes CO_2e
Year 1 (2009)	(-2,164) 0*
Year 2 (2010)	(45,586) 43,422*
Year 3 (2011)	94,067
Year 4 (2012)	101,471
Year 5 (2013)	108,464
Year 6 (2014)	115,067
Year 7 (2015)	121,304
Total estimated reductions (tonnes CO_2)	583,796
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**83,399**

* The Project emissions are negative in the first year; therefore, the amount is deducted from the emission reductions achieved in the second year.
NB: The earliest the Project is expected to gain registration is in March 2009, therefore, for simplicity's sake the CERs estimations begin from the beginning of 2009..

A.4.5. Public funding of the project activity:

The financial plans for the Project activity do not involve any public funding from Annex 1 countries.

SECTION B. Application of a baseline and monitoring methodology

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

This section was prepared using AM0025 version 10, "Avoided emissions from organic waste through alternative waste treatment processes"; and referring to the Tool to calculate the emission factor of an electricity system (Version 1); the Tool for the demonstration and assessment of additionality (Version 5); and the Tool to determine methane emissions avoided from dumping of waste at a solid waste disposal site (Version 3).

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

AM0025 is applicable to projects which involve the combustion of fresh waste which would otherwise be landfilled, to generate electricity and heat.

Specific details as to how the Project meets the applicability of AM0025 are given below:

- The project activity involves one of the following waste treatment options for the fresh waste that in a given year would have otherwise been disposed of in a landfill:
  a) a composting process in aerobic conditions;
  b) gasification to produce syngas and its use;
  c) anaerobic digestion with biogas collection and flaring and/or its use;
  d) mechanical/thermal treatment process to produce refuse-derived fuel /stabilized biomass and its use;
  e) incineration of fresh waste for energy generation, electricity and/or heat. The thermal energy generated is either consumed on-site and/or exported to a nearby facility. Electricity generated is either consumed on-site , exported to the grid or exported to a nearby facility. The incinerator is rotating fluidized bed or hearth or grate type;

Fresh waste will be incinerated in a circulating fluidized bed-type incinerator to produce thermal and electrical energy. The thermal energy will be exported to a nearby industrial park, and the electrical energy remaining after meeting the plants own needs will be exported to the grid. In the absence of the Project activity, the waste would be delivered to a landfill and allowed to decompose under anaerobic conditions.

- In the case of incineration of the waste, the waste should not be stored longer than 10 days. The waste should not be stored in conditions that would lead to anaerobic decomposition and, hence, generation of CH_4.

The waste will be stockpiled before combustion for no longer than 10 days. The capacity of the holding facility for the waste is 5000 tonnes; less than 10 days' worth of MSW for the 800 tonnes/day plant. Therefore, MSW will not be held for a long enough period for anaerobic breakdown to occur to a significant degree. During the first year, when the plant will only be combusting 400 tonnes per day of MSW, the amount of waste delivered to the plant, and

therefore held in the holding facility, will be reduced to meet the requirements of this applicability condition.

- The proportions and characteristics of different types of organic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity.

Detailed information on the proportions and characteristics of the MSW is included in this CDM PDD. The information was gathered through actual sampling and analysis over the period 2003-2005 of waste from the same sources as are to supply the Project activity.

- The project activity may include electricity generation and/or thermal energy generation from the biogas, syngas captured, RDF processed or fresh waste, respectively, from the anaerobic digester, the gasifier, RDF combustor and fresh waste combustor. The electricity can be exported to the grid and/or used internally at the project site.

The Project activity involves the generation of electricity and thermal energy using fresh waste combustors (special purpose boilers). The combustors will consume waste in the form of MSW. The electricity produced will be used to supply the site and the remainder will be exported to the local grid. Excess thermal energy will be exported to factories at a nearby industrial park.

- The residual waste from the incinerator does not contain more than 1% residual carbon.

According to the feasibility study, the residual waste from the incinerator will contain less than 1% residual carbon.

- The compliance rate of the environmental regulations during (part of) the crediting period is below 50%; if monitored compliance with the MSW rules exceeds 50%, the project activity shall receive no further credit, since the assumption that the policy is not enforced is no longer tenable.

There are currently no regulations requiring that MSW be disposed of by any of methods a) to e) above. The situation will be monitored every year to ensure compliance.

The Project activity involves the incineration of municipal solid waste originally intended for landfill. By diverting the MSW from disposal at a landfill, the methane emissions that would have been caused by the anaerobic breakdown of the MSW in the landfill will be avoided. Furthermore, combusting the waste to produce electricity to meet the needs of the site and for export to the local grid, and the sale of thermal energy to a nearby industrial site to replace thermal energy previously supplied by coal boilers, will replace energy production by more fossil fuel-intensive methods, leading to additional emission reductions. The above factors are all in accordance with the requirements of the methodology, and this PDD calculates carbon emission reductions accordingly.

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

The spatial extent of the Project boundary is shown in the figure below, and includes: the site of the Project activity where the waste is to be treated, including the facilities for processing the waste, on-site electricity generation and consumption, onsite fuel use, thermal energy generation and the wastewater

treatment facility; the Linyi Landfill Site; the boilers at the nearby industrial park that supply the thermal energy that is to be displaced in the Project activity; and the electricity generation plants connected to the North China Grid.

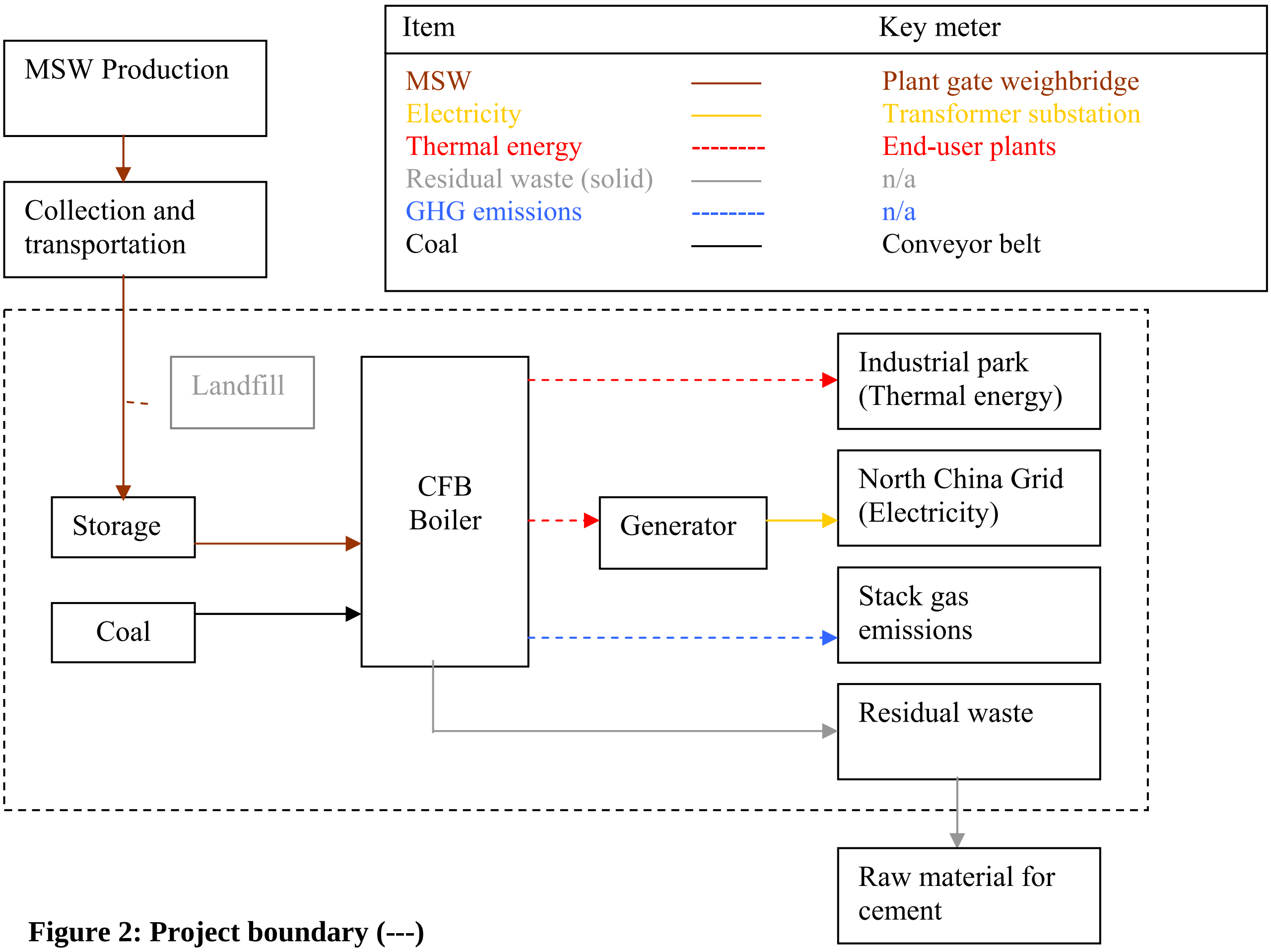

Figure 2: Project boundary (---)

Emission sources and gases included in or excluded from the Project boundary are listed in the following table:

Emissions sources included in or excluded from the Project boundary:

	Source	**Gas**	**Included?**	**Justification / Explanation**
Baseline	Emissions from electricity consumption	CO_2	Included	Electricity is provided to the site mainly by coal-fired power stations on the North China Grid. The Project activity will generate enough electricity to export to the grid.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from decomposition of waste at the landfill site	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not counted.
		CH_4	Included	Main source of emissions in the baseline.
		N_2O	Excluded	Excluded for simplification. This is conservative.

	Emissions from thermal energy generation	CO_2	Included	Displaces thermal energy generation by customers nearby who use coal-fired boilers.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project activity	Emissions from on-site electricity use	CO_2	Included	All electricity to be used by the Project activity is expected to be supplied by the Project's generators. CO_2 emissions from the on-site generation are calculated in 'Direct emissions from the waste treatment process'; however, if any electricity is drawn from the grid, the amount will be recorded to calculate the corresponding emissions.
		CH_4	Excluded	Amount is negligible so excluded for reasons of simplification.
		N_2O	Excluded	Amount is negligible so excluded for reasons of simplification.
	On-site fossil fuel consumption due to the Project activity other than for electricity generation	CO_2	Included	Will be an important emission source as it includes the coal that is co-combusted with the MSW.
		CH_4	Excluded	Amount is negligible so excluded for reasons of simplification.
		N_2O	Excluded	Amount is negligible so excluded for reasons of simplification.
	Direct emissions from the waste treatment process	CO_2	Included	CO_2 emissions from the combustion process shall be included as MSW contains various sources of fossilised carbon.
		CH_4	Included	In the experience of the project owner, the temperatures involved in the combustion process are high enough to ensure all CH_4 is combusted; however, emissions from this source will be recorded.
		N_2O	Included	A small amount of N_2O is produced from fresh waste combustion.
	Emissions from waste water treatment	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Included	The wastewater treatment should not result in CH_4 emissions, such as in anaerobic treatment; otherwise accounting for these emissions should be done.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.

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

The selection of the most plausible baseline scenario is performed as directed in the methodology.

Step 1: Identification of alternative scenarios.

The following credible alternatives are analyzed:
For MSW management, the alternatives considered are as follows:

M1 The project activity (i.e. incineration of waste) not implemented as a CDM project.
M2 Disposal of the waste at a landfill where landfill gas captured is flared
M3 Disposal of the waste on a landfill without the capture of landfill gas.

For electricity generation, the alternatives considered are as follows:

P1 Power generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity.
P2 Construction of a new on-site or off-site fossil fuel fired cogeneration plant.
P3 Construction of a new on-site or off-site renewable based captive power plant.
P4 Construction of a new on-site or off-site fossil fuel fired captive power plant.
P5 Construction of a new on-site or off-site renewable based captive power plant.
P6 Existing and/or new grid-connected power plants.

For heat generation, the alternatives considered are as follows:

H1 Heat generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity.
H2 Existing or Construction of a new on-site or off-site fossil fuel fired cogeneration plant.
H3 Existing or Construction of a new on-site or off-site renewable based cogeneration plant.
H4 Existing or new construction of on-site or off-site fossil fuel fired boilers.
H5 Existing or new construction of on-site or off-site renewable energy based boilers.
H6 Any other source such as district heat.
H7 Other heat generation technologies.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and sectoral policies as applicable.

As described in further detail in section B.5 below, M1 is not a realistic scenario because an incineration plant would not be a viable option for a company in the region. The revenue available for the disposal of the waste is relatively low when compared to the high initial capital costs required for such a project, meaning that such a project would have difficulty completing financial closure without significant public assistance. The fact that only around 3.72% of waste in China is disposed of by incineration[2] clearly supports this view.

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[2] The current situation of solid waste management in China, Qifei Huang *et al.*, Journal of Material Cycles and Waste Management (2006)

In the case of M2, there is no alternative landfill in the region with methane capture and destruction facilities and the capacity to handle the extra waste. Given the costs associated with the installation and operation of landfill gas capture facilities, and the absence of regulations requiring them, installation is not likely. In the absence of CDM-revenue or some other subsidy program to provide an incentive, the waste would have been disposed of at the Linyi Landfill Site and the capture and destruction of landfill gas would not occur. Therefore, the most likely scenario for the waste is M3: the continued disposal of MSW at Linyi Landfill Site for MSW Sanitation Treatment.

In the case of P1, according to a review of waste-handling practice in China performed by Shanghai JEC Environmental Consultant Co., Ltd., at the end of 2003 there were 457 landfills serving the 660 major Chinese cities included in the review[3]. Apart from simple safety control systems to prevent explosions, the overwhelming majority vent LFG directly into the atmosphere. The few that do utilize the LFG are all demonstration projects or receive additional funding from development organisations[4].

P2 would not be feasible as the construction and operation of a fossil fuel fired power plant below 135 MW in capacity is not permitted under current Chinese regulations. There is no alternative cogeneration plant in the area.

P3 would not be feasible because of the high investment costs and the relative lack of a suitable renewable energy source in the area.

P4 and P5 do not apply to this project as the MSW incineration plant is seeking to generate electricity primarily for sale to the local grid, rather than to meet existing energy requirements. In the absence of the project activity; therefore, P6 is the most likely scenario for the supply of electricity to the North China Power Grid: existing and new grid-connected power plants would supply electricity.

In the case of H1, financial closure would be difficult because the gas produced would need to be transported over 20km (to the region of the proposed incinerator) in order to reach industrial operations of a big enough scale to meet the supply. This would require a prohibitively large initial investment in pipelines and the installation of boilers able to burn the gas, as well as increased operation and maintenance costs. The returns of such projects are not high enough to justify large-scale implementation on income from energy alone. Furthermore, financial closure would only be possible under exceptional circumstances.

H2 and H3 would not be possible as the thermal energy requirements of the companies to be supplied under the project activity are currently met by existing coal-fired boilers. Investment in a cogeneration or thermal energy plant by the companies would not be feasible given that they have existing boiler equipment and the high investment costs and risks of a new purpose-built facility.

In the case of H4, as in the case of H2 and H3 above, the companies to be supplied by the project activity already have fossil fuel fired boilers installed, therefore, the continued use of these boilers is the

[3] http://www.shjec.cn/new/article.asp?articleid=17#top

[4] Environmental and Health Challenges of Municipal Solid Waste in China, SL Jones, China Environment Forum (2007) http://www.wilsoncenter.org/INDEX.CFM?TOPIC_ID=1421&FUSEACTION=TOPICS.ITEM&NEWS_ID=218565

most likely scenario in the absence of the project activity given there are no regulations prohibiting their use.

In the case of H5, there is no local supply of a renewable energy resource that could be used in place of the anthracite without incurring prohibitive costs or supply risks, furthermore, the investment required to adapt the existing boilers to use a renewable resource would not be economical without an additional income stream such as that obtained through CDM.

In the case of H6 and H7, no other alternative thermal energy source is available, and alternative heat generation technologies such as heat pumps or solar energy would either not be economical to install given that boilers are already in place, or they would not supply sufficient heat to meet requirements.

Therefore, the most realistic and credible baseline scenario is H4, "disposal of waste at a landfill without the capture of landfill gas".

As described above, the Project activity requires supplementary income from the CDM in order to be implemented. The Project participant proceeded with the implementation of this Project with the expectation that it would be registered as a CDM project activity and issued with CERs in the future. In the absence of the Project activity, the most likely scenario is, as described above, as follows:

- M3 Disposal of the waste on a landfill without the capture of landfill gas.
- P6 Existing and/or new grid-connected power plants.
- H4 Existing or new construction of on-site or off-site fossil fuel fired boilers.

The Project therefore corresponds to Scenario 1 in the methodology.

Step 3 and Step 4 of the methodology are described in section B.5. below

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):

Additionality is assessed and demonstrated using the latest version of the Tool for the demonstration and assessment of additionality (Version 5).

Below are the project development and CDM development timelines for the Linyi Project:

Project timeline (in order of occurrence)	**Date**	**Reference**
Initial Feasibility Study	Jul 22nd, 2002	Feasibility Study
Update of Feasibility Study	Jun 2006	Updated Feasibility Study
Financial closure	July 2006	China National Environmental Protection Corporation and Eden Investment Co., Ltd. become investors
DRC permission to begin construction	Sep 7th, 2006	DRC approval document
Signing of construction contract for project (Project start date)	Sep 16th, 2006	Construction contract
Starting date of operation	Nov 2007	Operation data

CDM timeline (in order of occurrence)	**Date**	**Reference**
Board decision to apply for CDM	Jul 4th, 2006	Board meeting minutes
Hiring of local CDM consultant	Jul 5th, 2006	Consulting contract with Blue Sky

		Investment Consulting and Management
Development of PIN	Jul 2006	PIN
Hiring of Mitsubishi UFJ Securities as CDM consultant	Oct 12th, 2006	Consulting contract with Mitsubishi UFJ Securities
Stakeholders' consultation	Dec 27, 2006	Stakeholders' meeting minutes
AM_REV_0031 – application to widen scope of AM0025 to include MSW incineration with energy generation	Jan 25th, 2007	UNFCCC website
Revision of AM0025 to include MSW incineration with energy generation	May 2-4, 2007	UNFCCC website (EB31)
Hiring of DOE	Sep 7th, 2007	Contract with DOE
PDD first published for public comments	Oct 2nd, 2007	UNFCCC website
Request for deviation	Nov 8th, 2007	UNFCCC website
Site visit by DOE	Jan 15-17, 2008	DOE records
Acceptance of request for deviation by EB	Feb 1st, 2008	UNFCCC website (EB37)
China DNA review meeting	May 13th, 2008	China NDRC website
PDD re-published for public comments	May 29th, 2008	UNFCCC website

The feasibility study was completed in 2002, and clearly referred to the advice from the Chinese government regarding the contribution that the CDM could make to various comprehensive resource-utilization projects, such as MSW combustion for heat and power generation.

The Project was originally to be started in spring 2004; however, financial difficulties forced a suspension. Further difficulties occurred and the Project was not implemented until China National Environmental Protection Corporation and Eden Investment Co., Ltd. made the decision to invest in the Project in July 2006. That the Project Developer was seriously considering CDM is shown by the Board meeting minutes stating the Board's commitment to CDM from the 4th of July 2006; the contract for PDD production which was signed with the Chinese consultant, Blue Sky Investment Consulting and Management, on the 5th of July 2006; and the PIN that was developed immediately upon bringing together the investment partnership, at the end of July 2006.

Between the completion of the feasibility study and the initiation of construction, the Project costs had significantly increased, consequently, CDM revenue progressively became a more significant source of income for the Project. A revised feasibility study was prepared in June 2006 to reflect these changes in cost. Following that and the bringing together of the investment partners, permission from the Development Reform Commission of Shandong Province was obtained for the Project on the 7th of September 2006, and permission to begin construction of the plant was obtained on the 19th of October 2006. Neither of these placed a requirement on the Project developer to implement the Project; however, so it is the equipment and construction contracts, signed on the 16th of September 2006 that constitute the Project Start Date according to the CDM guidelines. This was two months after the original agreement to develop the Project as CDM so it is clear that CDM was in the Project Developer's plans from the outset, and that CDM was a crucial part of those plans.

Preliminary PDD development continued subsequently to the above-mentioned CDM consultancy agreement, with formal PDD writing beginning in mid-2007 and the site visit in early 2008.

Prohibitive barriers that the Project activity faces are clearly identified using the Tool for the demonstration and assessment of additionality. The following steps from the additionality tool are completed below:

STEP 1 – Identification of alternatives to the project activity consistent with current laws and regulations
STEP 2 – Investment analysis
STEP 4 – Common practice analysis

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

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

As described above, the Project developer had the following alternatives to the Project activity:

- The proposed project activity not undertaken as a CDM project
- Continuation of current practice (no project activity or other alternative undertaken)

Sub-step 1b. Enforcement of applicable laws and regulations

All scenarios are in compliance with applicable laws and regulations[5].

Step 2 - Investment Analysis

Sub-step 2a. Determine appropriate analysis method

In order to determine whether the proposed Project is financially feasible without revenue from the sale of CERs, Option III – "Apply benchmark analysis", is completed below. As suggested in the Tool for the demonstration and assessment of additionality, Project IRR will be used in the investment analysis.

Sub-step 2b. – Option III. Apply benchmark analysis

Project IRR is deemed the most suitable financial indicator for the Project and, in line with the guidance in this sub-step in the additionality tool, is compared to a national benchmark for energy generation (electricity and thermal) projects of 8% (after tax).[6]

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

Due to high initial costs associated with the planning, engineering, and construction of the Project, it does not represent a feasible investment opportunity in the absence of additional revenue from the sale of CERs. As can be seen from the financial data displayed below, the Project IRR is not high enough to justify investment, considering the risks involved. With the CER revenue incorporated into the IRR

[5] (as footnote 3 above) Landfill Technology Codes for MSW, enforced on January 15, 1999, Chinese regulation reference no. CJJ17-88

[6] Methodology and Parameter of Economic Evaluation of Construction Projects, 2006, third edition, edited by NDRC and the Ministry of Construction. Published by China Planning Publish Co., Ltd.

calculation, the additional, relatively reliable revenue stream provides enough of an incentive for the Project developer to proceed.

Item	Assumptions/Sources	Value
Financial Details		
Costs		
Initial capital cost	Supplied by Project developer based on quotes (equipment and plant cost 146,120,000 Yuan)	238.98 million Yuan
Fuel cost/year (coal)	Based on the cost estimated in the feasibility study: 480 Yuan/tonne	31.68 million Yuan/year
O&M cost/yr	Estimated as 3% of the cost of the initial capital cost (238,980,000 Yuan)	7,167 million Yuan/yr
Revenues		
Electricity tariff	Average local price (including VAT of 17%)	0.36 Yuan/kWh
Electricity sales	Assuming the generator is in operation 330 days in a year, a load factor of 85%, and that 22% of the electricity is used on-site (131,274 MWh/year)	47.3 million Yuan/year
Thermal energy tariff	Average local price (including VAT of 13%)	19 Yuan/GJ
Thermal energy sales (year 2)	Assuming capacity factor of 912,000 GJ/y, and 33% exported in year 2. .	5.7 million Yuan/year
Thermal energy sales (year 3)	Assuming capacity factor of 912,000 GJ/y, and 66% exported in year 3. .	11.4 million Yuan/year
Thermal energy sales (year 4 onwards)	Assuming capacity factor of 912,000 GJ/y, and 100% exported from year 4.	17.3 million Yuan/year
Other income		
Waste disposal fee	MSW disposal fee (at 30 Yuan/ton), for 264,000 t/yr	7.9 million Yuan/year
Raw material sales (ash sold to cement plants)	Supplied by Project developer based on relevant price agreements	400,000 Yuan/year
Income tax		25%
Project life	Minimum projected life	22 years
Project IRR for operations		5.20%
Project IRR including CER revenue (assuming 8EUR/CER)		11.27%

The Project’s IRR is estimated to be 5.20%, which is much lower than the Project’s benchmark of 8% (after tax). The low IRR, compared to the hurdle rate, indicates that the Project is not financially feasible without an additional revenue stream, such as that obtained through the CDM. In the absence of CDM-derived revenue, the relatively low return does not justify the risks associated with implementing this new waste-incineration power project.

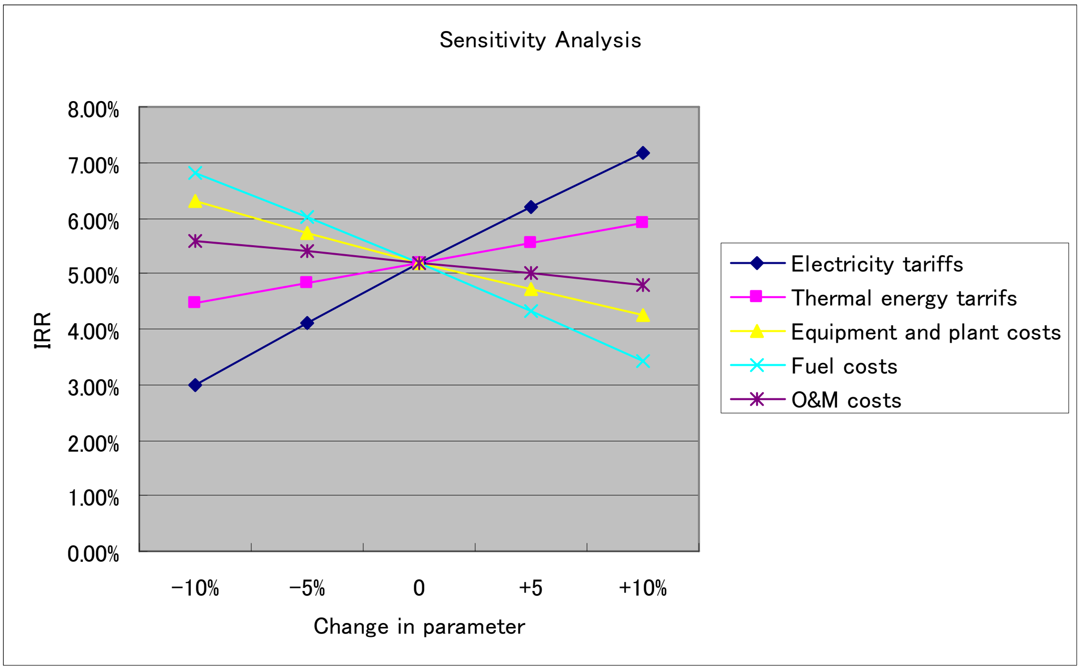
Sub-step 2d –Sensitivity Analysis

The following sensitivity analysis is performed to confirm the conclusion regarding the financial attractiveness of the Project is robust:

1) The average tariff for electricity
2) The average tariff for thermal energy
3) The costs for equipment and plant
4) Fuel costs
5) O&M costs

The following table and diagram give the results of the sensitivity analysis for each scenario

Summary of SA					
Changes	−10%	−5%	0	+5	+10%
Electricity tariffs	2.99%	4.13%	5.20%	6.21%	7.19%
Thermal energy tarrifs	4.47%	4.84%	5.20%	5.55%	5.89%
Equipment and plant costs	6.29%	5.72%	5.20%	4.70%	4.24%
Fuel costs	6.82%	6.02%	5.20%	4.34%	3.44%
O&M costs	5.59%	5.39%	5.20%	5.00%	4.80%



The Project IRR did not surpass the benchmark even after applying the different favourable conditions to the financial analysis. The sensitivity analysis confirms the fact that the Project is unlikely to be financially feasible, and successful implementation is dependent upon CDM assistance.

STEP 4 – Common Practice Analysis

Sub-step 4a – Analyse other activities similar to the proposed project activity

Projects in which fresh waste is combusted to produce energy are still very rare in China. In fact, waste incineration (most of which does not involve energy generation projects) accounts for less than 3.72% of all MSW disposal. Within Shandong Province the following MSW combustion power plants are in operation, or are under construction:

No.	Name of Project	Waste handling capacity	Run-time	Technology/remarks
1	Heze[7]	2 × 200 t/d	2001.4	In operation. MSW incineration technology with fluidized bed for power generation, by Zhejiang University
2	Zaozhuang[7]	1 × 150 t/d	2003.6	In operation. MSW incineration technology with fluidized bed for power generation, by Zhejiang University
3	Jinan[7]	Expected to be 1000 t/d	2004	Experiencing operation problems.
4	Zibo[8]	Expected to be 1000 t/d at full operation	2007.8	Currently testing operation. The ratio of waste to coal is 4:1
5	Taian[9]	Expected to be 800 t/d	N/A	Under construction
6	Weifang[10]	Expected to be 600 t/d	N/A	Ready to build since mid-2007, but still looking for financial closure

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

The plant in Jinan City opened in 2004, and has been experiencing problems with the combustion of MSW, preventing it from generating a supply of steam that can drive the steam turbine. The plant is still performing test procedures.

The Zaozhuang project involved the conversion of a coal-fired boiler into a waste boiler; however, because of the low NCV of the waste, for each tonne of MSW, approximately one tonne of quality coal needs to be co-fired.

[7] http://www.eedu.org.cn/news/etech/home/200605/7935.html

[8] http://www2.sdnews.com.cn/vip/sjst/2006-7/12_249304.html

[9] http://www.newenergy.org.cn/html/0077/200772_13963.html

[10] http://cache.baidu.com/c?m=9d78d513d9d430a44f9de2697d12c015694381132ba6a7020ca4843896732b31506793ac56200777a2d20c1716db434beb802102321456bc8cb9835dabbc85295f9f5731676f865662d40ed8ce5262817e9f00afe95bf0bb832f8eeb9796c854248b05402edab69c5a77498a3aed1433e1a18418480249e4b67123e859007ade6157b733a2b6256f7182f4df&p=c361c953c5904eaa0ebd9b7f0f05&user=baidu

The Heze waste combustion power plant is the first waste combustion power plant to be built in Shandong exclusively using domestic technology and equipment. It is also the only purpose-built waste combustion power plant in operation in Shandong now; however, its total loss to the end of year 2004 was 12.5 million Yuan, and for the first half of 2005, the loss was 3.16 million Yuan.

There are two main reasons as to why the above projects did not apply for the CDM:

1) Existing methodologies were not suitable for some projects;
2) Raw material issues: e.g. the coal consumption in the Zaozhuang project is too high.

Nationally, very few similar activities are being carried out by enterprises in China at present. Private project developers are reluctant to invest in this technology because in their view the high risks do not justify the low returns.

Despite the financial and technological difficulties faced by the Project, the Project developer for the Linyi MSW cogeneration plant, with CDM in its plans, decided to proceed with implementation. Given the above-mentioned prevalent practices for MSW treatment in China, and the barriers the project faces, it is clear that the Project fulfils the requirements of additionality.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project emissions

As per the guidelines in AM0025 (Version 10), project emissions are calculated as follows:

$$PE_y = PE_{elec,y} + PE_{fuel,on\text{-}site,y} + PE_{i,y} + PE_{w,y}$$

where:

PE_y	Project emissions during the year y (tCO_2e)
$PE_{elec,y}$	Emissions from electricity consumption on-site due to the project activity in year y (tCO_2e)
$PE_{fuel,on\text{-}site,y}$	Emissions from fossil fuel consumption on-site due to the project activity in year y (tCO_2e)
$PE_{i,y}$	Emissions from waste incineration in year y (tCO_2e)
$PE_{w,y}$	Emissions from waste water treatment in year y (tCO_2e)

There are no emissions from a composting process, an anaerobic digestion process, a gasification process or combustion of RDF/stabilized biomass since the Project activity only involves the incineration of waste.

Emissions from electricity use ($PE_{elec,y}$)

In the event that the Project activity involves electricity consumption, CO2 emissions are calculated as follows:

$$PE_{elec,y} = EG_{PJ,FF,y} * CEF_{elec}$$

where:

$EG_{PJ,FF,y}$	Amount of electricity generated in an on-site fossil fuel power plant or consumed from the grid as a result of the Project activity, measured using an electricity meter (MWh)
CEF_{elec}	Carbon emission factor for electricity generation in the Project activity (tCO_2/MWh)

The electricity consumed at the Project site will be generated by the Project activity. The Project emissions related to the auxiliary fossil fuels used to increase the temperature of the incinerator and fossil-based waste are, respectively, calculated in under, “Emissions from fuel use on-site”, and, “Emissions from fossil-based waste”, below. In the event that electricity is imported from the grid, the emission factor will be calculated according to the Tool to calculate the emission factor for an electricity system.

Emissions from fuel use on-site ($PE_{fuel,on\text{-}site,y}$)

Emissions from on-site fuel consumption (other than electricity generation, e.g., vehicles used on-site, auxiliary fossil fuels added to the incinerator to increase the temperature of the incinerator, etc) are calculated as follows:

$$PE_{fuel,\ on\text{-}site,y} = F_{cons,y} * NCV_{fuel} * EF_{fuel}$$

where:

$PE_{fuel,\ on\text{-}site,y}$	CO_2 emissions due to on-site fuel combustion in year y (tCO_2)
$F_{cons,y}$	fuel consumption on site in year y (kg)
NCV_{fuel}	net caloric value of the fuel (MJ/kg)
EF_{fuel}	CO_2 emissions factor of the fuel (tCO_2/MJ)

Local values are preferred as defaults for net calorific values and CO_2 emission factors. If local values are not available, IPCC default values may be used.

Emissions from waste incineration ($PE_{i,y}$)

Emissions from waste incineration are calculated as follows:

$$PE_{i,y} = PE_{i,f,y} + PE_{i,s,y}$$

where:

$PE_{i,f,y}$	fossil-based waste CO_2 emissions from waste incineration in year y (tCO_2e)
$PE_{i,s,y}$	N_2O and CH_4 emissions from the final stacks from waste incineration in year y (tCO_2e)

Emissions from fossil-based waste ($PE_{i,f,y}$)

The CO_2 emissions are calculated based on the monitored amount of fossil-based waste fed into the waste incineration plant, fossil-derived carbon content and combustion efficiency.

$$PE_{i,f,y} = \sum_i A_i \times CCW_i \times FCF_i \times EF_i \times \frac{44}{12}$$

where:

A_i	Amount of waste type i fed into the waste incineration plant (t/yr)
CCW_i	Fraction of carbon content in waste type i (fraction)
FCF_i	Fraction of fossil carbon in waste type i (fraction)
EF_i	Combustion efficiency for waste type i (fraction)
44/12	Conversion factor (tCO_2/tC)

N_2O and CH_4 emissions from the stacks due to waste incineration ($PE_{i,s,y}$)

From the two options in AM0025, option 2 is chosen to calculate N_2O and CH_4 emissions from the final stack due to waste incineration.

$$PE_{i,s,y} = Q_{biomass,y} * (EF_{N2O} * GWP_{N2O} + EF_{CH4} * GWP_{CH4}) * 10^{-3}$$

Where:

$Q_{biomass,y}$	Amount of waste incinerated in year y (tonnes/year)
EF_{N2O}	Aggregate N_2O emission factor for waste combustion (kgN_2O/tonne of waste)
EF_{CH4}	Aggregate CH_4 emission factor for waste combustion ($kgCH_4$/tonne of waste)

According to the methodology, if IPCC default emission factors are used, a conservativeness factor must be applied given their inherent uncertainty. This PDD selects the most conservative factor of 1.37.

Emissions from wastewater treatment ($PE_{w,y}$)

Wastewater generated by the Project activity will be treated using a chemical treatment method that does not result in any methane emissions ($PE_{w,y} = 0$). Parameters for this source of emissions are, therefore, not monitored; however, in the event that wastewater is treated anaerobically or released untreated, the necessary parameters will be monitored and CH_4 emissions will be estimated as follows:

$$PE_{CH4,w,y} = Q_{COD,y} * P_{COD,y} * B_0 * MCF_p$$

where:

$PE_{CH4,w,y}$	Methane emissions from the wastewater treatment in year y (tCH_4/y)
$Q_{COD,y}$	Amount of wastewater treated anaerobically or released untreated from the Project activity in year y (m^3/yr), which shall be measured monthly and aggregated annually
$P_{COD,y}$	Chemical Oxygen Demand (COD) of wastewater ($tCOD/m^3$), which will be measured monthly and averaged annually
B_0	Maximum methane producing capacity ($tCH_4/tCOD$)
MCF_p	Methane conversion factor (fraction), preferably local specific value should be used. In the absence of local values, default MCF_p values can be obtained from table 6.3, chapter 6, volume 4 of the 2006 IPCC Guidelines.

The 2006 IPCC Guidelines specify 0.25 $kgCH_4/kg$ COD as a value for B_0. Taking into account the uncertainty of this estimate, a value of 0.265 kg CH_4/kg COD as a conservative assumption for B_0 will be used.

In the event that all the CH_4 is emitted into air directly, then

$PE_{w,y} = PE_{CH4,w,y} * GWP_{CH4}$

If flaring occurs, the Tool to determine project emissions from flaring gases containing methane will be used to estimate methane emissions.

Baseline emissions

Baseline emissions are calculated as follows:

$BE_y = (MB_y – MD_{reg,y}) \times GWP_{CH4} + BE_{EN,y}$

where:

BE_y	baseline emissions in year y (tCO_2e)
MB_y	methane produced in the landfill in the absence of the Project activity in year y (tCH_4)
$MD_{reg,y}$	methane that would be destroyed in the absence of the Project activity in year y (tCH_4)
$BE_{EN,y}$	baseline emissions from generation of energy displaced by the Project activity in year y (tCO_2e)

Adjustment Factor (AF)

$MD_{reg,y} = MB_y * AF$

where:

AF	Adjustment Factor for MB_y (%)

The ‘Adjustment Factor’ will be revised at the start of each new crediting period taking into account the amount of GHG flaring that occurs as part of common industry practice and/or regulation at that point in time.

This PDD assumes the adjustment factor to be 0% given that the Linyi Landfill Site does not currently capture and destroy any of the methane emissions that are derived therefrom.

Rate of compliance ($RATE^{Compliance}_y$)

In case where there are regulations that mandate the use of one of the project activity treatment options and which is not being enforced, the baseline scenario is identified as a gradual improvement of waste management practices to the acceptable technical options expected over a period of time to comply with the MSW Management Rules. The adjusted baseline emissions ($BE_{y,a}$) are calculated as follows:

$BE_{y,a} = BE_y * (1 – RATE^{Compliance}_y)$

where:

$RATE^{Compliance}_{y}$	State-level compliance rate of the MSW Management Rules in that year y. The compliance rate shall be lower than 50% if it exceeds 50% the Project activity shall receive no further credit.

In such cases $BE_{y,a}$ will replace BE_y to estimate emission reductions.

No applicable regulations are currently in place that require the rate of compliance to be incorporated into the calculations. The regulatory situation and the compliance ratio $RATE^{Compliance}_{y}$ will be monitored *ex post* based on the official reports for instance annual reports provided by the municipal bodies.

Methane generation from the landfill in the absence of the project activity (MB_y)

The amount of methane that is generated each year (MB_y) is calculated as follows:

$MB_y = BE_{CH4,SWDS,y}$

where:

$BE_{CH4,SWDS,y}$	Methane generation from the landfill in the absence of the Project activity at year y, calculated as per the Tool to determine methane emissions avoided from dumping of waste at a solid waste disposal site. The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odour concerns. As this is already accounted for in the baseline emissions calculated, “f” in the tool shall be assigned a value of 0.

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j}^{D} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

φ	Model correction factor to account for model uncertainties (0.9)
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner (As mentioned above, 0 is applied)
GWP_{CH4}	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose
MCF	Methane conversion factor
$W_{j,x}$	Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons)
DOC_j	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	Decay rate for the waste type j
j	Waste type category (index)
x	Year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year y for which avoided emissions are calculated (x=y)
y	Year for which methane emissions are calculated

Where different waste types j are prevented from disposal, determine the amount of different waste types ($W_{j,x}$) through sampling and calculate mean from the sample, as follows:

$$W_{j,x} = W_x \cdot \frac{\sum_{n=1}^{z} p_{n,j,x}}{z}$$

where:

W_x	Total amount of organic waste prevented from disposal in year x (tons)
$p_{n,j,x}$	Weight fraction of the waste type j in the sample n collected during the year x
z	Number of samples collected during the year x

At the renewal of the crediting period, the following data will be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories:

- Oxidation factor (OX)
- Fraction of methane in the SWDS gas (F)
- Fraction of degradable organic carbon (DOC) that can decompose (DOC_f)
- Methane conversion factor (MCF)
- Fraction of degradable organic carbon (by weight) in each waste type j (DOC_j)
- Decay rate for the waste type j (k_j)

Note: Where for a particular year it cannot be demonstrated that the waste would have been disposed of in the landfill, the waste quantities prevented from disposal ($w_{j,x}$) in the tool should be assigned a value of 0 (zero).

Baseline emissions from generation of energy displaced by the project activity ($BE_{EN,y}$)

The Project activity corresponds to scenario 1 described in AM0025.

$BE_{EN,y} = BE_{elec,y} + BE_{thermal,y}$

where:

$BE_{elec,y}$	baseline emissions from electricity generated utilizing the combustion heat from incineration in the Project activity and exported to the grid (tCO_2e)
$BE_{thermal,y}$	baseline emissions from thermal energy produced utilizing the combustion heat from incineration in the Project activity displacing thermal energy from onsite/offsite fossil fuelled boilers (tCO_2e)

And,

$BE_{elec,y} = EG_{d,y} * CEF_d$

where:

$EG_{d,y}$	Amount of electricity generated utilizing the combustion heat from incineration in the Project activity and exported to the grid during the year y (MWh)
CEF_d	Carbon emissions factor for the displaced electricity source in the project scenario (tCO_2/MWh)

And,

$$BE_{thermal,y} = \frac{Q_y}{\varepsilon_{boiler} \cdot NCV_{fuel}} \cdot EF_{fuel,b}$$

where:

Q_y	Quantity of thermal energy produced utilizing the combustion heat from incineration in the Project activity displacing thermal energy from onsite/offsite fossil fuelled boilers during the year y in GJ
ε_{boiler}	Energy efficiency of the boiler used in the absence of the Project activity to generate the thermal energy
NCV_{fuel}	Net calorific value of fuel, as identified through the baseline identification procedure, used in the boiler to generate the thermal energy in the absence of the Project activity in GJ per unit of volume or mass
$EF_{fuel,b}$	Emission factor of the fuel, as identified through the baseline identification procedure, used in the boiler to generate the thermal energy in the absence of the Project activity in tons CO_2 per unit of volume or mass of the fuel

This PDD uses the 2006 IPCC Guidelines as a reference for $EF_{fuel,b}$. The IPCC Guidelines describe the emission factors for fuels in tons CO_2 per TJ on a net calorific value basis. Therefore, the calculation for $BE_{thermal}$ can be simplified to the following:

$$BE_{thermal,y} = \frac{Q_y}{\varepsilon_{boiler}} \cdot EF_{fuel,b}$$

This PDD makes a conservative estimation of boiler efficiency using Option A of the methodology on the basis of the results of a survey of coal-fired industrial boilers in operation in the Linyi region.[11] The survey found that the actual obtained efficiency of boilers is on average 60%, whereas the average efficiency according to the specifications provided by the manufacturers is 75%.

Option A in the methodology requires the use of the highest value among the following three values:

1. Measured efficiency prior to project implementation;
2. Measured efficiency during monitoring;
3. Manufacturer's information on the boiler efficiency.

Under option 3 then, the PDD assumes the most conservative of these ranges of figures, i.e. an efficiency in the baseline of 75%.

[11] Explanation of Efficiency of Little Boilers in Linyi, Special Equipment Inspection Institute of Linyi, 2008

Baseline emissions from electricity generated

As per AM0025, CEF_d is calculated according to the Tool to calculate the emission factor for an electricity system since the generated electricity from combustion heat from incineration will displace the electricity that would have been generated by other power plants connected to the baseline grid. The procedure for calculating CEF_d is as follows:

STEP 1. Identify the relevant electric power system

The Chinese DNA - Office of Climate Change under the National Development and Reform Commission - has published a delineation of the project electricity system and connected electricity system[12]. According to the delineation, the local grid to which the Project activity is connected is the North China Power Grid.

STEP 2. Select an operating margin (OM) method

Dispatch data is unavailable for the North China Power Grid; therefore, this PDD selects option (a), the Simple OM method, to calculate this parameter. As shown in the table below, low-cost/must-run resources constitute less than 1% of total North China Power Grid generation in each of the five most recent years for which data is available. Therefore, it is clear that the average over those years meets the requirement of being less than 50%.

Year	Low-cost/must-run generation (10^8 kWh)	Total Generation (10^8 kWh)	%
2001	29.27	3611.19	0.81
2002	36.25	4075.45	0.89
2003	39.79	4616.53	0.86
2004	40.32	5308.04	0.76
2005	30.41	5148.15	0.59

Source: China Electric Power Yearbooks 2002, 2003, 2004, 2005 and 2006

In calculating the simple OM, the ex-ante option of a 3-year generation-weighted average is chosen, and is based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, thus removing the requirement to monitor and recalculate the emissions factor during the crediting period. For the calculation, 2003, 2004 and 2005 are chosen as the data for these is the most recent.

STEP 3. Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generation power plants serving the system, not including low-cost/must-run power plants/units. It is calculated based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (option C) because the necessary data for option A or option B is not available, nuclear and renewable power generation are considered as low-cost/ must-run power sources and the quantity of

[12] http://cdm.ccchina.gov.cn/web/index.asp

electricity supplied to the grid by these sources is known. Electricity imports are treated as one power plant.

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{grid,y}}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{grid,y}$	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units in year y (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year y
y	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option)

STEP 4. Identify the cohort of power units to be included in the build margin

Since plant specific data for the North China Power Grid is not available, the capacity addition from one year to the next and the efficiency of the best available technology are used as a basis for determining the build margin of the grid, as clarified by the CDM Executive Board[13]. The build margin emission factor will be calculated *ex-ante* based on the most recent information available at the time of CDM-PDD submission to the DOE for validation and applied during the first crediting period. For the second crediting period, the build margin emission factor will be updated based on the most recent information available at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period will be used (Option 1).

STEP 5. Calculate the build margin emission factor

The procedure to calculate the Build Margin emission factor conservatively is as follows:

1) Using the latest available statistical data determine the two years with added capacity closest to 20% (above 20%)

- The capacity of each previous year x is compared with the capacity of the most recent year.

$$\text{Capacity increase}(\%) = \left(\frac{\text{Capacity of the most recent year}}{\text{Capacity of the year x}} - 1 \right) \times 100$$

Select the year of which the capacity increase is closest to and above 20% for the build margin emission factor calculation.

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

Calculate the build margin emission factor for that year with the efficiency of the best available technology

- Calculate the emission factor of each fuel source with the efficiency of the best available technology. For each fuel source, emission factor is calculated as follows:

$$\text{Emission factor} = 3.6 / \text{Best efficiency} / 1000 \times CO_2 \times \text{Oxidation factor}$$

- Calculate the weight of each emission source as the ratio of emission by source to total emission in the most recent year

$$\text{Weight for each fuel} = \frac{CO_2 \text{ Emission by each fuel}}{\text{Total } CO_2 \text{ emission}}$$

- Calculate the emission factor for thermal power generation.

$$\text{Emission factor for thermal power} = \sum_i \text{Emission factor}_i \times \text{Weight}_i$$

- Calculate the capacity addition ratio of each energy source (j: thermal, hydro, nuclear, wind, etc) between the most recent year and the selected year in step 1)

$$\text{Capacity addition ratio}_j = \frac{\text{Capacity addition}_j}{\text{Total capacity addition}}$$

$$\text{Capacity addition}_j = \text{capacity of the most recent year}_j - \text{capacity of the year selected}_j$$

- Calculate the Build Margin emission factor

$$EF_{BM} = \sum \text{Emission factor}_j \times \text{Capacity addition ratio}_j$$

* Emission factor of 0 will be applied for the emission factors other than thermal power generation.

STEP 6. Calculate the combined margin emission factor

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

The following default values will be applied for w_{OM} and w_{BM}:

- w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period.

Leakage

The sources of leakage considered are CO_2 emission from off-site transportation of MSW. There is no leakage to be considered from the residual waste from anaerobic digester, the gasifier, the processing/combustion of RDF/stabilized biomass, or compost in the event that it is disposed of in landfill, or leakage emissions from end use of stabilized biomass since the Project activity only involves the incineration of MSW.

$L_y = L_{t,y}$

where:

L_y	Leakage emissions in year y (tCO_2e)
$L_{t,y}$	Leakage emissions from increased transport in year y (tCO_2e)

Emissions from transportation ($L_{t,y}$)

The Project site is 23km closer than the Linyi Landfill Site is to the source of the MSW, Linyi City; therefore, the Project activity will not result in an increase in transport emissions from this source.

As regards the transport of the residual waste from the incinerator, it is to be sold as a raw material in the cement industry and therefore needs to be transported to the cement plants. The cement plants to be supplied are located within a 6km radius of the Project activity. These cement plants previously sourced the raw material that is to be replaced from suppliers in Fei County and Cangshan County, which are between 20 and 30 km away; therefore, the Project will not result in an increase in transport emissions from this source.

In the event that transport emissions do increase, such emissions will be incorporated as leakage and calculated as follows:

$$L_{t,y} = \sum_{i}^{n} NO_{vehicle,i,y} \times DT_{i,y} \times VF_{cons,i} \times NCV_{fuel} \times D_{fuel} \times EF_{fuel}$$

where:

$NO_{vehicles,i,y}$	Number of vehicles for transport with similar loading capacity
$DT_{i,y}$	Average additional distance travelled by vehicle type i compared to baseline in year y (km)
VF_{cons}	Vehicle fuel consumption in litres per kilometre for vehicle type i (l/km)
NCV_{fuel}	Calorific value of the fuel (MJ/Kg or other unit)
D_{fuel}	Fuel density (kg/l), if necessary
EF_{fuel}	Emission factor of the fuel (tCO_2/MJ)

Emissions Reductions

Emissions reductions will be calculated as follows:

$ER_y = BE_y – PE_y – L_y$

where:

ER_y	Emission reduction in year y (tCO_2e)
BE_y	Emissions in the baseline scenario in year y (tCO_2e)
PE_y	Emissions in the project scenario in year y (tCO_2e)
L_y	Leakage in year y (tCO_2e)

If the sum of PE_y and L_y is smaller than 1% of BE_y in the first full operation year of a crediting period, a fixed percentage of 1% for PE_y and L_y combined can be applied for the remaining years of the crediting period.

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

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied:	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	-

Data / Parameter:	**GWP_{N2O}**
Data unit:	tCO_2e/tN_2O
Description:	Global warming potential of N_2O
Source of data used:	IPCC
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied:	310 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	-

Data / Parameter:	Φ
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Tool to determine methane emissions avoided from dumping of waste at a solid waste disposal site
Value applied:	0.9

Justification of the choice of data or description of measurement methods and procedures actually applied:	Default value suggested in the tool.
Any comment:	-

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied:	The value for managed landfills is used, as directed by the Tool to determine methane emissions avoided from dumping of waste at a solid waste disposal site.
Any comment:	-

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied:	-
Any comment:	-

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied:	-
Any comment:	-

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane conversion factor
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied:	Value given for anaerobic managed solid waste disposal sites
Any comment:	-

Data / Parameter:	$\mathbf{k_j}$
Data unit:	-
Description:	Decay rate for waste type j
Source of data used:	Tool to determine methane emissions avoided from dumping of waste at a solid waste disposal site
Value applied:	See baseline data.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Mean Annual Temperature (MAT) = 13.2ºC (1958 – 2001) Mean Annual Precipitation (MAP) = 855.8mm (1992 – 2001) Potential Evotranspiration (PET) = 1359.74mm MAP/PET < 1 Based on this data, the climate is classed as: Boreal and Temperate, Dry
Any comment:	

Data / Parameter:	$\mathbf{DOC_j}$
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in waste type j
Source of data used:	Tool to determine methane emissions avoided from dumping of waste at a solid waste disposal site
Value applied:	See baseline data
Justification of the choice of data or description of measurement methods and procedures actually applied:	Values for wet waste chosen, based on IPCC defaults.
Any comment:	-

Data / Parameter:	$\mathbf{EF_{fuel,b}}$
Data unit:	$tCO2/TJ$
Description:	CO2 emission factor of fuel
Source of data used:	2006 IPCC Guidelines
Value applied:	98.3

Justification of the choice of data or description of measurement methods and procedures actually applied :	As evidenced by the use of IPCC data in the grid emission calculations published on the China DNA website, there are no national figures for this parameter. Therefore, this value will be set ex ante for each crediting period using the most up-to-date version of the IPCC Guidelines.
Any comment:	

Data / Parameter:	$\mathbf{EF_{OM}}$
Data unit:	tCO_2/MWh
Description:	Operating margin for the North China Power Grid
Source of data used:	Chinese DNA
Value applied:	1.1208 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated as directed in B.6.1. Calculations are shown in Annex 3.
Any comment:	To be updated at the start of each new crediting period.

Data / Parameter:	$\mathbf{EF_{BM}}$
Data unit:	tCO_2/MWh
Description:	Operating margin for the North China Power Grid
Source of data used:	Chinese DNA
Value applied:	0.9397 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated as directed in B.6.1. Calculations are shown in Annex 3
Any comment:	To be updated at the start of each new crediting period.

Data / Parameter:	$\mathbf{w_{BM}}$
Data unit:	%
Description:	Weighting of build margin emissions factor
Source of data used:	As described in the methodology
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	

Data / Parameter:	w_{OM}
Data unit:	%
Description:	Weighting of operating margin emissions factor
Source of data used:	As described in the methodology
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	

Data / Parameter:	ε_{boiler}
Data unit:	%
Description:	Energy efficiency of boilers used for generating thermal energy in the absence of the Project activity
Source of data used:	Survey by the Special Equipment Inspection Institute of Linyi
Value applied:	75
Justification of the choice of data or description of measurement methods and procedures actually applied :	Regional data option
Any comment:	Measured efficiency during monitoring is not applied since the boilers will not be used after project implementation.

Data / Parameter:	AF
Data unit:	%
Description:	Adjustment factor for MB_y
Source of data used:	Data from the Linyi Landfill Site.
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Linyi Landfill Site does not currently capture and destroy any of the methane emissions that are derived from the MSW disposed of there. To be revised at the start of each new crediting period, taking into account the amount of GHG flaring that occurs as part of common industry practice and/or regulations.
Any comment:	

Data / Parameter:	EF_{N2O}
Data unit:	kgN_2O/tonne of wet waste
Description:	Aggregate N_2O emission factor for waste combustion
Source of data used:	2006 IPCC guidelines
Value applied:	0.05

Justification of the choice of data or description of measurement methods and procedures actually applied :	In line with the guidance in the methodology.
Any comment:	

Data / Parameter:	**EF_{CH4}**
Data unit:	$kgCH_4$/tonne of wet waste
Description:	Aggregate CH_4 emission factor for waste combustion
Source of data used:	2006 IPCC guidelines
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	In line with the guidance in the methodology.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

Baseline emissions are claimed for the following sources:

- Emissions from decomposition of waste at the landfill site
- Emissions from displaced grid electricity
- Emissions from displaced thermal energy

$BE_y = BE_{CH4.SWDS,y} + BE_{elec,y} + BE_{thermal,y}$

This is completed for the year 2009 below. This year is selected because the earliest the Project is expected to be registered is December 2008:

By_e = 8,794 + 135,238 + 39,446

= 174,684 tCO_2e/yr

Emissions from decomposition of waste at the landfill site

$$BE_{CH4,SWDS,y} = \Phi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j}^{D} W_{j,x} \cdot DOC_j \cdot (1-e^{-k_j}) \cdot e^{-k_j \cdot (y-x)}$$

The table below shows the values used for the CH_4 emission calculation. These values were chosen in a conservative manner using IPCC defaults and the amount of waste, $A_{j,x}$, was estimated from historical data obtained from measurements of the composition of the waste.

Linyi City has an average annual temperature of 16°C and average annual rainfall of 855.8mm. There are no landfill sites in the region that collect landfill gas (LFG) for flaring/energy generation.

Data and defaults used for MSW						
Φ	F	DOC_j	k_j	DOC_f	MCF	$A_{j,x}$
0.9	0.5	See below	See below	0.5	1	264,000

MSW type	Portion (% wet base)	Dry matter content (%)	DOC_j (% content, dry waste)	k_j
Wood and wood product	1.17	85	50	0.02
Pulp, paper and cardboard	2.58	90	44	0.04
Food, food waste, beverage and tobacco	59.00	40	38	0.06
Textiles	1.63	80	30	0.04
Garden, yard and park waste	0.00	40	49	0.05
Glass, plastic, metal, other inert waste	35.62	100	0	0
Total	100.00			

Note: portions are the arithmetic means of actual measurements of MSW for the years 2003-2005

As described in the methodology, OX for managed SWDS is equal to 0.1.
Baseline emission reductions from the decay of MSW are presented below:

	Baseline emissions from decay (tCO_2/yr)
2009	8,794
2010	17,098
2011	24,938
2012	32,342
2013	39,335
2014	45,938
2015	52,175

Emissions from displaced grid electricity

As explained in B.6.1., the OM and BM have been calculated *ex ante* CEF using data that has been publicly released by the Chinese DNA (see Annex 3 for tables). The OM is 1.1208 tCO_2/MWh and the BM is 0.0.9397 tCO_2/MWh, giving a CM (CEF_d) of 1.0302 tCO_2/MWh. Assuming the 25MW generator is running for 330 days in a year, with a load factor of 85%, the total amount of electricity produced will be 168,300 MWh/yr. Based on data provided by the Project developer, this PDD assumes that 22% of the generated electricity is used on site, therefore, the total amount of electricity available to be exported to the grid ($EG_{d,y}$) will be approximately 131,274 MWh/yr. The emissions associated with this amount of grid-generated electricity are calculated as follows:

$$BE_{elec} = EG_y.CEF_d$$
$$= 131{,}274 \times 1.0302 \quad = 135{,}238 \ tCO_2/year$$

Emissions from displaced thermal energy

By the fourth year of the Project activity, the Project developer expects to supply in the region of 912,000 GJ/year of thermal energy in the form of steam to a local industrial park to replace the thermal energy supply from over 100 coal-based boilers. The implementation of this part of the Project is expected to occur in the following stages:

0% in the first year;
33% of the full amount in the second year (first year of CDM);
66% of that amount in third year;
100% from the fourth year onwards.

CERs for 2009 are calculated as follows:

$$BE_{thermal,y} = \frac{Q_y}{\in_{boiler}} \cdot EF_{fuel}$$

$$= \frac{912{,}000 \times 0.33}{0.75} \cdot 0.0983 \quad = 39{,}446 \ tCO_2$$

Project emissions

Project emissions are determined for the following sources:

- Emissions from electricity use
- Emissions from fuel use on-site
- Emissions from combustion of fresh waste

$PE_y = PE_{elec,y} + PE_{fuel,\ on\text{-}site,y} + PE_{i,y} + PE_{w,y}$

Project emissions are estimated as follows:

$= 0 + 135{,}647 + 49{,}995 + 0 = 185{,}642 \ tCO_2e/yr$

Emissions from electricity consumption on-site in the year y ($PE_{elec,y}$)

As the Project will be a net exporter of electricity, emissions resulting from grid-generated electricity are treated as 0 in this PDD. There may be times, however, when grid-generated electricity is used. To ensure all associated emissions are included, the amount of electricity drawn from the grid will be recorded continuously with an electricity meter.

Emissions from fuel use on-site in the year y ($PE_{fuel,onsite,y}$)

When running at full capacity, the project is expected to consume approximately 66,000 tonnes of coal per year as a supplementary fuel. CERs from this source are therefore calculated as follows:

$PE_{fuel,\ on\text{-}site,y} = F_{cons,y} * NCV_{fuel} * EF_{fuel}$

$= 66{,}000 * 20.908 * 98.3 \quad = 135{,}647\ tCO_2/yr$

<u>Emissions from waste incineration in the year y ($PE_{i,y}$)</u>

GHG emissions are determined from fossil-based waste within the MSW as well as from the boiler stacks. For the first year, this is estimated assuming approximately 800t/day of MSW will be combusted in the boiler, and the boiler will be in operation for 330 full days:

$PE_{i,y} \quad = PE_{i,f,y} + PE_{i,s,y}$

$= 44{,}389 + 5{,}606 \quad = 49{,}995\ tCO_2e/yr$

Emissions from fossil-based waste in the year y ($PE_{i,f,y}$)

$$P_{i,f,y} = \sum_i A_i \cdot CCW_i \cdot FCF_i \cdot EF_i \cdot \frac{44}{12}$$

The amounts of each waste type as a proportion of the predicted 800t/day that the plant will be combusting when at capacity, and their respective CCWs, FCFs and combustion efficiencies are shown in the table below:

Waste type	Amount (t/yr)	% Dry matter	CCW	FCF	Combustion factor
Wood and wood products	3,416	85	0.5	0	1
Pulp, paper and cardboard	7,534	90	0.46	0.01	1
Food, food waste, beverage and tobacco	172,280	40	0.38	0	1
Textiles	4,769	80	0.5	0.2	1
Garden, yard and park waste	0	40	0.49	0	1
Plastic	14,396	100	0.75	1	1
Ash	80,787	100	0.03	1	1
Glass, metal and other inert waste	8,789	100	0	0	1

The emissions from fossil based waste from the plant when operating at capacity (800t/day) are therefore calculated for four categories: pulp, paper and cardboard, textiles, plastic and ash, as follows:

$$= [(7534 \times 0.9 \times 0.46 \times 0.01) + (4769 \times 0.8 \times 0.5 \times 0.2) + (14396 \times 1 \times 0.75 \times 1) + (80787 \times 1 \times 0.03 \times 1)] \cdot 1 \cdot \frac{44}{12}$$

$= \ 44{,}389\ tCO2e/yr$

<u>*Emissions from waste incineration in the year y ($PE_{i,s,y}$)*</u>

The Project will combust approximately 264,000 tonnes of MSW per year when fully operational. Emissions from this source are therefore calculated as follows:

$PE_{i,s,y} \quad = \quad Q_{biomass,y} * (EF_{N2O} * GWP_{N2O} + EF_{CH4} * GWP_{CH4}) * 10^{-3}$

$PE_{i,s,y}$ = 264,000 * (68.5 * 310 + 0 * 21)

= 5,606 tCO_2e/year

Emissions from waste water treatment in the year y ($PE_{w,y}$)

Wastewater will not be treated anaerobically, but will be treated using a chemical treatment method which is not expected to result in greenhouse gas emissions. Emissions from this source are therefore assumed to be zero.

Leakage

Leakage emissions from increased transport in year y (tCO_2e)

As described in section B.6.1., the leakage emissions for the Project are considered to be zero. The necessary parameters will be monitored and if any leakage is found to occur, the corresponding amount of emissions will be calculated as directed in B.6.1..

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

Year	Estimation of baseline emissions (tCO_2e)	Estimation of project emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of emission reductions (tCO_2e)
Year 1 (2009)	183,478	185,642	0	(-2,164) 0*
Year 2 (2010)	231,228	185,642	0	(45,586) 43,422*
Year 3 (2011)	279,710	185,642	0	94,067
Year 4 (2012)	287,114	185,642	0	101,471
Year 5 (2013)	294,106	185,642	0	108,464
Year 6 (2014)	300,710	185,642	0	115,067
Year 7 (2015)	306,947	185,642	0	121,304
TOTAL	1,883,292	1,299,494	0	583,793

* In the first year, actual emission reductions are negative. The equivalent amount is deducted from the emission reductions achieved in the following year.

Average annual emission reductions for the first crediting period are 83,399 tCO_2e.

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**F_{cons}**
Data unit:	Tonnes per year
Description:	Quantity of fossil waste type *i* combusted in the Project activity during year y
Source of data to be used:	On-site measurements
Value of data applied	66,000 tonnes

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Monitored continuously by the meters located in the coal conveyor-belt system.
QA/QC procedures to be applied:	The measured amount of fuel consumed can be cross-checked against the paid fuel invoices (administrative obligation)
Any comment:	-

Data / Parameter:	**A_i**
Data unit:	t/yr
Description:	Amount of waste type i
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Total: 264,000 tonnes (see table below)
Description of measurement methods and procedures to be applied:	Data to be aggregated annually.
QA/QC procedures to be applied:	Regular sorting & weighing of waste (initially quarterly) by project proponent will be carried out. Procedures will be checked regularly by a certified institute/ DOE.
Any comment:	

MSW type	Portion (%)	tonnes/yr
Wood and wood product	1.17	3416.4
Pulp, paper and cardboard	2.58	7533.6
Food, food waste, beverage and tobacco	59.00	172280
Textiles	1.63	4759.6
Garden, yard and park waste	0.00	0
Plastic metal, other inert waste	4.93	14396
Ash	27.67	80787
Glass, metal and other inert waste	3.01	8789

Data / Parameter:	**CCW_i**
Data unit:	fraction
Description:	Fraction of carbon content in waste type i
Source of data to be used:	IPCC default data
Value of data applied for the purpose of calculating expected	Please see project emission calculations

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	From IPCC guidelines. QA/QC procedures not applicable.
Any comment:	-

Data / Parameter:	**FCF_i**
Data unit:	fraction
Description:	Fraction of fossil carbon in waste type i
Source of data to be used:	Actual measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	IPCC default data
Description of measurement methods and procedures to be applied:	To be determined through sampling where the samples shall be chosen in a manner that ensures estimation with 20% uncertainty at 95% confidence level. Testing to be performed annually.
QA/QC procedures to be applied:	
Any comment:	This is a conservative assumption.

Data / Parameter:	**f**
Data unit:	fraction
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data to be used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	To be carried out annually
QA/QC procedures to be applied:	Data to be made available to DOE at verification.
Any comment:	-

Data / Parameter:	**W_x**
Data unit:	t/yr
Description:	Total amount of fresh waste prevented from landfill disposal in year x
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	264,000 tonnes
Description of measurement methods and procedures to be applied:	Monitored continuously and aggregated annually
QA/QC procedures to be applied:	Weighbridge will be subject to periodical calibration in accordance with the manufacturer's guidelines. Receipts showing the income from the handling of MSW will be provided to the DOE to double check.
Any comment:	-

Data / Parameter:	**$P_{n,j,x}$**
Data unit:	-
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data to be used:	Sample measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Listed in section B.6.3
Description of measurement methods and procedures to be applied:	Sample the waste prevented from landfill disposal, using the waste category *j*, as provided in the table for DOC*j* and k*j*, and weigh each waste fraction. The size and frequency of sampling should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. As a minimum, sampling should be undertaken four times per year
QA/QC procedures to be applied:	Regular sorting and weighing of waste at least quarterly. Procedures will be reviewed by the DOE.
Any comment:	-

Data / Parameter:	**z**
Data unit:	-
Description:	Number of samples collected during the year *x*
Source of data to be used:	Project participant
Value of data applied for the purpose of calculating expected emission reductions in	-

section B.5	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Implemented by the project participant, validated by the DOE.
Any comment:	-

Data / Parameter:	**EG_d**
Data unit:	MWh/yr
Description:	Electricity generation of project using fresh waste
Source of data to be used:	Electricity meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	131,274 MWh/yr
Description of measurement methods and procedures to be applied:	Exported electricity continuously measured via a meter. According to the Project developer, 22% of electricity will be used on site. Gross electricity output and the electricity consumed on-site will also be monitored to provide an alternative means of verifying the exported amount.
QA/QC procedures to be applied:	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Third parties will be able to verify.
Any comment:	Electricity generated from the use of fresh waste and exported to the grid

Data / Parameter:	**$Q_{,y}$**
Data unit:	GJ/yr
Description:	Quantity of thermal energy produced by the project using fresh waste
Source of data to be used:	Device measuring quantity and temperature of steam
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Maximum estimated capacity: 912,000 GJ/yr; Exported in year 1 (0%): 0 GJ/yr; Exported in year 2 (33%): 300,960 GJ/yr (first year of CDM); Exported in year 3 (66%): 601,920 GJ/yr; Exported from year 4 (100%): 912,000 GJ/yr;
Description of measurement methods and procedures to be applied:	Based on the properties of steam / water supplied and recorded annually
QA/QC procedures to be applied:	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Third parties will be able to verify.
Any comment:	Thermal energy generated from the use of fresh waste and exported to customers. An estimated 300,000 tonnes of steam at 0.981Mpa and 296ºC will be supplied

	annually.

Data / Parameter:	**EF_i**
Data unit:	fraction
Description:	Combustion efficiency for waste type i
Source of data to be used:	2006 IPCC Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.0 for all waste types
Description of measurement methods and procedures to be applied:	As evidenced by the use of IPCC data in the grid emission calculations published on the China DNA website, there are no national figures for this parameter. Therefore, this value will be set ex ante for each crediting period using the most up-to-date version of the IPCC Guidelines.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**NCV_{fuel}**
Data unit:	MJ/tonne
Description:	NCV of the fossil fuel
Source of data to be used:	Official data for coal – data published on the official website of the China DNA.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	20,908
Description of measurement methods and procedures to be applied:	Since project specific data is not available, country specific value obtained from the Chinese DNA website is used. This parameter will be set ex ante for each crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data to be used:	NDRC Grid emission publication
Value of data applied for the purpose of calculating expected emission reductions in	Please see Grid calculations given in Annex 3

section B.5	
Description of measurement methods and procedures to be applied:	As evidenced by the use of IPCC data in the grid emission calculations published on the China DNA website, there are no national figures for this parameter.
QA/QC procedures to be applied:	
Any comment:	In line with NDRC publication, the figures used in the calculations given in Annex 3 are included in the calculations as tC/GJ, with the conversion factor for carbon dioxide (44/12) included in an adjacent column of the spreadsheet.

Data / Parameter:	**$NO_{vehicles}$**
Data unit:	-
Description:	Vehicles per carrying capacity per year
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Counter should accumulate the number of trucks per carrying capacity, annually
QA/QC procedures to be applied:	Implemented by the project proponent. Data to be made available to DOE at verification.
Any comment:	-

Data / Parameter:	**DT_v**
Data unit:	km
Description:	Additional distance travelled
Source of data to be used:	Expert estimate
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Recorded annually
QA/QC procedures to be applied:	Implemented by the project proponent. Data to be made available to DOE at verification.
Any comment:	-

Data / Parameter:	$\mathbf{VF_{cons}}$
Data unit:	Litres
Description:	Vehicle fuel consumption in litres per km for vehicle type i
Source of data to be used:	Fuel consumption record
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Recorded annually
QA/QC procedures to be applied:	Implemented by the project proponent. Data to be made available to DOE at verification.
Any comment:	-

Data / Parameter:	$\mathbf{RATE^{compliance}{}_{y}}$
Data unit:	Number
Description:	Rate of compliance
Source of data to be used:	Municipal bodies and local common practice
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The compliance rate is based on the annual reporting of the municipal bodies issuing these reports. The state-level aggregation involves all landfill sites in the country. If the rate exceeds 50%, no CERs can be claimed. This value should be monitored annually.
QA/QC procedures to be applied:	Data are derived from or based on those from municipal bodies, so QA/QC procedures for these data are not applicable.
Any comment:	-

Data / Parameter:	$\mathbf{f_{c/g/d/r/i}}$
Data unit:	%
Description:	Fraction of waste diverted from the landfill to all project activities
Source of data to be used:	Plant records, or local authority records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of	Monthly

measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**$Q_{COD,y}$**
Data unit:	m^3/yr
Description:	Amount of wastewater treated anaerobically or released untreated from the Project activity in year y
Source of data to be used:	Measured value by flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	This parameter will be measured monthly and aggregated annually.
QA/QC procedures to be applied:	The monitoring instrument will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	Only in case the wastewater is treated anaerobically or released untreated, this parameter will be monitored. If the wastewater is treated aerobically, emissions are assumed to be zero and this parameter does not need to be monitored.

Data / Parameter:	**P_{COD}**
Data unit:	tCOD/m^3
Description:	Chemical Oxygen Demand (COD) of wastewater
Source of data to be used:	Measured value by purity meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Measured monthly and averaged annually
QA/QC procedures to be applied:	The monitoring instruments will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	The Project Developer plans to treat wastewater chemically for the duration of the Project. In line with the methodology, unless the wastewater is treated anaerobically, this parameter is not monitored.

B.7.2 Description of the monitoring plan:

Purpose

The monitoring plan is designed to monitor parameters listed in B.7.1, which are required for calculation of the actual GHG emission reduction achieved by the Project.

Monitoring framework

Figure 3 below outlines the operational and management structure that CECIC will implement to monitor emission reductions and any leakage effects generated by the Project activity. CECIC will form an operational and management team, which will be responsible for monitoring of all the aforementioned monitoring parameters. This team will compose of a general manager and a group of operators. The group of operators, under the supervision of the general manager, will be assigned for monitoring of different parameters on a timely basis and will perform the recording and archiving of data in an orderly manner. Monitoring reports will be forwarded to and reviewed by the general manager on a monthly basis in order to ensure the Project follows the requirements of the monitoring plan.

The performance of the Project will be reviewed and analyzed by the consultants on a regular basis.

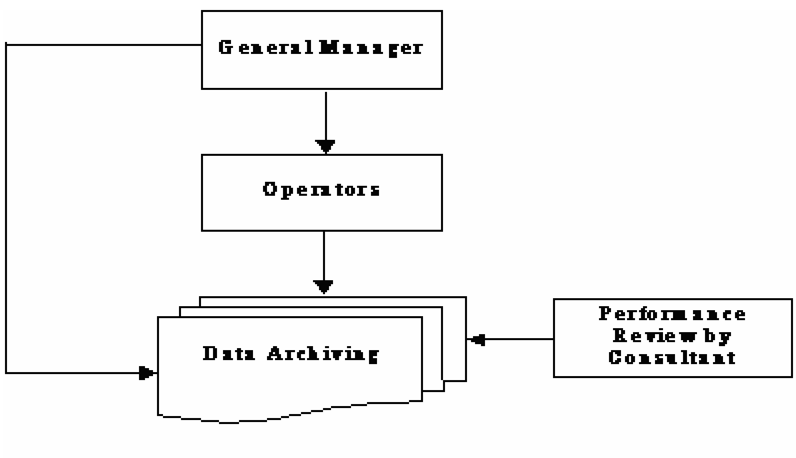

Figure 3. Operational and management structure for monitoring the Project activity.

Monitoring equipment and installation

The Project activity requires the monitoring of the following items:

- Electricity generation by the Project activity (the total amount, the amount used by the project activity, and the amount exported to the grid);
- Thermal generation from the Project activity (the amount exported to customers)

- The amount of waste consumed by the Project;
- Waste fraction of the different waste types;
- FCF of different waste types;
- Data on the relative amounts of MSW and coal combusted in the incinerator;
- Data needed to calculate CO_2 emissions from combustion of fossil-based waste;
- Data needed to calculate CO_2 emissions from the transportation of waste to the Project plant;
- Data needed to calculate CO_2 emissions from on-site consumption of fossil fuels;
- Data needed to calculate CH_4 and N_2O emissions from the boiler stacks;
- Rate of compliance by landfills in China with the national regulations regarding methane capture.
- Fraction of waste diverted from the landfill to all project activities.

The monitoring methodologies for each are stated in the respective sections of B.7.2.

Data collection

This monitoring plan includes MSW composition analysis, MSW properties analysis, and measuring of the quantity of MSW, electricity, and fuel consumption. Additionally, monitoring of laws and regulations, as well as compliance are included in this monitoring plan. The data to be collected is listed below:

(1) The MSW composition analysis, waste type by weight, and analysis of MSW properties.
(2) Electricity consumption, import and export will be recorded continuously and aggregated monthly. The time and date each monitoring period starts and ends will be recorded.
(3) The project proponent will keep all relevant receipts for electricity sales and receipts for the income from MSW handling, as well as all relevant receipts for the purchase of electricity and fuel. These receipts (or photocopies) will be made available to the auditor at verification.
(4) Annual fossil fuel consumption will be monitored from the fuel purchase invoices.
(5) The administration department will monitor MSW treatment laws, regulatory information and compliance statistics, as well as national and international publications (such as the IPCC guidelines). Administration will submit an annual report on the above to the general manager.

Calibration

Regular calibration will be necessary for the monitoring equipment. The necessary calibration will be performed according to the manufacturer's guidelines, or according to the applicable regulations, by a suitably skilled technician at the required frequency (at least once a year). A certificate of calibration will be provided for each piece of equipment after completion.

Data management

All data collected as part of monitoring plan should be archived electronically and be kept for at least 2 years after the end of the crediting period.

Monitoring report

A monitoring report in line with CDM regulations and the requirements of this monitoring methodology will be issued annually by the general manager.

The monitoring report will contain a summary of the whole monitoring plan, and will describe the implementation of the monitoring plan in that particular year, present the relevant results and data, and calculate emission reductions for the period.

The report will include:

- Quality assurance reports for the monitoring equipment;
- Calibration reports for the monitoring equipment (including relevant standards and regulations);
- Any maintenance and repair of monitoring equipment;
- The qualifications of the persons responsible for the monitoring and calculations;
- The tests performed and data obtained;
- Emission reduction calculations;
- A summary of the monitoring plan in that particular year;
- Any other information relevant to the monitoring plan.

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)

The baseline study was completed on 28/05/2008 by:

Joseph Cairnes/Matthew Setterfield
Clean Energy Finance Committee
Mitsubishi UFJ Securities (MUS)
8th Floor, Mitsubishi Building,
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Tel: +81-3-6213-6302
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CECIC Blue-Sky Investment Consulting & Management Co., Ltd
Beijing Image, No.1 Building, Unit 2, 10th Floor
No.15 Fucheng Road
Haidian District
Beijing

Tel: (8610) 62268849
Fax: (8610) 62261552

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:

16th of September 2006, the date that the construction contract for the plant was signed.

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

22 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:

01/07/2009 (based on the estimated earliest possible date of registration). To be updated accordingly by the secretariat should registration occur after this date.

C.2.1.2. Length of the first crediting period:

Seven (7) years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

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

An environmental impact report for the Project was completed in accordance with the relevant laws and regulations. The report has been approved by the Environment Protection Bureau of Shandong Province.

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

The main requirements that the above-mentioned report placed on the Project are as follows:

1) The percentage of bituminous coal will not exceed 20% of the total fuel. An automatic monitoring device is included in the feeder to measure the relative amounts of MSW and

bituminous coal. In addition, a device which separates alkali metals and discarded batteries will be installed.

2) The MSW storage pool will be non-permeable and a wastewater capture device will also be installed. Any leachate from the MSW will be combusted in the boiler.
3) The sulphur (S) content of bituminous coal is to be below 1.52% (0.46% of mixed fuels), desulphurization of the waste gases will result in the removal of at least 90% of the sulphur, and an additional filtration process will remove at least 99.8% of the dust from the waste gases. Stack gas emissions will meet *MSW Combustion Emission Standard* GB18484-2001, and stench emissions will meet *Stench Emission Standard* GB 14554-93. The chimney will be at least 120 m tall.
4) The wastewater will be separated into two waste streams: sanitary wastewater and industrial wastewater. The wastewater shall be recycled as much as possible, and any that is released will have been treated to meet the highest level of *Integrated Wastewater Emission Standard* GB8978-1996.
5) Anti-noise measures will be taken to ensure that the noise at the plant boundary meets the second level of *Industrial Enterprise Boundary Noise Standard* GB12348-90; the noise during project construction shall meet *Construction Boundary Noise Limitation* GB12523-90.
6) Residual waste from the incinerator will be sold as a replacement for clinker in cement manufacture. Any waste that is not utilized will be treated as hazardous waste.
7) A stack gas emission monitoring device will be installed according to national requirements, as stated in *Technical Guideline of Stack Gas Emission Monitoring in Coal/Oil-Fired Power Plant*.

The Project will meet all of the above requirements, and in response to a requirement of GB 18485-2001, the content of the waste will be monitored and a report submitted periodically to the local Environmental Protection Department.

The Project activity will lead to significant reductions in greenhouse gas emissions, when compared with the baseline scenario of coal-based generation and environmentally harsh methods of waste disposal. Additionally, the Project activity will significantly reduce harmful emissions (including SO_2, NOx and particulate matter) and lead to less tangible benefits for the local community such as improvements in the area's scenery and the reduction of noxious smells from the waste.

SECTION E. Stakeholders' comments

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

Survey questionnaires on the implementation of the Project were sent to the local residents, and the results compiled and reviewed by the project developer. A stakeholder consultancy meeting was organised, with announcements made in a local daily newspaper (Linyi Daily), on the internet at the site below and through posters placed at key transportation points and in nearby residential areas. A total of 37 people attended the stakeholders' meeting.

www.cecic-consulting.com.cn

E.2. Summary of the comments received:

Support for the Project was given from the local deputy mayor, on the grounds that it will bring an efficient method of dealing with increasing levels of waste being produced by the rapidly developing city of Linyi. Waste that would otherwise be disposed of at landfill, producing methane and polluting the local environment in the process. In addition to this, Linyi's wood-processing industry, the fourth largest in China, requires a large amount of heat to be supplied through small, inefficient boilers. Large efficiency gains and CO_2 emission reductions can be achieved by replacing the thermal energy supplied by these boilers with that produced by the Project activity.

The development of the Project is in line with local and national industrial policies, and it is undertaken using advanced equipment and technology developed within the country, leading to development gains within the country's industrial R&D sector.

The concerns raised in the answers to the questionnaires and at the stakeholders' meeting were as follows:

1) The production of dioxins during the combustion process,
2) Whether the Project activity's handling process for MSW would lead to any pollution of the local environment, and
3) Whether the proportion of MSW to coal would meet the national standards.

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

The owner addressed the above three concerns as follows:

1) The amount of dioxin produced in the combustion process will be much lower than the national standard (0.1Ng). Through control of the temperature in the furnace and filtration of the flue gas, levels of 0.01Ng (90% lower than the required standard) are expected to be achieved.

2) Leachate released from the MSW during the handling process will be collected and fed back into the boiler. The Project meets both national and EU standards. No new pollution will be produced.

3) The ratio of MSW to coal will be 8:2 by weight, in line with the national standards.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Linyi National Environmental New Energy Co., Ltd.
Street/P.O.Box:	No.15 Fucheng Road, Haidian District, Beijing
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Represented by:	Hang Ding
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Salutation:	Ms.
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Department:	
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State/Region:	
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URL:	www.ecoprogresso.pt
Represented by:	Pedro Mateus
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Last Name:	Mateus
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First Name:	Pedro
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Mobile:	
Direct FAX:	
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Personal E-Mail:	pmateus@ecoprogresso.pt

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The financial plans for the Project do not involve any public funding from Annex 1 countries.

Annex 3

BASELINE INFORMATION

Baseline data and information can be found in B.6.

TABLES OF OPERATING MARGING AND BUILD MARGIN CALCULATIONS

(i) Operating Margin:

OM = Total emissions 2003, 2004, 2005/Total power output 2003, 2004 , 2005

1.1208

CO2 emissions (tCO2e) for the Huabei Grid (2003):

Basic data for the North China Power Grid for 2003

Fuel Type	Unit	Beijing A	Tianjin B	Hebei C	Shanxi D	Inner Mongolia E	Shandong F	Subtotal G=A+B+C+D+E+F	EF (tC/TJ) H	Oxidation factor (%) I	NCV (MJ/t,km3) J	CO2 Emission K=G*H*I*J*44/12/10000(mass unit) K=G*H*I*J*44/12/1000 (volume unit)
Raw coal	10,000t	714.73	1052.74	5482.64	4528.51	3949.32	6808	**22535.94**	25.8	100	20908	445737636.11
Clean coal	10,000t						9.41	**9.41**	25.8	100	26344	234510.60
Other washed coal	10,000t	6.31		67.28	208.21		450.9	**732.7**	25.8	100	8363	5796681.31
Coke	10,000t					2.8		**2.8**	25.8	100	28435	75318.63
Coke oven gas	10E8 m3	0.24	1.71		0.9	0.21	0.02	**3.08**	12.1	100	16726	228559.67
Other coal gas	10E8 m3	16.92		10.63		10.32	1.56	**39.43**	12.1	100	5227	914399.71
Crude oil	10,000t						29.68	**29.68**	20	100	41816	910139.18
Gasoline	10,000t						0.01	**0.01**	18.9	100	43070	298.48
Diesel	10,000t	0.29	1.35	4		2.91	5.4	**13.95**	20.2	100	42652	440693.26
Fuel oil	10,000t	13.95	0.02	1.11		0.65	10.07	**25.8**	21.1	100	41816	834672.45
LPG	10,000t							**0**	17.2	100	50179	0.00
Refinery gas	10,000t			0.27			0.83	**1.1**	18.2	100	46055	33807.44
Natural gas	10E8 m3		0.5				1.08	**1.58**	15.3	100	38931	345076.60
Other petroleum produc	10,000t							**0**	20	100	38369	0.00
Other coking products	10,000t							**0**	25.8	100	28435	0.00
Other energy	10000t ce	9.83					39.21	**49.04**	0	100	0	0.00
											Subtotal	455551793.4

《China Energy Statistics Yearbook 2004》

Electriciy imports from NE China Grid	**2003**
Total imports, 2003 (MWh)	4,244,380 MWh

Electricity Generation from the Thermal Power Plants of North China Power Grid (2003)

Province	Electricity Gener (1E+8 **kWh**)	(**MWh**)	On-site use (%)	Power output (**MWh**)
Beijing	186.08	18608000	7.52	17208678.4
Tianjin	321.91	32191000	6.79	30005231.1
Hebei	1082.61	108261000	6.5	101224035
Shanxi	939.62	93962000	7.69	86736322.2
Inner Mongolia	651.06	65106000	7.66	60118880.4
Shandong	1395.47	139547000	6.79	130071758.7
Total				425364905.8

《China Electric Power Yearbook 2004》

North China Power Grid data net power imports from the Northeast China Power Grid (2003)

Total Power Output [MWh]	429,609,286
Total emission, tCO2	460375780.6

CO2 emissions (tCO2e) for the Huabei Grid (2004):

Basic data for the North China Power Grid for 2004

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	ıner Mongol	Shandong	Subtotal	EF (tC/TJ)	Oxidation factor (%)	NCV (MJ/t,km3)	CO2 Emission K=G*H*I*J*44/12/10000(mass unit) K=G*H*I*J*44/12/1000 (volume unit)
		A	B	C	D	E	F	G=A+B+C+D +E+F	H	I	J	
Raw coal	10,000t	823.09	1410	6299.8	5213.2	4932.2	8550	**27228.29**	25.8	100	20908	538547476.60
Clean coal	10,000t						40	**40**	25.8	100	26344	996856.96
Other washed coal	10,000t	6.48		101.04	354.17		284.22	**745.91**	25.8	100	8363	5901190.88
Coke	10,000t					0.22		**0.22**	25.8	100	28435	5917.89
Coke oven gas	10E8 m3	0.55		0.54	5.32	0.4	8.73	**15.54**	12.1	100	16726	1153187.45
Other coal gas	10E8 m3	17.74		24.25	8.2	16.47	1.41	**68.07**	12.1	100	5227	1578574.39
Crude oil	10,000t							**0**	20	100	41816	0.00
Gasoline	10,000t								18.9	100	43070	0.00
Diesel	10,000t	0.39	0.84	4.66				**5.89**	20.2	100	42652	186070.49
Fuel oil	10,000t	14.66		0.16				**14.82**	21.1	100	41816	479451.38
LPG	10,000t							**0**	17.2	100	50179	0.00
Refinery gas	10,000t		0.55	1.42				**1.97**	18.2	100	46055	60546.05
Natural gas	10E8 m3		0.37		0.19			**0.56**	15.3	100	38931	122305.63
Other petroleum produc	10,000t							**0**	20	100	38369	0.00
Other coking products	10,000t							**0**	25.8	100	28435	0.00
Other energy	10000t ce	9.41		34.64	109.73	4.48		**158.26**	0	100	0	0.00
											Subtotal	549031577.7

《China Energy Statistics Yearbook 2005》

Electriciy imports from NE China Grid	**2004**
Total imports, 2004 (MWh)	4,514,550 MWh

Electricity Generation from the Thermal Power Plants of North China Power Grid (2004)

Province	Electricity Gener (1E+8 **kWh**)	(**MWh**)	On-site use (%)	Power output (**MWh**)
Beijing	185.79	18579000	7.94	17,103,827
Tianjin	339.52	33952000	6.35	31,796,048
Hebei	1249.7	124970000	6.5	116,846,950
Shanxi	1049.26	104926000	7.7	96,846,698
Inner Mongolia	804.27	80427000	7.17	74,660,384
Shandong	1639.18	163918000	7.32	151,919,202
Total				489,173,110

《China Electric Power Yearbook 2005》

North China Power Grid data net power imports from the Northeast China Power Grid (2004)

Total Power Output [MWh]	493,687,660	
Total emission, tCO2	554332148.3	

CO2 emissions (tCO2e) for the Huabei Grid (2005):

Basic data for the North China Power Grid for 2005

Fuel Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongol	Shandong	Subtotal	EF (tC/TJ)	Oxidation factor (%)	NCV (MJ/t,km3)	CO2 Emission tCO2e K=G*H*I*J*44/12/10000(mass unit) K=G*H*I*J*44/12/1000 (volume unit)
		A	B	C	D	E	F	G=A+B+C+D +E+F	H	I	J	
Raw coal	10,000t	897.75	1675.2	6726.5	6176.45	6277.23	10405.4	**32158.53**	25.8	100	20908	636062535.80
Clean coal	10,000t						42.18	**42.18**	25.8	100	26344	1051185.66
Other washed coal	10,000t	6.57		167.45	373.65		108.69	**656.36**	25.8	100	8363	5192725.19
Coke	10,000t					0.21	0.11	**0.32**	25.8	100	28435	8607.84
Coke oven gas	10E8 m3	0.64	0.75	0.62	21.08	0.39		**23.48**	12.1	100	16726	1742396.48
Other coal gas	10E8 m3	16.09	7.86	38.83	9.88	18.37		**91.03**	12.1	100	5227	2111027.27
Crude oil	10,000t					0.73		**0.73**	20	100	41816	22385.50
Gasoline	10,000t			0.01				**0.01**	18.9	100	43070	298.48
Diesel	10,000t	0.48		3.54		0.12		**4.14**	20.2	100	42652	130786.39
Fuel oil	10,000t	12.25		0.23		0.06		**12.54**	21.1	100	41816	405689.63
LPG	10,000t							**0**	17.2	100	50179	0.00
Refinery gas	10,000t			9.02				**9.02**	18.2	100	46055	277221.01
Natural gas	10E8 m3	0.28	0.08		2.76			**3.12**	15.3	100	38931	681417.08
Other petroleum produc	10,000t							**0**	20	100	38369	0.00
Other coking products	10,000t							**0**	25.8	100	28435	0.00
Other energy	10000t ce	8.58		32.35	69.31	7.27	118.9	**236.41**	0	100	0	0.00
											Subtotal	647,686,276

《China Energy Statistics Yearbook 2006》

Electriciy imports from NE China Grid **2005**

Total imports, 2005 (MWh) 23,423,000 MWh

Electricity Generation from the Thermal Power Plants of North China Power Grid (2005)

Province	Electricity Gener (1E+8 kWh)	(MWh)	On-site use (%)	Power output (MWh)
Beijing	208.8	20880000	7.73	19,265,976
Tianjin	369.93	36993000	6.63	34,540,364
Hebei	1343.48	134348000	6.57	125,521,336
Shanxi	1287.85	128785000	7.42	119,229,153
Inner Mongolia	923.45	92345000	7.01	85,871,616
Shandong	1898.8	189880000	7.14	176,322,568
Total				560,751,013

《China Electric Power Yearbook 2006》

North China Power Grid data net power imports from the Northeast China Power Grid (2005)

Total Power Output [MWh]	584,174,013	
Total emission, tCO2	674805425.3	

3-year average OM

1.1208

Northeast China Grid OM data, for imports to the North China Grid, 2004, 2005, 2006

Basic data for the Northeast China Power Grid for 2003

Fuel Type	Unit	Liaoning A	Jilin B	Heilongjian C	Subtotal D=A+B+C	EF (tC/TJ) E	Oxidation factor (%) F	NCV (MJ/t, km3) G	CO2 Emissions H=G*D*E*F/10000*44/12 (mass unit) H=G*D*E*F/1000*44/12 (volume unit)
Raw coal	10,000t	3556.51	2006.66	2763.62	**8326.79**	25.8	100	20908	164695313
Clean coal	10,000t	70.83		3	**73.83**	25.8	100	26344	1839948.734
Other washed coal	10,000t	617.04	15.9	53.41	**686.35**	25.8	100	8363	5429988.017
Coke	10,000t				**0**	29.2	100	28435	0
Coke oven gas	1E+8 m3	1.66			**1.66**	12.1	100	16726	123184.7599
Other coal gas	1E+8 m3	5.31			**5.31**	12.1	100	5227	123141.3249
Crude oil	10,000t	3.39			**3.39**	20	100	41816	103954.576
Gasoline	10,000t					18.9	100	43070	0
Diesel	10,000t	0.32	0.34		**0.66**	20.2	100	42652	20850.00368
Fuel oil	10,000t	14.87	0.7	4.32	**19.89**	21.1	100	41816	643474.2257
LPG	10,000t	1.55			**1.55**	17.2	100	50179	49051.64513
Refinery gas	10,000t	4.03		0.46	**4.49**	18.2	100	46055	137995.8246
Natural gas	1E+8 m3		0.04	4.47	**4.51**	15.3	100	38931	984997.1241
Other petroleum produ	10,000t				**0**	20	100	38369	0
Other coking products	10,000t				**0**	25.8	100	28435	0
Other energy	10,000t ce	29.38			**29.38**	0	100	0	0
								Subtotal	174151899.2

《China Energy Statistics Yearbook 2004》

Electricity Generation from Thermal Power Plants on Northeast China Grid (2003)

Province	(1E+8 kWh)	Electricity Generation (MWh)	On-site use (%)	Power output (MWh)
Liaoning	797.51	79751000	7.17	74,032,853
Jilin	297.39	29739000	7.32	27,562,105
Heilongjian	484.93	48493000	8.48	44,380,794
Total				145,975,752

《China Electric Power Yearbook 2004》

Total emissions	174,151,899
Total Power Output	145,975,752
EF, 2003	1.193019

Basic data for the Northeast China Power Grid for 2004

Fuel Type	Unit	Liaoning A	Jilin B	Heilongjian C	Subtotal D=A+B+C	EF (tC/TJ) E	Oxidation factor (%) F	NCV (MJ/t, km3) G	CO2 Emissions H=G*D*E*F/10000*44/12 (mass unit) H=G*D*E*F/1000*44/12 (volume unit)
Raw coal	10,000t	4144.2	2310.9	3084.8	**9539.9**	25.8	100	20908	188689376.8
Clean coal	10,000t	84.75	1.09	4.88	**90.72**	25.8	100	26344	2260871.585
Other washed coal	10,000t	577.67	14.26	61	**652.93**	25.8	100	8363	5165589.096
Coke	10,000t				**0**	29.2	100	28435	0
Coke oven gas	1E+8 m3	4.83	2.91		**7.74**	12.1	100	16726	574367.4948
Other coal gas	1E+8 m3	57.33	4.19		**61.52**	12.1	100	5227	1426676.894
Crude oil	10,000t				**0**	20	100	41816	0
Gasoline	10,000t					18.9	100	43070	0
Diesel	10,000t	2.04	1.16	0.24	**3.44**	20.2	100	42652	108672.7465
Fuel oil	10,000t	12.81	1.78	2.86	**17.45**	21.1	100	41816	564536.2111
LPG	10,000t	2.19			**2.19**	17.2	100	50179	69305.22764
Refinery gas	10,000t	9.79		1.14	**10.93**	18.2	100	46055	335923.0208
Natural gas	1E+8 m3		0.03	2.53	**2.56**	15.3	100	38931	559111.4496
Other petroleum produ	10,000t				**0**	20	100	38369	0
Other coking products	10,000t				**0**	25.8	100	28435	0
Other energy	10,000t ce	26.97	5.07		**32.04**	0	100	0	0
								Subtotal	199754430.5

《China Energy Statistics Yearbook 2005》

Electricity Generation from Thermal Power Plants on Northeast China Grid (2004)

Province	(1E+8 **kWh**)	Electricity Generation (**MWh**)	On-site use (%)	Power output (**MWh**)
Liaoning	845.43	84543000	7.21	78,447,450
Jilin	332.42	33242000	7.68	30,689,014
Heilongjian	534.82	53482000	7.84	49,289,011
Total				158,425,475

《China Electric Power Yearbook 2005》

Total emissions	199,754,431
Total Power Output	158,425,475
EF, 2004	1.260873

Basic data for the Northeast China Power Grid for 2005

Fuel Type	Unit	Liaoning A	Jilin B	Heilongjian C	Subtotal D=A+B+C	EF (tC/TJ) E	Oxidation factor (%) F	NCV (MJ/t, km3) G	CO2 Emissions H=G*D*E*F/10000*44/12 (mass unit) H=G*D*E*F/1000*44/12 (volume unit)
Raw coal	10,000t	4305.41	2446.13	3383.21	**10134.75**	25.8	100	20908	200454895.9
Clean coal	10,000t				**0**	25.8	100	26344	0
Other washed coal	10,000t	524.74	19.26	24.16	**568.16**	25.8	100	8363	4494939.888
Coke	10,000t				**0**	29.2	100	28435	0
Coke oven gas	1E+8 m3	1.03	3.57	0.68	**5.28**	12.1	100	16726	391816.5856
Other coal gas	1E+8 m3	12.62	8.37		**20.99**	12.1	100	5227	486767.6854
Crude oil	10,000t	1.16			**1.16**	20	100	41816	35571.47733
Gasoline	10,000t				**0**	18.9	100	43070	0
Diesel	10,000t	1.18	1.48	0.57	**3.23**	20.2	100	42652	102038.6544
Fuel oil	10,000t	9.32	2.46	1.55	**13.33**	21.1	100	41816	431247.4323
LPG	10,000t	0.12			**0.12**	17.2	100	50179	3797.54672
Refinery gas	10,000t	5.48		1.32	**6.8**	18.2	100	46055	208991.4493
Natural gas	1E+8 m3		0.84	2.24	**3.08**	15.3	100	38931	672680.9628
Other petroleum produ	10,000t				**0**	20	100	38369	0
Other coking products	10,000t				**0**	25.8	100	28435	0
Other energy	10,000t ce	16.18			**16.18**	0	100	0	0
								Subtotal	207282747.6

《China Energy Statistics Yearbook 2006》

Electricity Generation from Thermal Power Plants on Northeast China Grid (2005)

Province	(1E+8 **kWh)**	Electricity Generation **(MWh)**	On-site use **(%)**	Power output **(MWh)**
Liaoning	836.97	83697000	7.03	77,813,101
Jilin	352.94	35294000	6.59	32,968,125
Heilongjian	580	58000000	7.96	53,383,200
Total				164,164,426

《China Electric Power Yearbook 2006》

Total emissions	207,282,748	tCO2
Total Power Output	164,164,426	MWh
EF, 2005	1.262653	tCO2/MWh

Northwest China Grid Generation and Supply Data, 2003

Province	Total generation (1E+8 kWh)	(MWh)	Parasitic use (%)	Net generation (MWh)	Hydro generation (1E+8 kWh)	Other generation (1E+8 kWh)	Thermal generation (1E+8 kWh)	Total (MWh)
Liaoning	823.36	82336000	7.17	76,432,509	23.83	2.02	797.51	
Jilin	338.83	33883000	7.32	31,402,764	40.8	0.64	297.39	
Heilongjian	495.98	49598000	8.48	45,392,090	11.05		484.93	
Total (MWh)				153,227,363				153,227,363

《China Electric Power Yearbook 2004》

Northwest China Grid Generation and Supply Data, 2004

Province	Thermal generation (1E+8 kWh)	(MWh)	Parasitic use (%)	Net thermal generation (MWh)	Hydro generation (1E+8 kWh)	(MWh)	Parasitic use (%)	Net hydro generation (MWh)	Other generation (1E+8 kWh)	Total gen (MWh)	Total (MWh)
Liaoning	845.43	84543000	7.21	78,447,450	39.47	3947000	1.33	3,894,505	2.64	264000	
Jilin	332.42	33242000	7.68	30,689,014	61.47	6147000	0.75	6,100,898	0.81	81000	
Heilongjian	534.82	53482000	7.84	49,289,011	13.38	1338000	1.27	1,321,007	0.46	46000	
Total (MWh)				158,425,475				11,316,410		391000	170,132,885

《China Electric Power Yearbook 2005》

Northwest China Grid Generation and Supply Data, 2005

Province	Total generation (1E+8 kWh)	(MWh)	Parasitic use (%)	Net generation (MWh)	Hydro generation (1E+8 kWh)	Thermal generation (1E+8 kWh)	Other generation (1E+8 kWh)	Total (MWh)
Liaoning	896.68	89668000	7.03	83,364,340	57.26	836.97	2.45	
Jilin	433.95	43395000	6.59	40,535,270	80.02	352.94	0.99	
Heilongjian	599	59900000	7.96	55,131,960	18	580	1	
Total (MWh)				179,031,569				179,031,569

《China Electric Power Yearbook 2006》

Average OM, 2003	1.136559
Average OM, 2004	1.174108
Average OM, 2005	1.157800

(ii) Build Margin:

Added capacity in the Huabei Grid (2003-2005):

Installed capacity in the North China Grid, 2005

Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3833.5	6149.9	22333.2	22246.8	19173.3	37332	111068.7
Hydro power	MW	1025	5	784.5	783	567.9	50.8	3216.2
Nuclear power	MW	0	0	0	0	0	0	0
Wind farm and others	MW	24	24	48	0	208.9	30.6	335.5
Total	MW	4882.5	6178.9	23165.7	23029.8	19950.2	37413.4	114620.5

Data source: China Electricity Yearbook 2005

Installed capacity in the North China Grid, 2004

Type	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3458.5	6008.5	19932.7	17693.3	13641.5	32860.4	93594.9
Hydro power	MW	1055.9	5	783.8	787.3	567.9	50.8	3250.7
Nuclear power	MW	0	0	0	0	0	0	0
Wind farm and others	MW	0	0	13.5	0	111.7	12.3	137.5
Total	MW	4514.4	6013.5	20730	18480.6	14321.1	32923.5	96983.1

Data source: China Electricity Yearbook 2005

Installed capacity in the North China Grid, 2003

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

Data source: China Electricity Yearbook 2005

	2003	2004	2005	Capacityaddition(2003-2005)	
Thermal	84006.6	93594.9	111068.7	27062.1	99.28%
Hydro	3266	3250.7	3216.2	-49.8	-0.18%
Nuclear	0	0	0	0	0.00%
Wind	90.1	137.5	335.5	245.4	0.90%
Total	87362.7	96983.1	114620.4	27257.7	100.00%
% of 2005 capacity	76.22%	84.61%	100.00%		
Capacity addition	23.78%	15.39%			

The China DNA has best-efficiency data for three types of power plant: solid-, liquid- and gas-fired. Emissions by type, and the representative emissions factor selected by the NDRC are shown below.

Thermal power generation in 2005

Fuel Type	CO2 Emission tCO2	%
Raw coal	636062535.8	98.21%
Clean coal	1051185.664	0.16%
Other washed coal	5192725.191	0.80%
Coke	8607.8432	0.00%
Crude oil	22385.49867	0.00%
Gasoline	298.4751	0.00%
Diesel	130786.3867	0.02%
Fuel oil	405689.6325	0.06%
Natural gas	681417.0792	0.11%
Coke oven gas	1742396.483	0.27%
Other coal gas	2111027.27	0.33%
Refinery gas	277221.0107	0.04%
	647686276.3	100.00%

Fuel type	EF (tC/TJ)	Emissions by typ
Solid	**25.8**	99.17%
Liquid	**21.1**	0.09%
Gas	**15.3**	0.74%

Best efficiency of Chinese power plants

Fuel type	Efficiency
Solid	**35.82%**
Liquid	**47.67%**
Gas	**47.67%**

Source: NDRC grid publications, 2007

Emission factor for fossil fuel

Fuel Type	Best Efficiency	Carbon emission (tC/TJ)	Oxidation factor (%)	Emission factor tCO2/MWh	Weighting
Solid	35.82%	25.8	1	0.9508	0.9429
Liquid	47.67%	21.1	1	0.5843	0.0005
Gas	47.67%	15.3	1	0.4237	0.0031
Weighted grid emission factor:					**0.9465**

	2003	New added capacity (2003-2005)	2004	2005
Total installed capacity	87362.7	27257.8	96983.1	114620.5
Thermal power installed capacity	84006.6	27062.1	93594.9	111068.7
Hydro power installed capacity	3266	-49.8	3250.7	3216.2
Total change	23.78%		15.39%	
Thermal split of new capacity		99.28%		
Weighted emission factor (tCO2/MWh)	0.9465			
Build margin emission factor	0.9397			

Annex 4

MONITORING INFORMATION

This has been completed in section B.7.

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