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

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SECTION A. General description of project activity

A.1 Title of the project activity:

Project title: Tangshan Jidong Cement Matoushan Matishan 25MW Cement Waste heat Recovery Project
PDD Version: 5.0
Completion date PDD: 30/04/2009

Revision history:
Version 1.0: First draft, prepared for host country approval
Version 2.0: Second draft, submitted for GSP under version 01 of the methodology
Version 3.0: Third draft, submitted for GSP under version 03 of the methodology due to difficulties with Fcap under Version 01 of the methodology
Version 4.0: Revised version based on Corrective Actions Requests from the DOE
Version 5.0: Revised version before submission to the EB

A.2. Description of the project activity:

Description and purpose of the project activity

The Tangshan Jidong Cement Matoushan Matishan 25MW Cement Waste heat Recovery Project (hereafter referred to as "the project" or "the proposed project activity") involves the capture and utilization of waste heat from two cement lines and the utilization of this waste heat for the purpose of power generation. The project will be implemented at the Matoushan and the Matishan clinker production line at the Cement Facility of Tangshan Jidong Cement Co., Ltd. (hereafter referred to as the cement production facility), which is located at the Wangguanying Mining area in the North of Fengrun District of Tangshan City in Hebei Province, China.

The main objective of the project is to utilize waste heat from the cement production lines for generating electric power which will be utilized on-site. The power produced by the project will displace power which would be supplied by the North China Grid in the absence of the project activity. The project will contribute to the more efficient use of energy at the cement facility and reduce reliance on exhaustible fossil fuel.

Baseline scenario and project boundary

The project scenario existing prior to the implementation of the project activity is same as the baseline scenario of the proposed project, i.e. import of electricity from an independent regional grid, North China Grid, and waste heat is vented to atmosphere. In line with the methodology, the greenhouse gasses accounted for are CO_2 emissions reductions from electricity generation in fossil fuel fired power plants that is displaced due to the proposed project activity and CO_2 project emissions from supplementary electricity consumption. The spatial extent of the project boundary as described in Section A.4.3 and B.3 in more detail and includes amongst others the cement production facility, the waste heat utilization equipment, and all power plants connected physically to the electricity system that the project is connected to.

Employed technology

The project will consist of the installation of 4 waste heat recovery (WHR) boilers, two at the pre-heater stage and the other two at the clinker cooler stage. The steam produced by the boilers will be used to power a steam turbine with an installed capacity of 25,000 kW. Annual power generation amounts to 159,460 MWh. After deduction of auxiliary power consumption, the expected net annual supply to cement production facility is 146,700 MWh. For a more detailed description of technology employed we refer to Section A.4.3.

The project will displace an equivalent amount of power which would be supplied the public grid. The internal grid of the cement production facility is connected via the Matoushan 110kV Transformer Station and the Quanhetou 110kV Transformer Station to the Hebei Power Grid which is part of the North China Power Grid.

Contribution to sustainable development

The generated power utilizes waste heat and will therefore not produce additional Greenhouse Gas (GHG) emissions, and will contribute to the sustainability of the cement sector in the Hebei Province, specifically through:

- Improving energy efficiency of the cement industry in Hubei Province in general through demonstrating efficient technology, and in particular improving energy efficiency at the Cement production facility.;
- Increasing the diversity of power supply and reducing reliance on exhaustible fossil fuel based power sources;
- Reducing global emissions of greenhouse gases, to combat global climate change;
- Creating employment opportunities for local residents.

This project fits with the Chinese government objective to improve energy efficiency in industry and the cement industry in particular.

A.3. Project participants:

The parties involved in the project are shown in Table A.1:

Table A.1 Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (host country)	Private entity: Tangshan Jidong Cement Co., Ltd.	No
United Kingdom	1. Private entity: Climate Change Capital Carbon Managed Account Limited	No
United Kingdom	2. Private entity: Climate Change Capital Carbon Fund II s.à.r.l.	No

For more detailed contact information on participants in the project activities, please refer to Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

People's Republic of China

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

Hebei Province

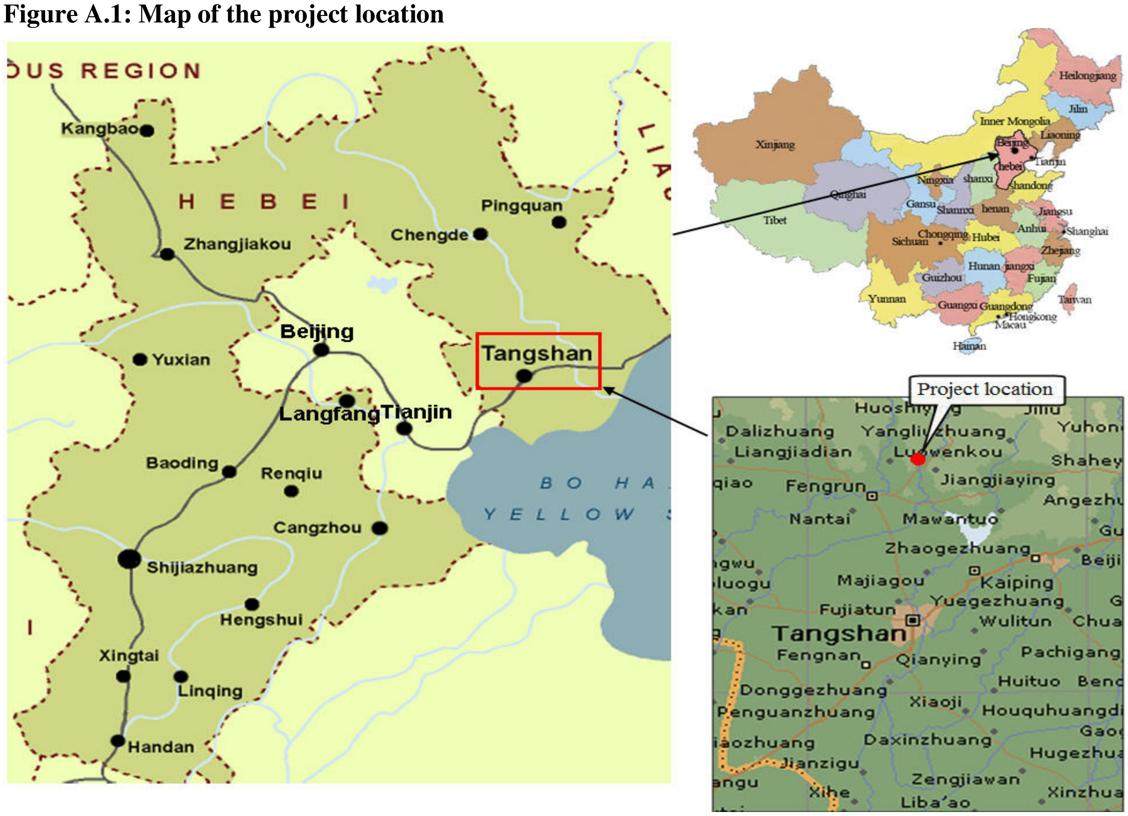
A.4.1.3. City/Town/Community etc:

Fengrun District of Tangshan City

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

The project will be implemented at the Matoushan and Matishan cement lines of Tangshan Jidong Cement Co., Ltd. in the Wangguanying Mining area in the North of Fengrun District of Tangshan City in Hebei Province, China. The project location is about 34 kilometers away from Tangshan City .The site location's approximate coordinates are east longitude of 118º12'54" and north latitude of 39º55'37". Figure A.1 shows the location of the project.

Figure A.1: Map of the project location



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

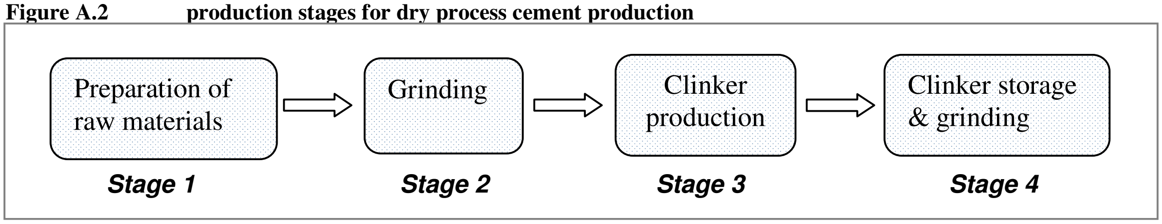
The project activity falls within Sectoral Scope 1: Energy Industries.

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

Cement Production:

The cement production facility will consist of two dry process rotary kiln cement production lines. The cement production process consists of several stages as indicated in Figure A.2.

Figure A.2 production stages for dry process cement production



The first stage involves the preparation of raw materials, such as limestone and clay. The materials are crushed, mixed and homogenized (stage 1) after which the materials are mixed with the required additives

such as silica sand and iron ore. This mixture is then ground into powder (stage 2) after which the raw materials are transported to stage 3, where the raw materials will be transformed into clinker through a process of calcination. The raw materials first go through a pre-heater (PH) stack where heaters pre-heat the materials. Afterwards, the materials pass through a long rotary kiln in which the materials are heated up to a high temperature and a material called clinker is produced. The materials leave the kiln as hot clinker which is then cooled by so-called Air Quenching Coolers (AQC). After cooling, clinker is usually stored in silos where it waits for further processing, such as mixing with other ingredients and grinding which depends on the intended purpose of the final product (stage 4).

Waste heat recovery:

The production of clinker consumes substantial amounts of energy of which part is lost into the atmosphere in the form of waste heat. At the cement production facility significant amounts of heat are lost at two stages: 1) the pre-heater (PH) stage where exhaust gasses from the heaters are cooled and waste heat is vented into the atmosphere and 2) the AQC stage where the clinker is cooled and waste heat is also not utilized. The proposed project activity will introduce waste-heat recovery technology that will utilise waste heat at these two stages for generation of electric power. Without the waste heat recovery project, the waste heat would not be utilized for any useful purpose.

The proposed project activity involves the installation of 4 waste heat recovery (WHR) boilers at two 4,500 ton/day cement production lines. The WHR boilers will be installed at the PH stage of both production lines to capture heat from exhaust gasses and at the AQC stage of the two production lines where they will capture heat contained in the clinker. The steam produced by the WHR boilers will be led to a steam turbine which will generate electric power that will be used on-site. The steam from the cement lines will be led to a 25,000 kW steam turbine.

The expected operational lifetime of the project is 20 years (FSR, page 56). All main equipments such as the AQC boiler, PH boiler, Steam Turbine, and Generator that will be installed and employed by the project activity are new and therefore it is assumed they will be operated for 20 years from the start of the project activity.

Table A.2 summarizes the technical specifications of the waste heat recovery and utilisation equipment

Table A.2 Technical specification of waste-heat utilisation equipment

AQC boiler (per unit) (new equipment)			
Manufacturer	Nantong Wanda Boiler Joint-stock Co., Ltd.	*Type*	Specific type-number not yet determined
Nominal air pressure	12.5barA	*Nominal steam temperature*	345°C
Nominal flow	20.0 t/h	*Operational lifetime*	20 years
PH Boiler (new equipment)			
Manufacturer	Anhui Hailuo New Energy-saving Equipments Manufacturing	*Type*	Specific type-number not yet determined
Nominal air pressure	12.5barA	*Nominal steam temperature*	337°C
Nominal flow	39.02 t/h	*Operational lifetime*	20 years
Steam Turbine (new equipment)			
Manufacturer	Nanjing Turbine and Electric Machinery (Group) Co., Ltd.	*Model*	Specific type-number not yet determined

Nominal capacity	23,800 kW	*Feed temperature*	334.1°C
		Operational lifetime	20 years
Generator (new equipment)			
Manufacturer	Nanjing Turbine and Electric Machinery (Group) Co., Ltd.	*Model*	Specific type-number not yet determined
Nominal capacity	25,000 kW	*Nominal voltage*	6.3kV
Nominal speed	3000rpm	*Power factor*	0.85φ
Operational lifetime	20 years	*Efficiency*	97~97.4

All the equipment employed is domestically manufactured and therefore does not involve the transfer of technology from an Annex I country.

Energy and mass flows:

The existing and forecast energy and mass flows diagram including the balance of the systems and equipments in the project activity is illustrated in the Figure A.3.

Figure A.3 Energy and Mass flow diagram of the project

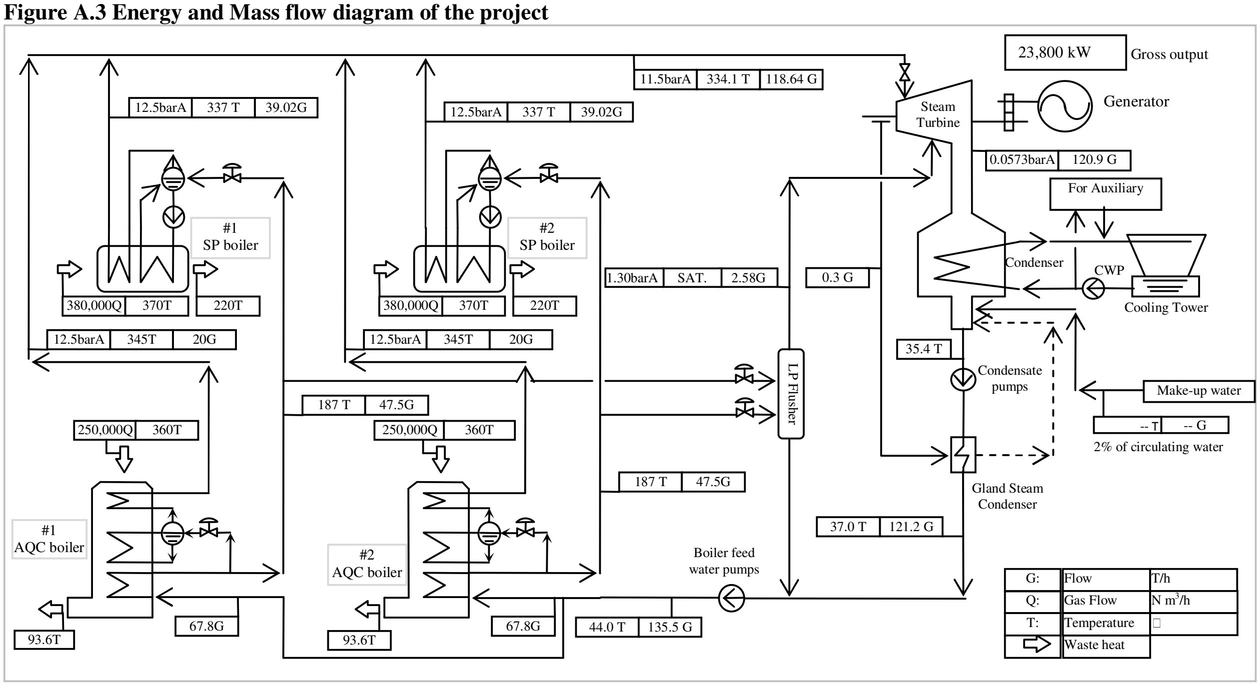


Table A.3a. Energy balance before the project activity

Total amount of Energy (TJ)	Purpose of the Energy	Amount of Energy (TJ)	Remarks
1,704 TJ	Vented	1,704 TJ [1]	Directly vented waste heat

Table A.3b. Energy balance after the project activity

Total amount of Energy (TJ)	Purpose of the Energy	Amount of Energy (TJ)	Remarks
1,704 TJ	Vented	760 TJ [2]	Exhaust heat of the SP and AQC boilers
	Losses	583 TJ [3]	Pre-generation losses
	Generated electricity	46 TJ [4]	Auxiliary consumption
		528 TJ [5]	Net electricity supplied to the internal grid of the cement production facility.

Monitoring equipments and their location in the systems:

Electricity monitoring instruments installed by the project activity to measure Net power supply from the project activity to the cement production facility are located on the power lines connecting the CDM project activity to the internal electricity grid of the cement production facility. An electrical connection diagram indicating the exact position and type of monitoring instruments, and a more detailed description on amongst others measuring intervals and calibration, is presented in Section B.7.2.

Grid connection, Baseline Scenario, and Sources and Gases in the Project Boundary:

Power generated by the project will be routed to the internal electricity system of the cement production facility, after it has been boosted on-site in an on-site step-up transformer station. The internal grid of the cement production facility is connected to the Hebei Provincial power grid, which in turn is connected to the North China Power Grid. The baseline scenario for the proposed project activity is supply of electricity generated on in the North China Power Grid to the cement production facility, which is

[1] See also table B.9. Gross energy content contained in hot air (relative to 0°C) in the SP stage and ACC stage is 364,778 kJ/ton clinker and 245,429 kJ/ton clinker. The combined Gross energy content contained in hot air (i.e. ACC + SP stage) is therefore 610,207 kJ/ton clinker produced. The projected annual clinker production of the Matishan and Matoushan cement lines is 2,792,250 ton. Consequently, the amount of non-utilized waste heat in the baseline is 1,704 TJ. A detailed calculation has been provided to the DOE in the form of an F_{cap} calculation sheet.

[2] Energy contained in the unutilized exhaust heat, relative to 0ºC, after exiting the SP and AQC boiler is 198,642 kJ/ton clinker, and 73,629 kJ/ton clinker respectively. Projected clinker production of the Matishan and Matoushan cement lines is 2,792,250 tons annually. Consequently, annual unutilized exhaust heat, relative to 0ºC, is 760 TJ annually. For a more detailed explanation, we refer to the F_{cap} calculation sheet.

[3] Losses occurring pre-generation include losses in the steam turbine, generator, SP & AQC boiler, and heat transmission pipes (all calculated in accordance with design specification provided by the manufacturer), and a standard power factor of 0.85φ which has also been evidenced. For a more detailed explanation, we refer to our F_{cap} calculation sheet.

[4] Auxiliary consumption is calculated as a percentage of theoretical power generation based on available waste heat. For a more detailed explanation, we refer to our F_{cap} calculation sheet.

[5] Based on total available waste heat, the potential power supply that could theoretical be provided to the internal production facility of the cement production facility is 148,902 MWh. Based on a standard energy conversion factor of 3600 kJ/kWh, this contains 536 TJ of energy. For a more detailed explanation, we refer to our F_{cap} calculation sheet. This theoretical power supply is 1.5% higher than the estimated annual net power supply from the FSR, and hence F_{cap} is calculated as 1.015 in Section B.6.1 of this PDD.

identical to the scenario existing prior to the start of implementation of the project activity. The proposed project activity will displace electricity grid generation in the baseline.

In line with methodology ACM0012, the greenhouse gasses accounted for are CO_2 emissions reductions from electricity generation in fossil fuel fired power plants that are displaced due to the proposed project activity and CO_2 project emissions from supplementary electricity consumption.

The spatial extent of the project boundary as described in Section B.3 in more detail and includes amongst others the cement production facility, the waste heat utilization equipment, and all power plants connected physically to the electricity system that the project is connected to. An indicative diagram of emission sources and gases particularly included in the project boundary has been shown in the Figure B.1, which also indicates the location of monitoring variables. Services provided by the project activity consist solely of the utilization of waste heat and the provision (i.e. supply) and sale of electricity to the cement production facility. In the absence of the project activity, electricity would have been provided by grid-connected power plants in the baseline, and the waste heat would not have been utilized.

Equipment(s) and systems in operation at the time of the implementation of the project activity therefore include the:

- Power plants connected to the North China Power Grid;
- Transmissions lines and transformer stations connecting the cement production facility to the North China Power grid, and the;
- Cement production facility itself (including the AQC and SP stage were the waste heat is generated).

Training and maintenance requirements:

The staff of the project activity received the appropriate training on the operation of the waste heat recovery equipment as specified in the equipment purchase contract.

Implementation schedule:

An indicative implementation schedule of the proposed project activity is indicated in Table A.4 below (the dates are best estimates), more specific details on the implementation schedule, including the "starting date of the project activity" and CDM consideration are provided in Table B.7.

Table A.4 Implementation schedule proposed project activity

Start date	Activity
10 August 2007	Construction of the project
10 February 2008	Debugging of equipment (each unit)
10 March 2008	System commissioning and connection to internal grid
April or May 2009	Estimated start operations

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

The estimation of the emission reductions in the crediting period is presented in Table A.5.

Table A.5 The estimation of the emission reductions in crediting period

Year	Annual estimation of emissions reductions in tons of CO_2e
Year 1: 10/08/2009 – 09/08/2010	148,431
Year 2: 10/08/2010 – 09/08/2011	148,431
Year 3: 10/08/2011 – 09/08/2012	148,431
Year 4: 10/08/2012 – 09/08/2013	148,431
Year 5: 10/08/2013 – 09/08/2014	148,431
Year 6: 10/08/2014 – 09/08/2015	148,431
Year 7: 10/08/2015 – 09/08/2016	148,431
Year 8: 10/08/2016 – 09/08/2017	148,431
Year 9: 10/08/2017 – 09/08/2018	148,431
Year 10: 10/08/2018 – 09/08/2019	148,431
Total estimated reductions (tons of CO_2e)	**1,484,310**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tons of CO_2e)	148,431

A.4.5. Public funding of the project activity:

There is no public funding from Annex I countries available to the proposed project.

SECTION B. Application of a baseline and monitoring methodology

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

Baseline and monitoring methodology:

Approved consolidated baseline and monitoring methodology ACM0012 (Version 03.1): "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects".

The methodology draws upon:

- Tool to calculate the emission factor for an electricity system (Version 01.1).
- Tool for the Demonstration and Assessment of Additionality (Version 05.2).

Reference: UNFCCC website: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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

The consolidated methodology makes a distinction between two types of project activities:

Type-1: All the waste energy in identified WECM stream/s, that will be utilized in the project activity, is, or would be flared or released to atmosphere in the absence of the project activity at the existing or new facility. The waste energy is as an energy source for:
- Cogeneration;
- Generation of electricity;
- Direct use as process heat source;
- For generation of heat in element process (e.g. steam, hot water, hot oil, hot air); or
- For generation of mechanical energy.

Type-2: An existing industrial facility, where the project activity is implemented, that captures and utilizes a portion of the waste gas stream(s) considered in the project activity.

The proposed CDM project activity is a Type-1 project, as it will utilize all waste heat generated by the cement facility for electricity generation.

The life time of the equipments of the project is 20 years. The project employs a fixed crediting period that will not exceed the end date of the project.

The approved consolidated baseline and monitoring methodology ACM0012 is applicable to the proposed project, because the project meets all the applicability criteria stated in the methodology:

- Energy generated in the project activity may be used within the industrial facility or exported from the industrial facility; [6]

[6] Electricity generated in the Project activity will be used within the industrial facility where the waste is generated.

- Electricity generated in the project activity will be used for captive purposes;
- Energy in the project activity will be generated by the owner of the industrial facility producing the waste energy;
- Regulations do not constrain the industrial facility that generates waste energy from using fossil fuels prior to the implementation of the project activity;
- The project activity involves a waste heat recovery project in a new facility;
- The emission reductions are claimed by the generator of the electricity using waste heat;
- Waste energy that is released under abnormal operation (for example, emergencies, shut down) of the plant shall not be accounted for;
- The waste gas/heat project is not implemented in a single-cycle power plant to generate power.

There are several applicability conditions stated in the PDD that are not applicable to the proposed project activity. Below we mention the conditions and the reasons why they are not applicable:

- If the project activity is based on the use of waste pressure to generate electricity, electricity generated using waste pressure should be measurable.
  This applicability condition is not relevant, as the project activity does not involve the use of waste pressure.
- In cases where the energy is exported to other facilities, an official agreement is signed by exists between the owners of the project energy generation plant with the recipient plant(s) that the emission reductions would not be claimed by recipient plant(s) for using a zero-emission energy source;
  This applicability condition is not relevant, as the energy is not exported to other facilities.
- For those facilities and recipients included in the project boundary, that prior to implementation of the project activity generated energy on-site, the credits can be claimed for specified period.
  This applicability condition is not relevant, as there was no on-site energy generation prior to implementation.

The latest version of ACM0012 (version 03.1) has been applied.

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

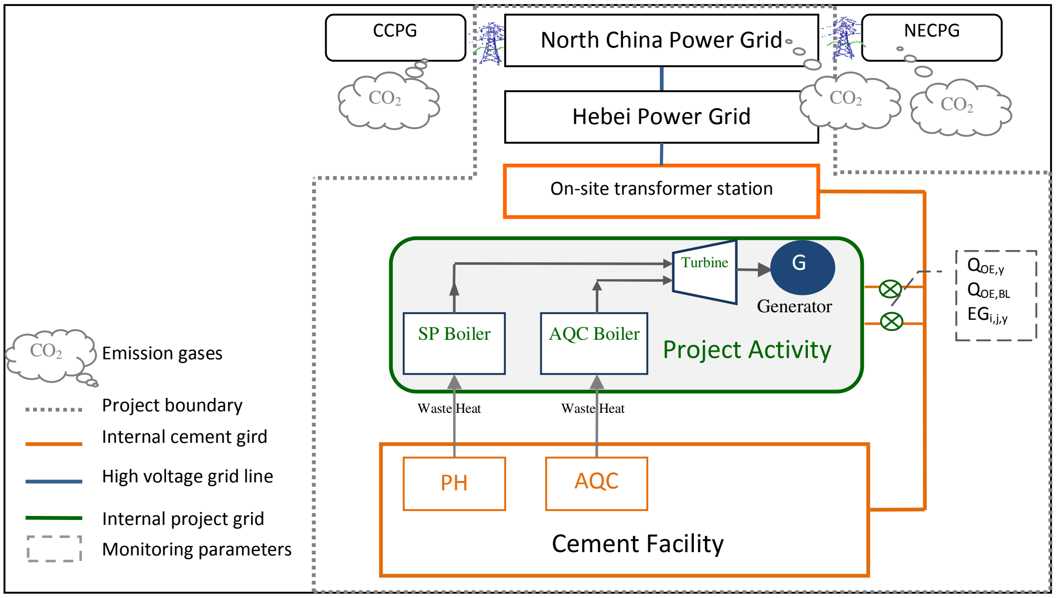
The baseline scenario of the proposed project activity is the consumption of electric power by the cement production facility which is supplied by the public electricity grid. The proposed project activity will displace part of the power that would be consumed by the cement production facility.

Table B.1: Summary of gases and sources included in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification, this is conservative.
		N_2O	Excluded	Excluded for simplification, this is conservative.
	Fossil fuel consumption in boiler for thermal energy	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification, this is conservative.
		N_2O	Excluded	Excluded for simplification, this is conservative.
	Fossil fuel consumption in cogeneration plant	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification, this is conservative.
		N_2O	Excluded	Excluded for simplification, this is conservative.
	Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification, this is conservative.
		N_2O	Excluded	Excluded for simplification, this is conservative.
Project Activity	Supplemental fossil fuel consumption at the project plant	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Supplemental electricity consumption	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Electricity import to replace captive electricity, which was generated using waste gas in absence of project activity	CO_2	Included	Only in case captive electricity in the baseline is replaced by import electricity
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Project emissions from cleaning of gas	CO_2	Included	Only in case waste gas cleaning is required and leads to emissions related to the energy requirement of the cleaning.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

Table B.1 provides an overview of emissions that potentially have to be taken into account when applying the ACM0012 methodology. As the project does not involve fossil fuel consumption, flaring of steam, or cleaning of gas, it is clear from table B.1 that the only greenhouse gas that needs to be accounted for in the calculation of emissions reductions is CO_2 as a result of fossil-fuel fired power generation of grid-connected power stations in the baseline scenario (because the proposed project activity does not involve captive electricity generation) and supplemental electricity consumption in the project activity. These gases and sources have been highlighted in Table B.1. In addition, an indicative diagram of emission sources and gases particularly included in the project boundary has been shown in the Figure B.1, which also indicates the location of monitoring variables.

Figure B.1 Indicative diagram of emission sources and gases particularly included in the project boundary and the monitoring variables.



The power generated through the utilization of waste heat by the proposed project activity will be supplied to the cement production facility and will displace electricity that would be supplied by the grid. The project will be applied at both cement lines of the cement production facility.

The project's spatial boundary can therefore in accordance with ACM0012 be defined to be comprised of:

- The cement production facility including the waste heat exhausts at the SP and AQC stages of cement production lines.
- The waste heat utilization equipment, which includes: four waste heat recovery boilers (two SP boilers and two AQC boilers), steam turbine/generator unit and auxiliary devices such as the de-aerator, condenser, water pre-heater, and cooling towers. The project's physical boundary is marked by the point where the project connects to the internal grid.
- All power plants connected physically to the electricity grid that the project will affect, i.e. the North China Power Grid, as elaborated further below.

According to the "Tool to calculate the emission factor for an electricity system (Version 01.1)", the relevant grid definition should be based on the following considerations:

1. If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used; or
2. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions

In case of larger countries with layered dispatch systems (e.g. provincial / regional / national), the regional grid definition can be used

According to above requirements, the regional grid (North China Power Grid) is selected as the project boundary.

The project is connected to the cement production facility, which in turn is connected to the Hebei Power Grid. The Hebei Power Grid is part of the North China Power grid. The regional grid definition used in this PDD follows the guidance of the Chinese DNA and the practice of other registered Chinese PDDs in defining the relevant regional grid as being composed of all power production facilities connecting to the Beijing, Tianjin, Shanxi, Hebei, Shandong, West Inner Mongolia and East Inner Mongolia grids.[7] This definition is used for all years considered, including those years in which the Shandong power grid did not formally belong to the North China Grid, to ensure data consistency. For ease of reference, we will use "North China Grid" throughout when referring to the regional grid composed of the Beijing, Tianjin, Shanxi, Hebei, Shandong, West Inner Mongolia and East Inner Mongolia power grids.

The North China Power Grid is connected to the Central China Power Grid and North East China Power Grid. There are electricity transfers from those two grids to the North China Power Grid. These imports are taken into account when calculating the combined margin emission factor of the North China grid.

In agreement with the methodology, leakage (arising from power plant construction, fuel handling, etc.) is ignored. The project participants also do not claim emission reductions resulting from a reduction of these emissions under the baseline level.

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

The baseline methodology ACM0012 prescribes that a baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s). Realistic and credible alternatives should be determined for:

- Waste energy use in the absence of the project activity;
- Power generation in the absence of the project activity;
- Steam/heat generation in the absence of the project activity;
- Mechanical energy generation in the absence of the project activity.

The proposed project activity does not generate steam/heat or mechanical energy and therefore the latter two are not applicable. Consequently, we confine the below discussion to the primer two baseline scenarios (i.e. "waste heat energy use in the absence of the project activity", and "power generation in the absence of the project activity").

This section discusses the plausible baseline scenarios, and selects the baseline scenario on the basis of a barrier analysis. More information can be found in Section B.5

Step 1: Define the most plausible baseline scenario for the generation of heat and electricity using the following baseline options and combinations.

Step 1a Baseline scenario for the use of the waste heat resource

7 The East Inner Mongolia grid belongs to the Northeast China Grid, but the data for the East Inner Mongolia grid and West Inner Mongolia grid are not reported separately. For this reason, a choice needs to be made whether or not to include the whole of Inner Mongolia in the North China Grid or the Northeast China Grid. The convention we use – all production facilities in Inner Mongolia belong to the North China Grid – is the standard one and also underlies the calculation of the emission factors published by the Chinese DNA 18 July 2008.

ACM0012 mentions:

"For the use of waste energy, the realistic and credible alternative(s) may include, inter alia":

- W1 WECM is directly vented to atmosphere without incineration or waste heat is released to the atmosphere or waste pressure energy is not utilized;
- W2 WECM is released to the atmosphere (for example after incineration) or waste heat is released to the atmosphere or waste pressure energy is not utilized;
- W3 Waste energy is sold as an energy source;
- W4 Waste gas/heat/pressure is used for meeting energy demand.
- W5 A portion of the waste gas produced at the facility is captured and used for captive electricity generation, while the rest of the waste gas produced at the facility is vented/flared;
- W6 All the waste gas produced at the industrial facility is captured and used for export electricity generation.

We discuss each of these alternatives in turn.

Alternative W1 is identical to W2 (i.e. waste heat is released to the atmosphere) and we therefore confine our following discussion to W2.

Alternative W2 is applicable and cannot be a priori rejected. It corresponds to the current practice at cement production facilities in the project area. The waste heat to be utilized in the proposed project activity would not be used in the absence of the project activity, and would be released into the atmosphere.

Alternative W3 is not applicable, as there are no users of heat located near to the cement production facility. Therefore, transport of heat over long distances is not economical. Additionally, sale of heat to surrounding consumers faces institutional barriers relating to the enforcement of contracts.

Alternative W4 if interpreted as implying any other use of waste heat than generating power (to be discussed below), is not applicable as the cement plant will be self-sufficient in heat in accordance with the design. Alternative W4 is also not consistent with current practice of cement production facilities in the project area. Alternative W4 is applicable and cannot be rejected to the extent that it implies the use of waste heat for power generation.

Alternatives W5 and W6 are not applicable as the proposed project activity does not utilize waste gas.

Conclusion: We conclude that alternative W2, atmospheric release of waste heat, and W4, the use of waste heat to meet energy (*in casu*, power) demand, are the possible baseline alternatives for the use of waste heat available at the cement production facility.

Step 1b Baseline scenario for power supply

ACM0012 mentions:
"For power generation, the realistic and credible alternative(s) may include, inter alia":

- P1 Proposed project activity not undertaken as a CDM project activity;
- P2 On-site or off-site existing/new fossil fuel fired cogeneration plant;
- P3 On-site or off-site existing/new renewable energy based cogeneration plant;
- P4 On-site or off-site existing/new fossil fuel based existing captive or identified plant;

- P5 On-site or off-site existing/new renewable energy or other waste energy based existing captive or identified plant;
- P6 Sourced Grid-connected power plants;
- P7 Captive Electricity generation using waste energy (if project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency than the project activity.);
- P8 Cogeneration using waste energy (if project activity is cogeneration using waste energy, this scenario represents cogeneration with lower efficiency than the project activity)."
- P9 Existing power generating equipment is either decommissioned to build new more efficient and larger capacity plant or modified or expanded, and resulting in higher efficiency, to produce and only export electricity generated from waste gas. The electricity generated by existing equipment for captive consumption is now imported from the grid;
- P10 Existing power generating equipment is either decommissioned to build new more efficient and larger capacity plant or modified or expanded, and resulting in higher efficiency, to produce electricity from waste gas for own consumption and for export;
- P11 Existing power generating equipment is maintained and additional electricity generated by grid connected power plants.

Of these alternatives, we can exclude P2, P3, and P8 as irrelevant, because the proposed project activity does not have a heat supply component (also note that there is no demand for heat or other forms of energy besides electricity as explained in above for alternative W3, and it is therefore not realistic that the proposed project activity would produce anything else than electricity). We also can eliminate alternatives P9, P10 and P11, because no existing power generating equipment is involved. We therefore confine our discussion to alternatives P1, P4, P5, P6, and P7.

Alternative P1 is applicable. It is in conformity with Chinese laws and cannot be a priori rejected.

Alternative P4 is not applicable. Creation of captive power generation capacity are impossible because: (1) the construction of small thermal power plants is prohibited by the Chinese government (see Section B.5, sub-step 1b for details); and (2) gas-fired thermal power generation is not feasible due to the fact that there is no connection to a natural gas pipeline at the project location.

Alternative P5 is not applicable. The project location does not have sufficient renewable or other waste based energy resources (hydro, wind, biomass, waste gas, waste pressure) to establish a power plant using these resources. Apart from this, at least in the case of wind power and biomass-fired power plants, the costs of renewable power is substantially above the cost of thermal power.[8]

Alternative P6 is applicable. It is in conformity with Chinese laws and cannot be a priori rejected.

Alternative P7 is not applicable. The proposed project activity utilizes waste heat for electricity generation and no other technology is available.

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[8] See for example *Meier (2002)*, Economic and Financial Analysis of the China Renewable Energy Scale-up Programme (CRESP), in which the additional power supply costs of wind farms and biomass power plants vs coal-fired power plants are calculated. Additionally the "*Trial Measures for Pricing and Cost Sharing Management for Renewable Energy Power*" provides for special tariffs for windfarms and biomass power plants to overcome their cost disadvantage.

Conclusion: We conclude that alternative P1, the proposed project activity not undertaken as a CDM project activity, and alternative P6, sourced grid connected power plants, are the possible baseline alternatives for the supply of power.

Overall conclusion step 1

Our conclusions may be summarized in the following matrix, which provides the possible alternative baseline combinations.

Power generation option **Use of waste heat**	**P1**	**P6**
W2	Not applicable. This scenario is not internally consistent – if the waste heat is released in the atmosphere, it is not available for power generation.	**Alternatives combination I** Applicable. This scenario corresponds to the current practice at cement production facilities in the project area: power supply by the grid, and non-utilization of the waste heat [9]
W4	**Alternatives combination II** Applicable This scenario uses the waste heat to generate power to substitute power that would have been supplied by the grid, without the support of CDM	Not applicable. This scenario is not internally consistent – there would be no energy use for the waste heat

Alternative combinations I and II are further investigated in the next steps.

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

This step is skipped, because both alternative combinations identified in Step I do not give rise to the selection of a fuel. The reasons are: (1) there is no heating component; (2) the two alternatives for the power supply do either use no fossil fuel (the proposed project activity undertaken without the support of CDM), or use the generation mix of the grid.

Step 3: Use Step 2 and/or step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" to identify the most plausible baseline scenarios by eliminating non-feasible options

As argued in Step 1, only two alternative combinations of the use of waste heat and power supply options cannot be rejected a priori. These are the current situation: power supply by the grid, and non-utilization of the waste heat (Alternative combination I) and the proposed project activity without the support from CDM (Alternative combination II). A detailed barrier analysis based on Version 05.2 of the Tool for the

[9] For older existing cement production facilities, a captive power plant is also a common option. We have excluded this from the baseline scenario as explained above, option P4 is not applicable as the relevant cement production facility does not have captive power generation capacity and the creation of a new captive power plant is not in accordance with Chinese regulations.

demonstration and assessment of additionality is performed in Section B5, to which we refer for details. Below we present the summary of the results of the barrier analysis, summarizing why different scenarios are eliminated during the barrier analysis.

- Alternative combination I is not eliminated. It corresponds to current practice at cement production facilities in the project area.
- Alternative combination II is eliminated, because the proposed project activity, without the support from CDM, faces a number of barriers, which include investment barriers, barriers due to prevailing practice, technological barriers, and financial barriers. (See Section B.5, sub-step 3a for details).

Therefore, alternative combination I, power imports from the grid combined with the non-utilization of waste heat, is the only scenario that is not eliminated and is hence selected as the baseline scenario of the project. The baseline scenario of the project there involves the continued operation of existing power plants connected to the North China Grid *plus* the addition of new power plants connected to the North China Grid to meet the demand of electric power.

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

The additionality of the project activity is demonstrated using the steps described in the 'Tool for the Demonstration and Assessment of Additionality' (Version 05.2)

Reference: See UNFCCC Website:

http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

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

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

This methodological step requires a number of sub-steps, the first of which is the identification of realistic and credible alternatives to the project activity. Based on the previous section, we conclude that alternative W2, atmospheric release of waste heat, and W4, the use of waste heat to meet energy (*in casu*, power) demand, are the a priori credible baseline alternatives for the use of waste heat available at the cement production facility. Alternative P1, the proposed project activity not undertaken as a CDM project activity, and alternative P6, sourced grid connected power plants, are the a priori credible baseline alternatives for the supply of power.

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

The second sub-step involves the confrontation of the alternatives with China's applicable laws and regulations.

Use of waste heat

Both alternatives for waste heat utilization (W2 and W4) are in agreement with Chinese laws and regulations. In the case of the non-use of the waste heat, this may require some further explanation. China has several policies, laws and regulations in place (see below), and this may raise the question of whether use of the waste heat is mandatory.

The key policies / regulations /laws to encourage improvements in energy efficiency which bear relevance to the proposed project activity are the *Cleaner Production Promotion Law*, the *Energy Conservation Law*, the *Policies Outline of Energy Conservation Technologies* (enacted in 1984 and revised in 1996), and the *China Medium and Long Term Energy Conservation Plan* among others. The above-mentioned policies encourage the utilization of waste heat but do not include specific measures which would involve mandatory implementation of waste heat utilization or financial incentives in the form of grants or subsidies.[10] Therefore, atmospheric release of the waste heat, although not encouraged by the Chinese authorities, is in compliance with existing policies and regulations.

Power supply options

Alternative P1**,** the proposed project activity without the support of CDM, is in accordance with applicable laws and regulations and will be considered a realistic alternative.

Alternative P6, provision of power from the grid, is in line with the Chinese regulations.

Conclusion: Alternatives W2 and W4 are credible alternatives for the use of waste heat, while Alternatives P1 and P6 are credible alternatives as options for power supply. Our conclusions may be summarized in the following matrix, which provides the possible alternative baseline combinations.

Power generation option **Use of waste heat**	**P1**	**P6**
W2	Not applicable. This scenario is not internally consistent – if the waste heat is released in the atmosphere, it is not available for power generation.	**Alternatives combination I** Applicable. This scenario corresponds to the current practice at cement production facilities in the project area: power supply by the grid, and non-utilization of the waste heat
W4	**Alternatives combination II** Applicable This scenario uses the waste heat to generate power to substitute power that would have been supplied by the grid, without the support of CDM	Not applicable. This scenario is not internally consistent – there would be no energy use for the waste heat

Alternative combinations I and II are in line with the Chinese regulations and are further investigated in the next steps. We will argue that there are several barriers that prevent alternative combination II, the waste heat recovery project without the benefits from registration as a CDM project, from being

[10] See for more information on energy efficiency promotion policies: Global Environment Institute (2005), *Financing of Energy Efficiency Improvement for Cement Industry in China*, GEI Report, January 2005.

implemented. These barriers include an investment barrier (elaborated in Step 2 below) and technological and first-of-its-kind barriers (elaborated in Step 3).

Step 2. Investment Analysis

We analyze whether Alternative combination II, the proposed project activity without the support of CDM, is an economically attractive alternative compared to alternative scenarios through conducting an investment analysis as defined in the additionality tool.

Sub-step 2a: Determine appropriate analysis method

The analysis will be analyzed through Option III of the additionality tool, i.e. benchmark analysis. This method is applicable because:

- Option I: Simple cost analysis, does not apply, because the project generates economic returns through cost savings from the displacement of power purchased from the grid.
- Option II: Investment comparison analysis is not used, because the identified alternative (non-use of the waste heat and purchase of the power from the grid) does not involve investments.
- Option III: Benchmark analysis is applicable, because there is one investment decision for which an IRR can be calculated and compared against a company benchmark.

Conclusion: We conclude that option III is applicable to the project activity.

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

The "Tool for the Demonstration and Assessment of Additionality" (Version 05.2) provides, under sub step 2, the option (option C) of employing a "Company Internal Benchmark" to demonstrate additionality:

The proposed project activity faces a prohibitive barrier to implementation due to insufficient financial returns. To illustrate this, we perform a benchmark analysis in which we compare the financial returns of the proposed project activity to a company-specific benchmark for investment decisions.

Company Internal Benchmark

The internal company benchmark in accordance with the latest "Guidance on the assessment of Investment Analysis" and the "Additionality Tool" is the Weighted Average Cost of Capital (WACC). The WACC for Jidong is calculated according to the following equation[11]:

WACC = After Tax Cost of Debt * (Total Debt / Total Capital) +
Cost of Preferred equity * (Preferred Equity / Total Capital) +
Cost of Equity * (Equity capital / Total Capital)

The WACC for Jidong is 15.58%.[12]

[11] This formula mirrors the general formula for estimating the after-tax WACC as documented in *Valuation: Measuring and Managing the Value of Companies. Third Edition McKinsey & Company.* Pg 202

[12] As outlined in EB39 Annex 35, the weighted average cost of capital (WACC) is an appropriate benchmark for a project IRR. The WACC is calculated after tax and we will therefore compare the WACC to IRRs after tax.

The following input values for the WACC calculation are relevant:

- **Total Debt** is calculated by adding all short-term and long-term debts from Jidong's 2005 audited annual report (i.e. most recent full year available before investment decision).

- **Total Equity** is calculated by multiplying the total number of shares by the share price on 30 June 2006 (i.e. most recent data before investment decision).

- **Total Capital –** is the sum of Total Equity and Total Debt

- **After Tax Cost of Debt –** This is the return that lenders require on a company's debt. The rate applied to determine the cost of debt (K_d) is the weighted average interest rate the company is paying on its debt in 2006 as reported in Jidong's 2005 year end audited financial statements. As companies benefit from the tax deductions available on interest paid, the net cost of the debt is actually the interest paid less the tax savings resulting from the tax-deductible interest payment. Therefore, the after-tax cost of debt is calculated according to the formula K_b*(1 - corporate tax rate).

- **Cost of Preferred Equity –** The capital structure of Jidong does not include preferred stocks so the cost of preferred equity is zero.

- **Cost of Equity:** The Cost of Equity can be derived through the Capital Asset Pricing Model (CAPM), the Gordon Growth Model or the P/E Method[13]. The Gordon Growth Model is not appropriate for Jidong as historical dividends have not been proportional to the company profits and therefore reflect a distorted growth profile in the period around decision making due to a rapid phase of growth. The CAPM method, whilst popular, requires the estimation of factors including the Market Risk Premium and measuring the systematic risk, or '*Beta*' of Jidong. Objective third party data is not available for these factors therefore it is not possible to evaluate and suitably evidence reliable risk premiums to calculate the cost of equity for Jidong projects using the CAPM method. Using the P/E method, the cost of equity calculation is based on publically reported data and does not require the application of risk premiums and is an appropriate approach for Jidong. The P/E method calculates the cost of equity as:

  Cost of Equity $r_e(L)$ is calculated as follows:

$$r_e(L) = \frac{b(1+g)}{P/E} + g$$

Where

b	Dividend payout ratio	Based on historic Earnings per Share and Dividend payout as reported in Jidong audited financial statements from 2001 to 2005 inclusive.
g	Estimate of growth of	Based on historic and future forecast net earnings data

[13] Wharton Business School - http://finance.wharton.upenn.edu/~benninga/fnce728/chap09.pdf

	future earnings	taken from analyst reports from four securities companies published in 2006.
P/E	Share Price/Earnings per Share	Based on 2005 Audited Financial Statements and Jidong share price as publically reported on 30.06.06.

The detailed WACC calculation and all supporting evidence is provided to the DOE.

Investment decision making process

To further support the internal company benchmark, Jidong has formally published an official clarification on its internal "investment decision making process", which has been provided to the DOE for verification. The procedures and criteria listed in this document state that Jidong makes investment decisions based on the returns of previous projects and the returns of competing projects. This approach can be further confirmed by the fact that all previously implemented projects have been implemented with an expected IRR above a certain threshold (as we demonstrate below in table "Table B.2 Previous investment decisions of Jidong"). The WACC, as calculated above can be considered a reasonable representation of returns of previous and potential projects on which basis Jidong makes its investment decisions. In fact, the WACC could be considered low and conservative considering the high average returns on other previous projects. Jidong's decision making process based on returns of other projects is consistent with the approach taken in this PDD to demonstrate additionality of the proposed cement WHR project: i.e. in accordance with Jidong's own decision making process, Jidong has implemented all previous projects above a certain threshold, which can be represented by its internal WACC. As we will demonstrate, the IRR of the proposed CDM project activity without CER revenues is below the WACC and below the IRR of all previously implemented projects, and Jidong would therefore not have implemented the project without CER revenues in line with its own decision making guidelines.

Previously implemented projects by Jidong

The latest Additionality Tool (version 05.2) requires an analysis of previous projects: "*The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e. that project activities under similar conditions developed by the same company used the same benchmark"*. The Guidance on the Assessment of Investment Analysis" (Version 02.1) adds that it should be demonstrated that the Company Internal Benchmark has been "*used for similar projects with similar risks, developed by the same company or"*. The DOE has been provided with an overview of investment decisions made by the Board which we will discuss below, demonstrating that the company internal benchmark has not only been used consistently in the past, but that comparing the proposed project activity (i.e. a WHR project) to this benchmark is *conservative*.

In the case of energy efficiency technologies which are being introduced to a new market, both the cost and the perceived risk [14] will normally reduce over time until it becomes attractive to implement such

[14] Perceived risk is a factor that is frequently mentioned as preventing industrial energy efficiency projects from being implemented. See for example World Bank (1998), *Project appraisal document on a proposed loan in the amount of 63 million US$ and a proposed GEF grant of 22 million US$ equivalent to the People's Republic of China for an energy conservation project*, The World Bank, 26 February 1998, Report No. 17030-CHA. See pages 4-5, and World Bank (2008), *Project appraisal document on a proposed loan in the amount of 200 million US$ and a proposed Global Environmental Facility Trust Fund grant of US$ 13.5 million to the*

technologies without government incentives and/or support. Following the first projects (which may benefit from public support or special incentives) the cost and perceived risk tend to go down thanks to accumulated experience in producing key equipment, development of skilled personnel, increased availability of spare parts, and accumulated experience in implementing the project.

This pattern also applies to cement WHR technologies in China. The first demonstration project was implemented in China in 1998 with support from New Energy and Industrial Technology Development Organization (NEDO) of Japan (a government organization) and the State Development and Planning Commission. This support was needed to overcome prohibitive barriers.[15] The project was followed by a few follow-up demonstration projects supported by UNIDO as part of its energy efficiency programme focusing on Township and Village Enterprises.[16]

After these demonstration projects, it took some time before the Chinese cement enterprises started to implement waste heat recovery projects. As of February 2007, waste heat recovery projects were only implemented in 47 NSP cement production lines, out of a total of 706 NSP cement production lines.[17] These numbers include projects implemented with NEDO and UNIDO support and projects developed as CDM project activities; we therefore conclude that the penetration of waste heat recovery projects in China has been quite slow and that the overall penetration rate – on a pure commercial basis – remains very low.

Over time, as costs and perceived risks go down, projects gradually become closer to commercially viable and bankable. This is a period in which projects do not need massive government support, but need the added incentive of CDM to be implemented. After that, the time may come that projects are commercially viable and bankable, and can be implemented without any support. The upshot is that if projects apply for CDM, it is unlikely that they were earlier able to implement a project without government support or CDM.

This explains why companies currently implementing projects utilizing new energy efficiency technology with CDM support (such as cement companies implementing waste heat recovery for power generation projects) almost per definition do not have a list of previously implemented identical projects (i.e. projects implemented previously with the same technology) that did not receive public and/or CDM support.

The same applies to some extent to Jidong. Jidong only has one project that is somewhat similar to the proposed project activity. A certified design institute prepared a FSR for Jidong for a demonstration 9.58MW cement WHR project in 2001, which calculated an optimistic project IRR of 33.73% after taxes. Even thought this financial indicator seemed to indicate the project would be significantly financially attractive, it was not attractive enough to overcome the risk perception of Jidong and subsequently Jidong decided not to implement this project as a pure WHR project, but rather to implement it as a combined coal-fired / WHR project. A FSR for the coal-fired addition was written in 2002 with a project IRR of 24.88% after taxes, after which this ‘combined project’ was implemented.

People’s Republic of China in support of the energy efficiency financing project, The World Bank, 21 April 2008, Report No. 38641-CN. See page .

15 This project was implemented at the Anhui Ninggou Cement Plant.

16 GHG Emission Reduction in Chinese Township and Village Enterprises (TVE), Phase II, implemented from 2000-2006.

17 IFC (2007), *Energy Efficiency Improvement Potential & Opportunities in China’s Cement Industry. General Report*. International Finance Corporation. The information is provided on p.15

Additional to this project, Jidong has implemented a number of cement lines and grinding mills, of which we analyzed all implemented since 2004.[18] Although it could be argued that these cement lines and grinding mills are not identical to the proposed project activity, we can take comfort that comparing a CDM cement WHR project to these projects is a *conservative* interpretation of the requirements as the return requirements on the proposed project activity are higher.

Comparing the proposed WHR project activity to other type of projects previously implemented by Jidong is *conservative* because the implementation of a WHR project involves additional risks compared to implementation of cement lines and grinding mills with which Jidong has extensive experience. Additionally, implementation of WHR does not directly support the core activity of Jidong (i.e. the production and sale of cement) and it does not support Jidong in its mission to survive and expand in an increasingly competitive and expending market. Clearly, Jidong favours the implementation of cement lines and grinding mills over the implementation of WHR projects and comparing the IRR of a WHR project to the IRRs of previously implemented cement lines and grinding mills is therefore conservative.[19]

The previously implemented projects are listed in Table B.2. The IRRs are all taken from the feasibility studies of the respective projects. The DOE has verified the accuracy of the information on the list below by reviewing information on each of the projects on the list.

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18 Additionally, two other cement lines have been implemented since 2004 (i.e. the Matishan cement line and the Matoushan cement line). These projects can not be considered similar and compared to the company benchmark on the basis of the IRR in the feasibility study for the following reason: During an official meeting in May 2006 which was amongst others attended by the Chairman of the Board, Jidong decided that these two cement lines should be implemented because Jidong expected the price of cement to significantly increase in the future due to a lack of supply and high demand for cement in Beijing and Tianjin. This high cement price would ensure the financial feasibility of the two cement lines. The meeting minutes have been provided to the DOE for review. Based on the above, it is incorrect to list the IRRs mentioned in the FSRs for these two projects (cement lines) as the decision to implement the two projects was made on this explicit expectation of cement price increases. In other words, the projects were implemented on the basis of a higher expected IRR than mentioned in the feasibility study reports.

19 -The World Bank (2008), Project appraisal document on a proposed loan in the amount of 200 million US$ and a proposed Global Environmental Facility Trust Fund grant of US$ 13.5 million to the People's Republic of China in support of the energy efficiency financing project, The World Bank, 21 April 2008, Report No. 38641-CN, states on page 1 that "Although Chinese experts agree that the majority of the identified industrial energy conservation investments are financially viable, most of the concerned enterprises would rather invest in business expansion than energy conservation" and on page 2: "There is a large financing gap for medium and large-sized energy conservation investments in the industrial sector, which normally cost US$ 5-25 million per project. Given the economic and financial attractiveness of such projects, the GOC [Government of China; our addition] has gradually eliminated public funds earmarked for industrial energy conservation project finance since late 1990s, expecting Chinese enterprise to invest their own resources and banks to build energy conservation lending business lines. This expectation has not materialized".

-IFC (2007), Energy Efficiency Improvement Potential & Opportunities in China's Cement Industry. General Report. International Finance Corporation, states on pages 38 that "The decision-makers always give their utmost priority to the expansion of the production capacity and the occupation more market shares and bears no extra financial resources and energy to implement the electricity generation project by using waste heat aim at the reduction of energy costs."

Table B.2 Previous investment decisions of Jidong

Previous investment decisions of Jidong (WHR)		Project IRR after tax	Date of issuance of FSR
1	"Jidong Cement Co., Ltd. WHR Demonstration Project" combined with the "Tangshan Jidong Cement Co., Ltd 92t/h CFB Boiler Project".	33.73% and 24.88% respectively [20]	Apr 2001 and Jan 2002 respectively
Previous investment decisions of Jidong (other projects)		**Project IRR after tax**	**Date of issuance of FSR**
1	Anshan Grinding Mill	28.18 %	Dec 2003
2	Fengrun (Cishan) cement production line	16.06 %	April 2006
3	Fufeng cement production line	16.27 %	July 2006
4	Fuyu grinding mill station	27.51 %	Jan 2003
5	Huhehaote grinding mill station	49.74 %	Dec 2003
6	Inner Mongolia cement production line	22.28 %	Feb 2005
7	Jingyang cement production line	22.60 %	Feb 2004
8	Sanyou 2 cement production line	16.92 %	April 2006
9	New Panshi cement production line	18.48 %	April 2005
	Average	**24.23 %**	

From the above table the following is clear that:

- As explained in the above paragraph, Jidong, like all other companies implementing projects utilizing relatively new energy efficiency technologies, does not have a long list of previously implemented WHR projects. In fact, only one earlier project utilizing waste heat had been implemented.
- One previously implemented WHR related project was implemented with a financial return in the FSR (the available data source at the time of the investment decision) above the Company Internal Benchmark. Note that even though the IRR was above the Company Internal Benchmark, the waste heat of this project had to be complemented by coal-fired power for Jidong to overcome the barrier it perceived.
- The financial returns of previous "core business" investment decisions of Jidong have been consistently above the benchmark and the average project IRR after taxes of the previous projects (i.e. 24.23%) is significantly above the Company Internal Benchmark. As explained above, it is *conservative* to compare these projects to the CDM project activity.

We also would like to note that the strategic focus of Jidong is on cement production. Therefore, Jidong focuses on the construction of cement production lines, and securing raw materials for the production of cement. Investments in waste heat utilization for power generation are not at the core of the company strategy. Based on this consideration (combined with the WACC for Jidong, the decision making process of Jidong, and financial returns of previous investment decisions) we will use a benchmark of 15.58% after taxes for investments in waste heat utilization projects as a *conservative* internal company benchmark for investment decisions on non-strategic projects.

Sub-step 2c — option III: Calculation and comparison of financial indicators

Table B.3 summarizes the data used in the calculation of the project IRR.

[20] A PDF of the financial section of the FSR of the previously implemented WHR project has been provided to the DOE.

Table B.3 Main parameters used in the calculation of the project IRR.

Proposed project activity			
Item	**Data**	**Unit**	**Source**
Installed capacity	25	MW	FSR
Total investment	153,225,800	RMB	FSR
Working capital	8,281,800	RMB	FSR
Estimated annual power supply	146,700,000	kWh	FSR
Power price avoided (after deduction VAT)	0.378	RMB/kWh	FSR
O&M cost	28,530,000	RMB	FSR
Lifetime of the project	20	Years	FSR
Baseline grid emission factor	1.0118	tCO2/MWh	FSR
Assumed CER price	8	EUR /tCO_2e	Minimum
Exchange rate	10.399	RMB/EUR	FSR

Source of input values:

The FSR was completed and issued (November 2006) by the "Hebei Province Building Material Industry Design & Research Institute". This entity is an independent organization which is qualified to compile design reports for the cement industry (it has obtained a "*A grade of Engineering Consultation Certificate in cement industry, cement products, and inorganic-nonmetallic material*", issued by the "National Development and Reform Commission" of the Peoples Republic of China). Additionally, the FSR has been implicitly approved when the General Project Approval was obtained (3 July 2007) by the "Tangshan Development and Reform Commission". The FSR can be considered an independent and realistic assessment of the proposed project activity, including the parameters listed therein which are used as input values in the investment analysis.

The FSR (source for all input values) was completed and issued in November 2006. Therefore, in accordance with the "Guidance on the Assessment of Investment Analysis" (Version 02.1), all input values were known before the investment decision (March 2007 [21]) and can be considered appropriate values to be used in the financial calculation of the proposed project activity.

As the FSR has been first issued only a couple of months before the start of the project activity and investment decision (March 2007), we conclude that requirement (a) of EB 38 para 54 is satisfied as this period is "sufficiently short to confirm that it is unlikely that the input values would have materially changed" and that additionally the FSR has been re-submitted in identical form and approved after the investment decision, indicating it was still applicable. Additionally, the input values used in the PDD and associated annexes are fully consistent with the FSR and lead to the same calculated IRR as in the FSR, satisfying requirement (b) of EB 38 para 54. Finally, requirement (c) is satisfied as the input values used were known by the PO at the time of the investment decision and are applicable.

Additional justification input values

To confirm the input values in the FSR estimated by the independent and certified design institute are reasonable, we have compared them were possible to actual values and reference projects.

[21] In March 2007, the equipment purchase contract was signed. This date is the formal start of the project activity in accordance with the Glossary of CDM Terms and subsequent guidance from the EB as all others dates that could be considered real action or irreversible commitments from the side of the project entity are at a later stage and the project activity started construction activities in August 2007.

- The project did not finish construction yet and it is therefore not possible to compare the estimated O&M cost and the estimated Investment cost to actual real values. Alternatively, we have compared the estimated values to all similar cement WHR projects that are either registered or requesting registration at the moment of writing. A detailed analysis has been provided to the DOE for review and we have confirmed that the investment cost is significantly below (more than 2 Standard Deviation) what could be expected based on the observed investment cost in the other similar projects. This implies the estimated investment cost of the proposed project activity is conservative (i.e. leading to an overestimation of the IRR). Likewise, we have compared the estimated O&M cost of the proposed project activity to the reference group and conclude that there is not significant difference in O&M cost between the proposed project activity and the projects that are either registered or requesting registration.
- The avoided power price of 0.378 RMB/kWh after deducting VAT, which like all other financial input values is taken from the FSR issued by an independent and certified design institute, corresponds to the effective power price that would have been paid by the cement production facility in the absence of the proposed project activity, noting that VAT paid can be offset against VAT that needs to be paid to the Chinese tax authorities. This estimation by the design institute is almost identical to the Gross power price of 0.4378 RMB/kWh (i.e. Net power price of 0.374 RMB/kWh after deduction of 17% VAT) for purchase of electricity from the grid by the cement production facility, officially regulated and published by the "Hebei Provincial Pricing Administration" according to the "Notice on Adjusting Power Price in North China Power Grid" issued by National Development & Reform Committee in 2006. Evidence has been provided to the DOE.
- For the F_{cap} calculation (see also Tables B8, B9, and B10) the theoretical available electrical power supply has been calculated based on the available waste heat in the clinker production line. Based on the available heat, the potential maximum electrical power supply has been calculated as 148,901 MWh annually. As explained in more detail in the explanation on F_{cap}, preceding and proceeding tables B.8, B9, and B.10 in the PDD, this theoretical maximum electricity output is calculated based on design specifications of the equipment provided by the equipment supplier, a standard load factor of 0.85φ, and standard losses & auxiliary consumption (together 8%), which are all reasonable and have all been evidenced to the DOE. Estimated annual power supply in the FSR, which is used for the IRR calculation is slightly lower than the theoretical maximum, i.e. 146,700MWh. We conclude that the estimated value is reasonable, and that it is not possible that this value would increase with more than 1.5%, as the available waste heat would simply not be sufficient to increase power supply with more than 1.5%. The sensitivity analysis shows furthermore that with a 1.5% variation the benchmark value would not be reached.
- The baseline emission factor is calculated in this PDD, see Section B.6 and Annex 3. The assumed CER price of 8 EUR/tCO_2e is equal to the minimum price set by the Chinese DNA. The actual CER price cannot be used, because the actual price is considered confidential. The exchange rate applied is the actual exchange rate at the moment of writing this section of the PDD.

Use of fixed input values

The application of flat and fixed input values, such as the power price and the O&M cost, for the financial calculation (as done in our and FSR calculation) is appropriate in case both the input values and the

benchmark are defined in real terms (as opposed to nominal terms[22]) and when there is no expectation that the change in the nominal value of the input parameters will differ significantly from the rate of inflation. The use of fixed real input values is common practice in China and is in accordance with guidance for the preparation of feasibility studies which demonstrates that the benchmark is defined in real terms and therefore the application of fixed real input values is appropriate. The IRR calculation compares the real IRR with a real benchmark which in both cases takes out the effects of general price increases due to inflation.

An analysis of the actual development of the electricity price over time is hampered by the fact that the power sector in China has undergone several regulatory changes and consistent electricity price data over a longer period is not available. It is however expected that the electricity price will be adjusted in the future to correct for inflation and therefore the assumption that the electricity price will develop proportionally to the rate of inflation (as done in the IRR calculation assuming fixed real input values) can be considered reasonable. However, as any of such corrections for inflation would lag behind actual inflation, assuming that electricity prices will be corrected for inflation instantaneously, as is done in our analysis (i.e. assuming a fixed flat electricity price in accordance with the definition of the benchmark), implies that actual real revenues from the sale of power are somewhat overstated and the IRR calculation likely leads to a conservative interpretation of the additionality requirements. In contrast, it is expected that O&M cost will increase at a higher rate than inflation. Annual inflation in Hebei Province over the last 6 years was 2.28% on average [23], compared to an annual increase of approximately 12.53% in the incomes of resident of city [24] and 7.48% in purchasing price of raw material, fuel and power [25] over the same period. It is clear that the O&M cost which are for a large part influenced by wages and purchasing price of raw material, fuel and power, is like to increase at a higher rate than inflation, where the power price is not expected to do so as explained above. Hence, the application of flat and fixed input values, such as the power price and the O&M cost, for the financial calculation (as done in our and FSR calculation) is appropriate and conservative compare to applying flexible input values.

Calculation Result

The benchmark analysis compares the proposed project activity with the benchmark defined in step 2(b). The main results of the financial analysis are presented in Table B.4, where the project IRR after taxes of the project with and without CDM revenues is compared to the benchmark.

Table B.4 Comparison of calculated project IRR (after taxes) and the benchmark rate

Analyzed scenario	**IRR after taxes (%)**
Proposed project activity, no revenues from CDM	12.55%
Benchmark (WACC)	*15.58%*
Proposed project activity, CER revenues at 8 EUR/tCO_2e	18.90%

22 Nominal value refers to any price or value expressed in money of the day, as opposed to real value. The latter adjusts for the effect of inflation.

23 Average inflation from 2002 to 2007 was 2.28% (calculated by averaging annual values) sources from http://www.tjcn.org/tongjigongbao/hebei/20080526/56.html

24 Average annual Incomes of resident of city in Hebei increased from RMB 5,984.8 in 2002 to RMB 11,690.5 in 2007, an annual average increase of around 12.53%. Source: http://www.tjcn.org/tongjigongbao/hebei/20080526/56_6.html

25 Annual purchasing price increase of Raw Material, Fuel and Power in Hebei from 2002 to 2007 was around 7.48% (average yearly values). Source : http://www.tjcn.org/tongjigongbao/hebei/20080526/56.html

Table B.4 clearly indicates that the IRR after taxes for the proposed project activity is substantially below the benchmark. This demonstrates that the proposed project activity is not a commercially attractive option. The detailed spreadsheet calculations are available to the DOE for review.

Table B.4 also demonstrates that with the inclusion of revenues from CDM, calculated at the minimum CER price acceptable to the Chinese DNA, the IRR increases to a value above the benchmark; in other words, with the revenues from CDM the project becomes commercially attractive.

Sub-step 2d: Sensitivity analysis

The 'Tool for the demonstration and assessment of additionality' requires that a sensitivity analysis is conducted to check whether the financial attractiveness remains unaltered for reasonable variations in the critical assumptions. The following parameters were used as critical assumptions:

- Total investment
- Annual Operation and Maintenance costs
- Annual power supply
- Avoided annual power costs

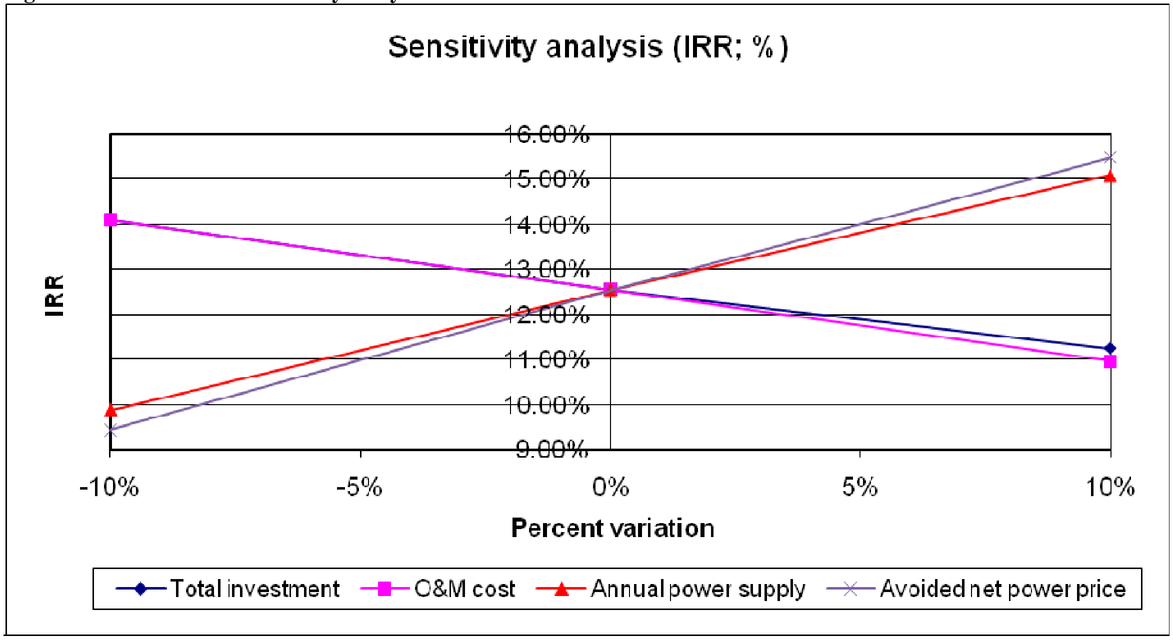
In the sensitivity analysis, variations of ±10% have been considered in the critical assumptions. Variations of over 10% are not likely to occur as input values are all reasonable as explained above. The results of the sensitivity analysis for the IRR are shown in Table B.5, while Figure B.2 provides a graphic depiction.

Table B.5 Results of Sensitivity Analysis: project IRR after taxes (%)

	Percentage variation		
Variable	**- 10%**	**0%**	**+ 10%**
Total investment	14.09%	12.55%	11.24%
O&M cost	14.09%	12.55%	10.96%
Annual power supply	9.88%	12.55%	15.09%
Avoided power price	9.45%	12.55%	15.47% [26]

[26] As demonstrated above under the heading "*Additional justification input values*", the assumed power price is estimated by the independent and certified design institute completing the FSR, and is lower (i.e. a conservative interpretation of the additionality requirements) than the relevant power price for industrial facilities applicable at the time, as issued/notified by the Provincial Pricing Administration. Additional to assuming this conservative price, we included a detailed clarification under the heading "*use of fixed input value*" to explain why assuming a fixed power price over the project lifetime is appropriate and likely a conservative interpretation of the additionality requirements. We therefore conclude that an increase of 10% in the power price is not realistic.

Figure B.2 Results of the sensitivity analysis for IRR



The IRR before taxes remains below the benchmark of 15.58%. The results therefore indicate that the project IRR after taxes of the proposed project activity with reasonable modifications in the critical assumptions remains below the internal company benchmark.

The conclusion may be clear that with reasonable modifications in the critical assumptions, the main results remain unaltered. The project remains commercially less attractive without the revenues from the sale of CERs in comparison with the main alternative, i.e. the continued import of power from the grid. The results of the sensitivity analysis therefore confirm that the project faces significant economic barriers.

Step 3. Barrier Analysis

<u>Sub-step 3a: Identify barriers that prevent the implementation of the proposed CDM project activity:</u>

Besides the low economic returns, the proposed project activity faces a barrier due to the limited access to financial resources and the risks associated with the implementation of such project. The revenues are therefore considered to be an essential part in raising the attractiveness of the project in order to arrange financing. The barriers to attract financial resources are discussed below:

Barrier to attract financial resources:

Absence of financial instruments / assessment capabilities of banks:
The banking system in China carries out bank loan assessments based on relatively simple collateral and profitability requirements. The banks often lack expertise to assess technological aspects and are unfamiliar with energy saving technologies such as waste heat utilization. The risks associated with the

implementation of advanced technology is sufficient reason for a bank not to extend a loan to the project entity and availability of alternative financial instruments (such as risk capital) provided through the financial services sector is limited in China.

Limited access to financial resources due to regulations on industries with overcapacity:
The above-mentioned difficulties in arranging financing through the banking system are compounded by recent government restrictions on bank lending to industries with production overcapacity.[27] The cement industry is potentially facing these official lending restrictions as it is mentioned as one of the industries with potential overcapacity. At present, banks have already reduced bank lending to the cement industry resulting in cement companies experiencing significant difficulties in obtaining bank loans and credit.[28]

Alternative financing channels
As the project entity is a domestically oriented manufacturer with limited experience with international transaction, alternative financing channels such as through international capital markets were not available to the project entity.

The above-mentioned investment barriers clearly show that the project entity faces significant difficulties in arranging financing. The investment barrier can be demonstrated by the fact that applications for a bank loan were approved with specific reference to the availability of additional revenues to the project through CDM, explicitly mentioning that the fact the project would obtain additional revenues through CDM was an important part of the approval decision. A report by the Tangshan Branch of the Agricultural Bank of China to the Hebei Provincial Branch Office of the Agricultural Bank of China has been provided to the DOE for review, demonstrating that CDM was indeed an important factor in obtaining a bank loan.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

The current practice for new cement production facilities in the project area, i.e. import of power from the grid and non-utilization of waste heat, does not involve an investment and is not affected by the above mentioned barriers. The continued consumption of power from the grid does not involve any risks and is common for cement plants in the region.

Step 4. Common practice analysis

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

Common options for electric power supply for cement production facilities in China are 1) power supplied from the public electricity grid or 2) power supplied by a captive coal-fired power plant in the case of older existing cement production facilities. Activities similar to the project activity are considered to be any project at a cement production facility that utilizes waste heat from either the pre-heater stage or clinker cooling stage for the generation of electric power.

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27 The cement industry is defined as an "over-growing" industry by the Chinese government and the Chinese central bank (the People's Bank of China), and treated with a restriction on bank lending. Evidence has provided to the DOE. See also: *http://www.shgzw.gov.cn/gb/gzw/xxzh/mrjj/jrsc/userobject1ai19192.html*

28 State Council (2006), *Announcement of the State Council on Structural Adjustments in Industries with Production Overcapacity*, Guo Fa [2006] Document No. 11.

For the common practice analysis we have analyzed the North China Power Grid. The Chinese power grid is divided into a few large regional power grids based on differences in natural resources, geographical location, level of economic development, grid structure, infrastructure, demand & supply (maximum load), seasonal characteristics and power dispatching policies in general.[29] The provincial grids within one regional grid all face similar conditions as they are connected through one grid. Note also that each regional grid has a limit on its power dispatching capacity to other regional grids.[30] For projects importing electricity from the grid (such as the cement production facility implementing the proposed WHR project), the decision to implement a "grid-replacing" captive WHR power station is influenced by the regional grid they are located in, as this determines the stability, availability, and reliability of its power purchases in case they continue to import from the grid.

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

According to information prepared by the Tianjin Cement Industrial Design Institute (a certified and public entity, leading in the field of cement design) shown in Table B.6, only three cement WHR projects are located in the North China Power Grid.[31]

Of these three cement WHR projects which are located in North China Power Grid, one is financially supported by the central government and the local government, as a demonstration National major construction project. This is the "Beijing Cement Plant Co,.ltd".[32]

The two remaining projects (i.e. the Quzhai Cement Co,.ltd of Luquan City and the Shandong Zibo Donghua Cement Company) have both applied for CDM support in order to overcome prohibitive barriers these projects are facing.[33]

It is clear that waste heat utilization is not common practice, in the wider project area.

Conclusion

From the above analysis it can be concluded that the proposed project activity is not common practice in the wider project area that can be considered similar and therefore sub-steps 4a and 4b of the tool for the demonstration and assessment of additionality are satisfied.

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29 Data source: 2007 ChinaElectricPowerYearBook-P41

30 Data source: http://www.china5e.com/power/powernews.aspx?newsid=e9e34778-d28a-4b7c-8a83-bf039ee65f00&classid=%u7535%u529b

31 Including the provinces of Beijing, Tianjin, Shanxi, Hebei, Shandong, West Inner Mongolia and East Inner Mongolia grids, as described in Section B.3

32 Data source (provided in PDF format to the DOE): http://shxy.wh.sdu.edu.cn/jpkc/UploadFiles_7340/200704/20070409124940669.doc

33 Data source: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1190289409.91/view
http://cdm.unfccc.int/Projects/Validation/DB/BELGH65USAF3ZGAVO17J96TGVU6W6P/view.html

Table B.6 Overview of waste-heat utilization projects at cement plants in China as of 2006.[34]

Name of the company	Province	Cement production	Installed capacity	Operationalization
Hailuo Group Ningguo Cement Manufacturing [35]	An'hui	4000 t/d new dry-method process	6480 kW	Feb 1998
Shanghai Wan'an Enterprise	Shanghai	1200 t/d new dry-method process	2500 kW	May 2003
Guangxi Liuzhou Cement Manufacturing	Guangxi	4000 t/d new dry-method process	6000 kW	July 2004
Zhejiang Shenhe Cement Stock Company	Zhejiang	2500 t/d new dry-method process	3000 kW	March 2005
Zhejiang Qinglongshan Cement Stock Company	Zhejiang	1200 t/d＋2500t/d new dry-method process	2×3000 kW	June 2005
Zhejiang Changxing Xiaopuzhongsheng Cement Co,.ltd	Zhejiang	2500 t/d new dry-method process	3000 kW	June 2005
Zhejiang Changxing Meishanzhongshengjiancai Co,.ltd	Zhejiang	5000 t/d new dry-method process	6000 kW	July 2005
Zhejiang Sanshi Cement Stock Co,.ltd	Zhejiang	2500 t/d＋5000t/d new dry-method process	9000 kW	n.a.
Zhejiang Zhongxinyuan Cement Co,.ltd	Zhejiang	2500t/d new dry-method process	3000 kW	November 2005
Hainan Sanyahuashengtianya Cement Co,.ltd	Hainan	5000 t/d new dry-method process	6000 kW	May 2006
Zhejiang Haolong Jiancai Co,.ltd	Zhejiang	1200 t/d new dry-method process	1500 kW	January 2006
Huarun Cement (Pingnan) Co,.ltd	Guangxi	5000 t/d new dry-method process	7500 kW	Under construction
Quzhai Cement Co,.ltd of Luquan City	Hebei	n.a.	2×4500 kW	Under construction
Zhejiang Zhenda Cement Co,.ltd	Zhejiang	n.a.	2000 kW	Under construction
Huainan Shunyue Cement Co,.ltd	Anhui	n.a.	9000 kW	Under construction
Gansu Qilianshan Cement Co., ltd	Gansu	n.a	6000 kW	Under construction
Hede Sanshi Cement Co,.ltd	Anhui	n.a.	9000 kW	Under construction
Changsha Pingtang Cement Co,.ltd	Hunan	n.a.	3000 kW	Under construction
Zhejiang Hongshi Cement Stock Co,.ltd	Zhejiang	n.a.	2×7500kW	Under construction
Gaoan Hongshi Cement Co,.ltd	Jiangxi	n.a.	9000 kW	Under construction
Jiangxi Taihe Yuhua Cement Co,.ltd	Jiangxi	n.a.	2000 kW	Under construction
Shandong Zibo Donghua Cement Company	Shandong	n.a.	6000 kW	Under construction
Beijing Cement Plant Co,.ltd	Beijing	2 * 2,500 t/d new dry-method process	7,500 kW	Under construction

[34] Prepared by the Tianjin Cement Industrial Design Institute, May 2006

[35] The "Hailuo Group Ningguo Cement Manufacturing" and the "Guangxi Liuzhou Cement Manufacturing" were demonstration projects supported by NEDO of Japan and utilize imported Japanese equipment.

Serious CDM consideration

The CDM registration will have, as its main impact, an increase in the commercial attractiveness of the project, raising the IRR above the benchmark. Thus, CDM will help to make the project commercially more attractive, and will help to overcome the investment barrier.

Start of the project activity

In March 2007, the equipment purchase contract was signed. This date is the formal start of the project activity in accordance with the Glossary of CDM Terms and subsequent guidance from the EB as all others dates that could be considered real action or irreversible commitments from the side of the project entity are at a later stage and the project activity started construction activities in August 2007.

Early and continued CDM consideration

Table B.7 provides an overview of key events in the development of the project, which indicates that the benefits from CDM have been taken into account in an early stage of the development of the waste heat recovery projects, before the start of the project activity defined in accordance with CDM Glossary and Terms (see also the paragraph above and Section C.1.1). Before the start of the project activity, Jidong first considered the possibilities of CDM in August 2006 and started to negotiate with Climate Change Capital (CCC). After issuance of the initial FSR, the project entity signed a LOE for the sale/purchase of CERs with CCC in December 2006. After the initial and early CDM consideration before the formal start of the project activity, the project entity continued to consider CDM and take real and concrete steps toward registration as a CDM project activity parallel to the project development. Amongst others, a CDM stakeholder consultation was organised 6 months after the start of the project activity and the PDD was uploaded for GSP 7 months after the start of the project activity.

Table B.7: Overview of key events in the development of the project

Date	Key Event
August 2006	Jidong considered developing waste heat recovery projects under the CDM program
15 August 2006	Began to contact and negotiate with Climate Change Capital (CCC) on CDM development cooperation
November 2006	Approval Copy of FSR issued
7 December 2006	Signed LOE for CDM project development with CCC
December 2006	Design made by Anhui Hailuo Building Material Design Institute
28 January 2007	The Ninth Session of the Fifth Board meeting approved the Matoushan and Matishan WHR projects
30 March 2007	Signed equipment purchase contract
5 June 2007	CDM development contract between the CER buyer (CCC) and CDM consultants (Caspervandertak Consulting)
3 July 2007	Received project approval
9 August 2007	A CDM stakeholder consultation meeting was organised
August 2007	Matoushan and Matishan projects started construction work
19 Sep 07-18 Oct 07	First GSP under Methodology ACM0012 version 1
January 2008	LOA by Chinese DNA
03 Sep 08-02 Oct 08	Second GSP under Methodology ACM0012 version 3
April or May 2009	Estimated start operations

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

In accordance with the ACM0012 methodology, baseline emissions for the year *y* are calculated as:

$$BE_y = BE_{En,y} + BE_{flst,y} \quad \text{(B.1)}$$

With:

- BE_y are the total baseline emissions during the year *y* in tons of CO_2;
- $BE_{En,y}$ are baseline emissions from energy generated by the project activity during the year *y* in tons of CO_2, and;
- $BE_{flst,y}$ are baseline emissions from generation of steam, if any, using fossil fuel, that would have been used for flaring the waste gas in absence of the project activity (tCO_2e per year).

As the project does not use waste gas for energy production, $BE_{flst,y}$ is zero in accordance with the methodology.

The calculation of baseline emissions from energy generated by the project activity during the year *y* in tons of CO_2 ($BE_{En,y}$) depends on the identified baseline scenario. The methodology recognizes two different scenarios, depending on the baseline options for the (non-) utilization of the waste energy resource, power supply, and heat supply. As discussed in Section 4 and 5, the relevant baseline options are W2 and P6, which in the methodology is labelled Scenario 1. Thus we have identified Scenario 1 as the applicable scenario for the calculation of baseline emissions as electricity is obtained from the grid. According to Scenario 1, $BE_{En,y}$ can be calculated according to the following formulae:

$$BE_{En,y} = BE_{Elec,y} + BE_{Ther,y} \quad \text{(B.2)}$$

With:

- $BE_{Elec,y}$ are baseline emissions from electricity during the year *y* in tons of CO_2, and;
- $BE_{Ther,y}$ are baseline emissions from thermal energy (due to heat generation by element process) during the year *y* in tons of CO_2.

The project does not involve the use of waste energy resource to provide heat. Thus, $BE_{Ther,,y}$ is equal to zero. According to the methodology (see step a), p.10), $BE_{Elec,y}$ for Type-1 activities can be calculated according to the following formulae:

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_j \sum_i (EG_{i,j,y} * EF_{Elec,i,j,y}) \quad \text{(B.3)}$$

With:

- $BE_{Elec,y}$ are baseline emissions due to displacement of electricity during the year *y* in tons of CO_2;
- $EG_{i,j,y}$ is the quantity of electricity supplied to the recipient *j* by generator, which in the absence of the project activity would have been sourced from i^{th} source (*i* can be either grid or identified source) during the year *y* in MWh;
- $EF_{Elec,i,j,y}$ is the CO_2 emission factor for the electricity source *i* (i=gr (grid) or i=is (identified source)), displaced due to the project activity, during the year *y* in tons of CO_2/MWh;
- f_{wcm} is the fraction of total electricity generated by the project activity using the waste energy resource (in the case of the proposed project activity, waste heat). This fraction is 1 if the electricity generation is purely from use of the waste energy resource (in the case of the proposed project activity, waste heat), without the additional firing of additional fossil fuels.

- f_{cap} is energy that would have been produced in project year y using waste energy generated in base year expressed as a fraction of total energy produced using waste source in year y. The ratio is 1 if the waste gas/heat/pressure generated in the project year y is the same or less than that generated in base year.

Determination of f_{cap}

The ACM0012 Methodology requires the capping of baseline emissions irrespective of planned / unplanned or actual increases in output of plant, change in operational parameters and practices, etc. through the parameter f_{cap}. The methodology provides three methods for the determination of the parameter f_{cap}, as indicated below:

- Method-1: Where the historical data on energy released by the waste energy carrying medium is available, the baseline emissions are capped at the maximum quantity of waste energy released into the atmosphere under normal operation conditions in the three years previous to the project activity.
- Method-2: Where historical data is not available, manufacturer's data for the industrial facility shall be used to estimate the amount of waste energy the industrial facility generates per unit of product generated by the process that generates waste energy.
- Method-3: In cases where it is not possible to measure the waste energy (heat, sensible heat, heat of reaction, heat of combustion etc.), enthalpy or pressure content of Waste Energy Containing Medium (WECM) an alternative method may be used as described in ACM0012.

Due to technical limitations (i.e. high dust concentration in the air containing the waste heat and strong fluctuations in pressure and flow) direct measurement of waste heat does not provide a reliable basis for the determination of f_{cap} and would not form a proper basis for subsequent monitoring. Therefore, Method-3 provided by the methodology is applied which provides two alternative approaches for the determination of f_{cap} as indicated below:

- Case-1: The energy is recovered from WECM and converted into final output energy through waste heat recovery equipment. For such cases f_{cap} should be the ratio of actual energy recovered under the project activity (direct measurement) divided by the maximum theoretical energy recoverable using the project activity waste heat recovery equipment. For estimating the theoretical recoverable energy, manufacturer's specifications can be used. Alternatively, technical assessment can be conducted by independent qualified/certified external process experts such as chartered engineers.
- Case-2: The energy is recovered from WECM in intermediate energy recovery equipment using an intermediate source. For example, an intermediate source to carry energy from primary WECM may include the sources such as water, oil or air to extract waste energy entrapped in chemicals (heat of reaction) or solids (sensible heat). This intermediate energy source is finally used to generate the output energy in the final waste heat recovery equipment. For these cases f_{cap} is the ratio of actual intermediate energy recovered under the project activity (direct measurement) divided by maximum theoretical intermediate energy recoverable from intermediate waste heat recovery equipment. For estimating the theoretical energy, manufacturer's specifications can be used. Alternatively, technical assessment can be carried out by independent qualified/certified external process experts such as chartered engineers.

For the proposed project activity we apply the "Case-1" approach as the proposed project involves the capture of waste heat in waste heat recovery equipment (boilers) that converts the energy into steam, (i.e. the Waste Energy Containing Medium). Energy is subsequently converted to electricity (i.e. final output energy) which provides a reliable basis for determination of f_{cap} and monitoring.

The determination of f_{cap} under the "Case 1" approach consists of calculating the ratio of actual energy recovered under the project activity (direct measurement) divided by the maximum theoretical energy recoverable using the project activity waste heat recovery equipment. For estimating the theoretical recoverable energy, manufacturer's specifications can be used and the following equation shall be used. Alternatively, technical assessment can be conducted by independent qualified/certified external process experts such as chartered engineers.

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} \quad \text{(B.4)}$$

Where:

- $Q_{OE,BL}$, is the output/intermediate energy that can be theoretically produced (in appropriate unit), to be determined on the basis of maximum recoverable energy from the WECM, which would have been released (or WECM would have been flared or energy content of WECM would have been wasted) in the absence of CDM project activity;
- $Q_{OE,y}$, is the quantity of actual output/intermediary energy during the year y (in appropriate unit).

In case of the proposed project activity $Q_{OE,BL}$, consists of the theoretical maximum electrical output (in kWh) that can be generated with the available waste heat, while $Q_{OE,y}$, is the actual electrical output of the project in year y (in kWh). Below we describe the determination how we determine $Q_{OE,BL}$.

The proposed project activity is implemented at a new clinker production line and therefore data on available waste heat from the specific clinker production line is not available. In the planning of the proposed project activity, the project entity commissioned a comprehensive test by an independent testing institute at one of its existing clinker production lines, i.e. the Sanyou 1 clinker production line, to assess the available waste heat from its clinker production facilities. The clinker production facilities apply the same clinker production technology and therefore the test at the Sanyou 1 facility can be considered representative for the available waste heat at the clinker production line where the proposed project activity is implemented.

The assessment of available waste heat at the Sanyou 1 clinker production line involved the measurement (volume / pressure / temperature) of hot air released from the SP and AQC stages of the clinker production process and the results are indicated in table B.8.

Table B.8: Measurement results to determine available waste heat from the clinker production line

Information from test report on available waste heat at Sanyou 1		
SP stage	*Volume of hot air*	226,050 Nm^3/hour
	Temperature	404 °C
AQC Stage	*Volume of hot air*	170,181 Nm^3/hour
	Temperature	312 °C
Clinker production during testing (from operations log)	*Daily clinker production*	3150 tons
	Hourly production (calculated)	131 tons

The information contained in table B.8 provides an indication of total available waste energy, which is the only energy used for the boilers to produce steam, but not all waste energy can be utilized by currently available waste heat utilization technologies as part of the waste energy will still be released into the atmosphere as heat contained in the exhaust of the waste heat recovery boilers. We calculate the waste heat which can be sensibly utilized by applying the following approach:

- First, we calculate gross energy content (relative to 0°C) of the hot air released from the SP and AQC stage applying the standard specific heat capacity of dry air (i.e. 1005.7 J/kg*K).
- Second, we calculate the energy contained in the exhaust air of the waste heat boilers by applying the design exhaust temperature specifications of the equipment to be used in the proposed project activity (220°C for the SP Stage and 93.6°C for the AQC stage) to account for waste heat which will remain unused by the waste heat utilization equipment.
- Third, we calculate the net available energy for the proposed project activity by subtracting the energy contained in the exhaust air from the gross available energy and calculate the net available energy for the proposed project activity as approximately 337,937 kJ/ton clinker (see table B.9 below).

Table B.9: Overview of data to determine available waste heat from the clinker production line

Calculation of available waste heat per ton of clinker		
Waste heat availability SP Stage	*Hot air availability SP stage (at 404 °C)*	898 kg air / ton clinker
	Gross energy content contained in hot air (relative to 0°C)	364,778 kJ/ton clinker
	Remaining heat contained in exhaust from waste heat boiler(at 220 °C)	198,642 kJ/ton clinker
	Net available waste heat	**166,137 kJ/ton clinker**
Waste heat availability AQC stage	*Hot air availability AQC stage (at 312 °C)*	782 kg air / ton clinker
	Gross energy content contained in hot air (relative to 0°C)	245,429 kJ/ton clinker
	Remaining heat contained in exhaust from waste heat boiler(at 93.6 °C)	73,629 kJ/ton clinker
	Net available waste heat	**171,801 kJ/ton clinker**
Combined heat availability	*Net available waste heat*	**337,937 kJ/ton clinker**

Subsequently, we calculate the potential electrical output that can be produced utilizing the available waste heat and the design specifications of the waste heat equipment which will be applied in the proposed project activity. We calculate that on the basis of the available waste heat, about 58 kWh / ton clinker can theoretically be generated (see Table B.10). We subsequently calculate the annual electrical output that can theoretically be produced on the basis of available waste heat ($Q_{OE,BL}$) by multiplying the above figure with the average annual clinker production. As the project is implemented at a new clinker production line there is no data available on recent clinker production. We therefore estimate annual clinker production on the basis of the clinker production capacity and a load factor of 85% which is the projected load factor in the feasibility study of the clinker production line. On the basis of the above data we calculate annual available electrical output on the basis of design specifications listed in the table below and available heat as 148,901 MWh.

Table B.10: Calculation of F_{cap}

Tangshan Jidong Cement Matoushan Matishan 25MW Cement WHR Project			
Design specifications of waste heat utilization equipment			
Boiler efficiency SP Stage	94%	*Steam turbine efficiency*	80~82%
Boiler efficiency AQC Stage	97%	*Generator efficiency*	97~97.4
Efficiency of heat transmission pipes	98%	*Power factor of generator*	0.85φ
Transformation & transmission losses	8%		
Calculation of design electrical power output			
Available heat of SP stage after boiler and heat transmission losses			*166,137 kJ/ton clinker*
Available heat of AQC stage after boiler and heat transmission losses			*171,801 kJ/ton clinker*
Available electrical output (after conversion to electrical energy)			***58 kWh / ton clinker***

Clinker production in most recent 3 years	
Nominal capacity of clinker production line	2 x 4500 tons / day
Load factor (FS)	85%
Projected annual production	**2,792,250 tons**
Calculation of fcap	
Available electrical output on the basis of design specifications and available heat	148,901 MWh [36]
Projected electrical output of proposed project activity	146,700 MWh [37]
f_{cap}	**1.015**

We calculate an *ex-ante* estimation of f_{cap} by dividing the above calculated theoretical available electrical output by the projected maximum electrical output in accordance with equation B.4:

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} = \frac{148{,}901MWh}{146{,}700MWh} = 1.015$$

For values larger than 1 (f_{cap} as 1.015) a value of 1 is applied in subsequent calculations of emission reductions. The project entity will monitor electrical output of the proposed project activity in accordance with the methodology and f_{cap} will be updated ex-post in case the actual electrical output exceeds the electrical output which is theoretically available on the basis of the current baseline conditions. A detailed calculation spreadsheet with the above calculation of f_{cap} is available to the validator.

Baseline emissions and emission reductions

In accordance with the above, in particular noting again that $BE_{flst,\ y}$ and $BE_{Ther,,\ y}$ are each equal to zero, we can calculate the baseline emissions with the following formulae:

$$BE_y = BE_{En,y} = BE_{Elec,y} = f_{cap} * EG_y * EF_{Elec,y} \qquad \text{(B.5)}$$

Methodology ACM0012 refers to the "Tool to calculate the emission factor for an electricity system (Version 01.1)" for the determination of the CO_2 emission factor of the electricity ($EF_{Elec,\ y}$) in case the displaced electricity is supplied by a connected grid system. In accordance with the above mentioned tool, the baseline emission factor is calculated as a combined margin: a weighted average of the operating margin emission factor and the build margin emission factor. The latter is in this particular case calculated *ex ante* on the basis the latest additions to the grid.

This PDD refers to the Operating Margin (OM) Emission Factor and the Build Margin (BM) Emission Factor published by the Chinese DNA on 09 August 2007. We will refer to these emission factors as the 'published emission factors'. Our calculation results in a slightly lower combined margin emission factor than the one that can be calculated based on the published OM and BM emission factor. Therefore our calculated result is conservative.

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36 Calculated as annual average clinker production times available electrical output per unit of clinker production, and corrected 8% losses (transformation losses, transmission losses, and auxiliary power consumption).

37 The data is referred from Feasibility Study Report.

For more information on the published OM and BM emission factors, please refer to:
http://cdm.ccchina.gov.cn:80/english/NewsInfo.asp?NewsId=1891
-Baseline emission factors:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1364.pdf
-Calculation of OM:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1358.xls
-Calculation of BM:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1365.pdf

The description below focuses on the key elements in the calculation of the published emission factors and the subsequent calculation of emission reductions. The full process of the calculation of the emission factors and all underlying data are presented in English in Annex 3 to this PDD.

Selection of values for net calorific values, CO_2 emission factors and oxidation rates of various fuels.

As mentioned above, the Chinese DNA has entrusted key experts with the calculation of the grid emission factors. In these calculations choices have been made for the values of net calorific values, CO_2 emission factors, and oxidation rates. The net calorific values are based on the China Energy Statistical Yearbook, and the oxidation rates and the CO_2 emission factors are based on IPCC default values. Their use in the calculation of the published emission factors means that these values are deemed appropriate by the Chinese authorities for the calculations of the Chinese emission factors. The following table summarizes the values used. Note that the table lists the carbon emission factor of the fuels, the CO_2 emission factor has been obtained by multiplying with 44/12. The same values have been applied for the CO_2 emission factors for fuels used in connected grids (i.e. the Central China Grid and North East China Grid). Rounded figures have been reported but exact figures have been used in the calculations in this PDD.

Table B.11. Default values used for net calorific values, oxidation factors, and CO_2 emission factors of fuels

Fuel	Unit	NCV	Oxidation factor	Carbon emission factor	CO_2 emission factor
		(TJ/unit)	(Fraction)	(TC/TJ)	(TCO_2/TJ)
Raw coal	10^4 Tons	209.08	1	25.8	94.60
Clean coal	10^4 Tons	263.44	1	25.8	94.60
Other washed coal	10^4 Tons	83.63	1	25.8	94.60
Coke	10^4 Tons	284.35	1	29.2	107.07
Coke oven gas	10^8 m^3	1672.6	1	12.1	44.37
Other gas	10^8 m^3	522.70	1	12.1	44.37
Crude oil	10^4 Tons	418.16	1	20.0	73.33
Gasoline	10^4 Tons	430.70	1	18.9	69.30
Diesel	10^4 Tons	426.52	1	20.2	74.07
Fuel oil	10^4 Tons	418.16	1	21.1	77.37
LPG	10^4 Tons	501.79	1	17.2	63.07
Refinery gas	10^4 Tons	460.55	1	15.7	57.57
Natural gas	10^8 m^3	3893.10	1	15.3	56.10
Other petroleum products	10^4 Tons	383.69	1	20.0	73.33
Other coking products	10^4 Tons	284.35	1	25.8	94.60
Other E (standard coal)	10^4 Tce	292.70	1	0.0	0.00

Data source: All data are from the files mentioned above, and have been crosschecked against the original sources cited, as follows:

- Net calorific values: China Energy Statistical Yearbook, 2004p302;
- Oxidation factors and Carbon emission factors: IPCC default values; see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).
- CO_2 emission factors: calculated from carbon emission factors

Description of the calculation process

The key methodological steps according to the "Tool to calculate the emission factor for an electricity system" are:

1. Identify the relevant electric power system
2. Select an operating margin (OM) method
3. Calculate the operating margin emission factor according to the selected method
4. Identify the cohort of power units to be included in the build margin (BM)
5. Calculate the build margin emission factor
6. Calculate the combined margin (CM) emission factor

Step 1. Identify the relevant electric power system

The baseline calculation is applied to the North China Power grid which is defined as including the grids of Beijing, East and West Inner Mongolia, Hebei, Shandong, Shanxi, and Tianjin, as is further elaborated in Section B.3. Section B.3 also describes how the project boundary is decided.

Step 2. Select an operating margin (OM) method

The "Tool to calculate the emission factor for an electricity system" offers several options for the calculation of the OM emission factor. Of these, dispatch analysis, cannot be used, because dispatch data, let alone detailed dispatch data, are not available to the public or to the project participants. For the same reason, the simple adjusted OM methodology cannot be used. Because low-cost/must-run resources constitute less than 50% of total grid generation (see table B.12), we will employ the Simple OM method.

Table B.12 Installed capacity and electricity generation of the North China Power Grid, 2001-2005

Year	Installed capacity (%)					Electricity supplied (%)				
	Thermal	Hydro	Nuclear	Others	Total	Thermal	Hydro	Nuclear	Others	Total
2001	95	5	0	0	100	99	1	0	0	100
2002	96	4	0	0	100	99	1	0	0	100
2003	96	4	0	0	100	99	1	0	0	100
2004	97	3	0	0	100	99	1	0	0	100
2005	97	3	0	0	100	99	1	0	0	100

Source: China Electric Power Yearbook (editions 2002, 2003, 2004, 2005 and 2006).

Data vintage selection

In accordance with the "Tool to calculate the emission factor for an electricity system", the OM is calculated according to the "ex ante option": A three-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DEO for validation, without the requirement to monitor and recalculate the emissions factor during the crediting period.

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

According to the Simple OM method, the OM emission factor is calculated as the generation-weighted

average emissions per unit of electricity (measured in tCO_2/MWh) of all generating sources serving the system, excluding the low-operating cost and must run power plants. The OM emission factor may be calculated based on three options:

-Option A: Based on data on fuel consumption and net electricity generation of each power plant;

-Option B: Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit;

-Option C: 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

We calculate the OM emission factor according to option C of the Simple OM method, as data required for option A and B (i.e. data on fuel consumption, electricity generation, average efficiency etc of each specific power plant/unit serving the grid) is not available to the public or the project participants.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad \text{(B.6)}$$

With:

- $EF_{grid,OMsimple,y}$ is the simple operating margin CO_2 emission factor in year *y* (tCO_2 /MWh);
- $F_{i,j,y}$ the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*. *j* refers to the power sources delivering electricity to the grid, not including low operating costs and must-run power plants. Imports (from North East China Power Grid) are considered a power source, and the relevant emissions are determined using the average emission factor of the North East China Power Grid.
- $COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of fuels used by relevant power sources *j* and the percentage oxidation of the fuel in year(s) *y*;
- $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The CO_2 emission coefficient is equal to the net calorific value of fuel i, multiplied by the oxidation factor of the fuel and the CO2 emission factor per unit of energy of the fuel i.

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \quad \text{(B.7)}$$

With:

- NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*,
- $OXID_i$ is the oxidation factor of the fuel,
- $EFC_{O2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i*.

Choice of aggregated data sources

The published OM emission factor calculates the emission factor directly from published aggregated data on fuel consumption, net calorific values, and power supply to the grid and IPCC default values for the CO_2 emission factor and the oxidation rate.

Calculation of the OM emission factor as a three-year full generation weighted average

On the basis of these data, the Operating Margin emission factors for 2003, 2004 and 2005 are calculated. The three-year average is calculated as a full-generation-weighted average of the emission factors. For details we refer to the publications cited above and the detailed explanations and demonstration of the calculation of the OM emission factor provided in Annex 3. We calculate the Operation Margin Emission Factor as 1.1207 tCO_2e/MWh.[38]

The calculation of the OM emission factor is done once (*ex ante*) and will *not* be updated during the first crediting period. This has the added advantage of simplifying monitoring and verification of emission reductions.

Step 4. Identify the cohort of power units to be included in the build margin (BM)

According to the "Tool to calculate the emission factor for an electricity system", the sample group of power units m used to calculate the build margin consist of either:

(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently

A direct application of this approach is difficult in China. The Executive Board (EB) has provided guidance on this matter with respect to the application of the AMS-1.D and AM0005 methodologies for projects in China on 7 October 2005 in response to a request for clarification by DNV on this matter. The EB accepted the use of capacity additions to identify the share of thermal power plants in additions to the grid instead of using power generation. The relevance of this EB guidance extends to the "Tool to calculate the emission factor for an electricity system". The calculation in step 5 and the calculation of the published BM Emission Factor are based on this approach and are described below.

Data vintage selection

In accordance with the "Tool to calculate the emission factor for an electricity system", the BM is calculated according to option one: For the first crediting period, the build margin emission factor is calculated ex-ante based on the most recent information available. For the second crediting period, the build margin emission factor will be updated based on most recent data available at the time of submission of the request for registration. For the third crediting period, the build margin emission factor calculated for the second crediting period will be used.

Step 5. Calculate the build margin emission factor

The Build Margin Emission Factor is, according to the "Tool to calculate the emission factor for an electricity system", calculated as the generation weighted average emission factor (measured in tCO_2/MWh) of a sample of *m* power plants:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \quad \text{(B.8)}$$

[38] The Operating Margin as published by the Chinese authorities is slightly higher, i.e. 1.1208 tCO_2e/MWh . Therefore our calculated result is conservative to use.

With:

- $EF_{grid,BM,y}$ is the build margin CO_2 emission factor in year *y* (tCO_2/MWh);
- $EG_{m,y}$ is the net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh);
- $EF_{EL,m,y}$ is the CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh);
- m are the power units included in the build margin;
- y is the recent historical year for which power generation data is available.

The sample, according to the methodology, should be over the latest 5 power plants added to the grid, or over the last added power plants accounting for at least 20% of power generation, whatever is the greater. We apply an indirect approach based on the EB decision mentioned in step 4.

First we calculate the newly–added installed capacity and the share of each power generation technology in the total capacity. Second, we calculate the weights of each power generation technology in the newly-added installed capacity.[39] Third, emission factors for each fuel group are calculated on the basis of an advanced efficiency level for each power generation technology, IPCC default oxidation factors and a weighted average carbon emission factor on the basis of IPCC default carbon emission factors of individual fuels.

Since the exact data are aggregated, the calculation will apply the following method: We calculate the share of the CO_2 emissions of solid fuel, liquid fuel and gas fuel in total emissions respectively by using the latest energy balance data available; the calculated shares are the weights.

Using the emission factor for advanced efficient technology we calculate the emission factor for thermal power; the BM emission factor of the power grid will be calculated by multiplying the emission factor of the thermal power with the share of the thermal power in the most recently added 20% of total installed capacity.

Detailed steps and formulas are as below:

First, we calculate the share of CO_2 emissions of the solid, liquid and gaseous fuels in total emissions respectively.

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \qquad (B.9)$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \qquad (B.10)$$

39 Newly added capacity is determined as follows. First, the latest year (2005) for which data on total installed capacity is available is identified. Then, the last year is identified in which the total installed capacity was below 80% of the total installed capacity in 2005. This defines “newly added capacity”. Note that this approach does not follow the EB decision in response to the DNV request as mentioned in the main text to the letter, but the approach taken is the one that has been followed in numerous PDDs since the EB decision.

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \text{(B.11)}$$

with:

- $F_{i,j,y}$ the amount of the fuel i consumed in y year of j province (measured in tce;
- $COEF_{i,j,y}$ the emission factor of fuel i (measured in tCO_2/tce) while taking into account the carbon content and oxidation rate of the fuel *i* consumed in year *y*;
- *COAL,OIL* and *GAS* subscripts standing for the solid fuel, liquid fuel and gas fuel

Second, we calculate the emission factor of the thermal power

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \quad \text{(B.12)}$$

While $EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ represent the emission factors of advanced coal-fired , oil-fired and gas-fired power generation technology, see detailed parameter and calculation in Annex 3.

Third, we calculate BM of the power grid

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad \text{(B.13)}$$

While CAP_{Total} represents the total newly-added capacity and $CAP_{Thermal}$ represents newly-added thermal power capacity.

The λs are calculated on the basis of the weight of CO_2 emissions of each type of fuel in the total CO_2 emissions from thermal power. Subsequent calculation of the Build Margin emission factor yields a baseline emission factor of 0.9028 tCO_2e/MWh.[40]

For details we refer to Annex 3.

The calculation of the BM emission factor for the first crediting period is done once (*ex ante*) and will *not* be updated during the first crediting period. This has the advantage of simplifying monitoring and verification of emission reductions.

Step 6. Calculate the combined margin (CM) emission factor

The Baseline Emission Factor is calculated as a Combined Margin, using a weighted average of the Operating Margin and Build Margin.

$$EF_{Elec,y} = EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,MB,y} * w_{BM} \quad \text{(B.14)}$$

The "Tool to calculate the emission factor for an electricity system" provides the following default weights: Operating Margin, w_{OM} = 0.5; Build Margin, w_{BM} = 0.5

[40] The Build Margin as published by the Chinese authorities is slightly higher, i.e. 0.9397 tCO_2e/MWh . Therefore our calculated result is conservative to use.

Applying the default weights and the calculated emission factors, we calculate a Baseline Emission Factor of **1.0118** tCO_2e/ MWh.[41]

Calculation of Baseline Emissions

Baseline Emissions are calculated by multiplying the Baseline Emission factor by the net quantity of electricity supplied to the cement production facility by the project according to formula B.5 repeated below for convenience:

$$BE_y = BE_{En,y} = BE_{Elec,y} = EG_y * EF_{Elec,y}$$

Calculation of Project Emissions

The proposed project activity does not generate project emissions as:

1) No auxiliary fuel will be combusted to supplement waste heat;
2) No gas will be cleaned as the proposed project utilizes waste heat;
3) There is no captive electricity generation on site and the proposed project is not a "Type-2 project".

Also note that any auxiliary electricity consumption by the proposed project activity will be measured and deducted from gross electricity supply to the internal grid of the cement production facility, and are therefore already accounted for as we employ Net electricity supply to for the calculation of baseline emissions.

Calculation of emission reductions

The project does not involve project emissions or leakage in accordance with the methodology, and therefore project emissions are equal to baseline emissions. Using the results of the preceding sections, we can calculate the emission reductions using formula B.15

$$ER_y = f_{cap} \times EG_y \times 1.0118 \quad \text{(B.15)}$$

The estimated baseline emissions (see Section A4.4) are based on expected Net power supply to the cement production facility and an *ex ante* calculation of the emission factor in the first crediting period, and will hence be revised during the implementation of the project activity on the basis of actual power supply to the cement production facility and actual waste energy generation by the cement production facility.

[41] The Combined Margin that can be calculated based on the CM and BM as published by the Chinese authorities is slightly higher, i.e. 1.03025 tCO_2e/MWh . Therefore our calculated result is conservative to use.

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

Data / Parameter:	f_{wcm}
Data unit:	Fraction
Description:	Fraction of total energy generated by the project activity using waste gas.
Source of data used:	Feasibility study
Value applied	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The ACM0012 methodology refers to waste gas, but from the context it is clear that this value refers to waste energy resource in general. In the case of the project activity we have interpreted f_{wcm} therefore as the fraction of total energy generated using waste heat. The methodology prescribes that this fraction is 1 if the electricity generation is purely from use of the waste energy resource (i.e. waste heat).
Any comment:	-

Data / Parameter:	f_{cap}
Data unit:	Fraction
Description:	Energy that would have been produced in project year y using waste gas/heat generated in base year expressed as a fraction of total energy produced using waste gas in year y.
Source of data used:	Calculated on the basis of test report / feasibility study
Value applied	1.015
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of f_{cap} has been calculated ex-ante on the basis of the output that can be theoretically be produced on the basis of available waste heat when the cement line is operated under normal load factors and projected power output. See section B.6.1. for details on the determination of f_{cap}.
Any comment:	See section B.6.1 for details on the calculation method.

Data / Parameter:	$Q_{OE,BL}$
Data unit:	MWh
Description:	Output/intermediate energy that can be theoretically produced (in appropriate unit), to be determined on the basis of maximum recoverable energy from the WECM, which would have been released (or WECM would have been flared or energy content of WECM would have been wasted) in the absence of CDM project activity.
Source of data used:	Calculated on the basis of a test report and equipment specifications (see for details section B.6.1
Value applied	148,901MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been calculated on the best data available which includes a test report of the available waste heat which provides an accurate estimate of total usable waste heat and the specifications of the waste heat recovery equipment.
Any comment:	See section B.6.1 for details on the calculation method.

Data / Parameter:	$Q_{OE,y}$
Data unit:	MWh

Description:	Quantity of actual output/intermediate energy during year y
Source of data used:	Feasibility Study Report
Value applied:	146,700
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project applies Method-3, Case-1 which needs the annual output energy which in this case consists of power supplied by the project activity to the internal power grid and data referred from FSR.
Any comment	-

The following data and parameters are mentioned in the ACM0012 methodology, but are related to the calculation of the grid emission factor in accordance with the "Tool to calculate the emission factor for an electricity system":

Data / Parameter:	$\mathbf{EF_{grid,CM,y}}$ (in the context of this project activity, identical $\boldsymbol{EF_{elec,y}}$)
Data unit:	tCO_2e/MWh
Description:	Combined Margin Grid Emission Factor
Source of data:	Calculated ex-ante based on the OM emission factor and BM emissions factor.
Value applied:	**1.0118** tCO_2e/ MWh.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated ex-ante based on the OM emission factor and BM emissions factor. For more information see Section B.6.1 and Annex 3.
Any comment:	-

Data / Parameter:	$\mathbf{EF_{grid,BM,y}}$
Data unit:	tCO_2e/MWh
Description:	Build Margin Grid Emission Factor
Source of data:	Calculated ex-ante (see Annex 3)
Value applied:	0.9028 tCO_2e/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated ex-ante. For more information see Section B.6.1 and Annex 3.
Any comment:	-

Data / Parameter:	$\mathbf{EF_{grid,OM,y}}$
Data unit:	tCO_2e/MWh
Description:	Operating Margin Grid Emission Factor
Source of data:	Calculated ex-ante (see Annex 3)
Value applied:	1.1207 tCO_2e/MWh
Justification of the choice of data or description of	Calculated ex-ante. For more information see Section B.6.1 and Annex 3.

measurement methods and procedures actually applied:	
Any comment:	-

Data / Parameter:	$EG_{m,y}$, EG_y, $EG_{j,y}$, $EG_{k,y}$ and $EG_{n,h}$
Data unit:	MWh (per annum)
Description:	Net electricity generated and delivered to the grid by power plant / unit *m,j,k*, or *n* in year *y* or hour *h*
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Electric Power Yearbook (Editions 2004, 2005 and 2006)
Value applied:	For detailed values; see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	For the calculation of the OM emission factor, total electricity supply per power generating category has been used instead of electricity supply per power plant/unit. For the calculation of the BM emission factor, the latest 20% capacity addition to the grid has been employed. For values and a detailed description of the calculation method see Annex 3 and Section B.6.1 respectively.

Data / Parameter:	Internal power consumption of power plants
Data unit:	Percentage
Description:	Internal consumption of power by source
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Electric Power Yearbook (Editions 2004, 2005 and 2006)
Value applied:	For detailed values; see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	$FC_{i,m,y}$, $FC_{i,y}$, $FC_{i,j,y}$, $FC_{i,k,y}$, $FC_{i,n,y}$, and $FC_{i.n.h}$
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power plants / units *m,j,k*, or *n* in year *y* or hour *h*
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Energy Statistical Yearbook, 2003, 2004 and 2005 editions
Value applied:	For detailed values; see Annex 3
Justification of the	These data are the best data available, and have been published by the

choice of data or description of measurement methods and procedures actually applied:	Chinese authorities.
Any comment:	For the calculation of the OM emission factor, total fuel consumption per power generating category has been used instead of fuel consumption per power plant/unit. For the calculation of the BM emission factor, the latest 20% capacity addition to the grid has been employed. For values and a detailed description of the calculation method see Annex 3 and Section B.6.1 respectively.

Data / Parameter:	**Efficiency of advanced thermal power plant additions**
Data unit:	%
Description:	
Source of data used:	See the downloadable files mentioned above for the full data set. Data are based on the best technologies available in China.
Value applied:	Coal: 36.53%; Oil: 45.87%; Gas: 45.87%
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	**Capacity by power generation source**
Data unit:	MW
Description:	For the different power generation sources, installed capacity in 2003, 2004 and 2005 in the North China Grid. Calculated by summing provincial data.
Source of data used:	China Electric Power Yearbook (Editions 2004, 2005 and 2006)
Value applied:	For detailed values; see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	$\mathbf{EF_{co2,i,y}}$ **and** $\mathbf{EF_{co2,m,i,y}}$
Data unit:	tCO_2/GJ
Description:	tCO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	Data used are IPCC default values. See 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy
Value applied:	For detailed values; see Annex 3
Justification of the choice of data or description of measurement methods	These data are the most recent data available, and have been used by the Chinese authorities to calculate the emission factors.

and procedures actually applied:	
Any comment:	

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ / mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Energy Statistical Yearbook, (2004) p. 302.
Value applied:	For detailed values; see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	**Electricity imports from connected grids**
Data unit:	MWh (per annum)
Description:	Electricity imports of power from other grids
Source of data used:	Original data are from China Electric Power Yearbook (Editions 2004, 2005 and 2006)
Value applied:	For detailed values; see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Inapplicable data and parameters

The following data and parameters are mentioned in the ACM0012 methodology, but are not applicable:

Data / Parameter:	η_{BL} ($\eta_{EP,i,j}$, $\eta_{Plant,j}$, η_{Cogen})
Data unit:	
Description:	Baseline efficiency of the element process /captive power plant/ cogeneration plant
Source of data used:	NA The proposed project activity does not involve element process / captive power/cogeneration in the baseline scenario. Therefore no value is applied and no monitoring is required
Value applied	NA
Justification of the choice of data or description of	NA

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$\eta_{BL,t}$ ($\eta_{EP,i,j,t}$, $\eta_{Plant,j,t}$, $\eta_{Cogen,t}$)
Data unit:	
Description:	Baseline efficiency of the element process/captive power plant/cogeneration plant during time interval *t* where *t* is a discrete time interval during the year *y*
Source of data used:	NA The proposed project activity does not involve element process / captive power/cogeneration in the baseline scenario. Furthermore, this data/ parameter is only applicable if measurement based load v/s efficiency curve option is chosen. Therefore no value is applied.
Value applied	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	

Data / Parameter:	$Q_{WCM,BL}$
Data unit:	Mass unit (kg) of WECM or other relevant unit
Description:	Average quantity of waste energy released in atmosphere by WECM in three years prior to the start of the project activity
Source of data used:	Not applicable
Value applied	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable. The proposed project activity does not involve this parameter for calculation as it applies Method-3, case-1. Therefore this parameter is not applicable.
Any comment:	

Data / Parameter:	t_{ref}, P_{ref}, H_{ref}
Data unit:	deg C, kg/cm^2 (a), kJ/kg respectively or other appropriate unit
Description:	Reference temperature
Source of data used:	Use the following values or other appropriate pressure with proper justification 0 for reference temperature 1 atm for reference pressure 0 kJ/kg for reference enthalpy
Value applied	Not applicable
Justification of the choice of data or description of	Not applicable. The proposed project activity does not involve this parameter for calculation as it applies Method-3, case-1. Therefore this parameter is not applicable.

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$t_{wcm,BL}$
Data unit:	deg C or other appropriate unit
Description:	Average temperature of WECM in three years prior to the start of the project activity
Source of data used:	To be measured using appropriate temperature measuring instrument (e.g. Pressure gauge, Manonmeter etc.)
Value applied	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable. The proposed project activity does not involve this parameter for calculation as it applies Method-3, case-1. Therefore this parameter is not applicable.
Any comment:	

Data / Parameter:	$P_{WCM,BL}$
Data unit:	kg/cm^2 (a) or any other appropriate unit
Description:	Average pressure of WECM in three years prior to the start of the project activity
Source of data used:	To be measured using appropriate temperature measuring instrument (e.g. Pressure gauge, Manonmeter etc.)
Value applied	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable. The proposed project activity does not involve this parameter for calculation as it applies Method-3, case-1. Therefore this parameter is not applicable.
Any comment:	

Data / Parameter:	$H_{WCM,BL}$
Data unit:	kJ/kg or any other appropriate unit
Description:	Average pressure of WECM in three years prior to the start of the project activity
Source of data used:	From engineering data books (e.g. steam tables)
Value applied	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable. The proposed project activity does not involve this parameter for calculation as it applies Method-3, case-1. Therefore this parameter is not applicable.
Any comment:	

Data / Parameter:	$d_{wcm,BL}$

Data unit:	(kg/m^3 at actual conditions)
Description:	Density of WECM at actual temperature and pressure in three years prior to the start of the project activity (kg/m^3 at actual conditions)
Source of data used:	From standard books
Value applied	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable. The proposed project activity does not involve this parameter for calculation as it applies Method-3, case-1. Therefore this parameter is not applicable.
Any comment:	The density figure used for calculations should correspond to average pressure and temperature of WECM

Data / Parameter:	$Q_{ff,,fl,B}$
Data unit:	TJ
Description:	Fossil fuel used to flare (directly) the waste gas prior to the implementation of the project activity. At least one year's historic data shall be used and preferably three years historic should be used. Preferably three years historic data shall be used and at least one-year historic data should be used.
Source of data used:	Not applicable. The proposed project activity does not involve the flaring of waste gas in the baseline.
Value applied	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	

Data / Parameter:	$Q_{WG,FL,B}$
Data unit:	Nm^3
Description:	The amount of waste gas flared using steam prior to the implementation of the project activity. Preferably three years historic data shall be used and at least one year historic data should be used.
Source of data used:	This parameter is not applicable as the proposed project activity does not include the flaring of waste gas in the baseline.
Value applied	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	

Data / Parameter:	$Q_{st,fl,B}$
Data unit:	TJ
Description:	Steam used to flare the waste gas prior to the implementation of the project

	activity. At least one year's historic data shall be used and preferably three years historic should be used. Preferably three years historic data shall be used and at least one year historic data should be used.
Source of data used:	This parameter is not applicable as the proposed project activity does not include the flaring of waste gas in the baseline.
Value applied	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	

Data / Parameter:	**$EG_{Captive,B}$**
Data unit:	MWh
Description:	Captive electricity generated from the captured portion of waste gas produced at the facility in the absence of the project activity (MWh); the maximum value for the 3 years prior to the project activity is used in calculations where indicated as the conservative approach
Source of data used:	Not applicable. The proposed project activity does not include capturing of waste gas in the baseline.
Value applied	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	

Data / Parameter:	**$Q_{WG,captive,\ BL}$**
Data unit:	kg
Description:	Quantity of waste gas captured and used for captive power generation in the absence of the project activity, use the maximum figure from 3 years historic data
Source of data used:	Not applicable. The proposed project activity does not include capturing and utilizing of waste gas to generate captive electricity in the baseline.
Value applied	NA
Justification of the choice of data or description of measurement methods and procedures actually applied :	NA
Any comment:	

Data / Parameter:	Thermal energy produced using stream of WECM considered under Type-2 project activity
Data unit:	Any suitable unit (MWh, Tj, MCal)
Description:	Average annual quantity of thermal energy produced using stream (or part of

	stream) of WECM considered under Type-2 project activity for three years prior to its implementation
Source of data used:	Not applicable. The proposed project activity does not include capturing and utilizing of waste gas to generate captive electricity in the baseline.
Value applied	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

In section B.6.1. it was concluded that emission reductions are equal to baseline emissions as the project will claim emission reductions only for Net power supply to the internal grid. The project involves the construction of a new waste-heat utilization project and does not involve to co-firing of auxiliary fuels and therefore project emissions and leakage are zero. Hence, the emission reductions due to the project are equal to the baseline emissions. The parameter f_{cap} is calculated ex-ante on the basis of equation B.4 and will be updated ex-post on the basis of the actual power supply and equation B.4 (see also Section B.6.1).

Annual baseline emissions (and hence emission reductions) can therefore be calculated as indicated below:

$$BE_y = f_{cap} \times EG_y \times EF_{Elec,y} = 1 \times 146,700 \times 1.0118 = 148,431 tCO_2e$$

We obtain the following values for the estimation of baseline emissions during the crediting period:

Table B.13 The estimation of baseline emissions in crediting period

Year	Year	Annual net power supply to the grid (EGy) (MWh)	f_{cap}	Baseline emission factor (tCO_2/MWh)	Baseline emissions (tCO_2e)
1	10/08/2009 – 09/08/2010	146,700	1	1.0118	148,431
2	10/08/2010 – 09/08/2011	146,700	1	1.0118	148,431
3	10/08/2011 – 09/08/2012	146,700	1	1.0118	148,431
4	10/08/2012 – 09/08/2013	146,700	1	1.0118	148,431
5	10/08/2013 – 09/08/2014	146,700	1	1.0118	148,431
6	10/08/2014 – 09/08/2015	146,700	1	1.0118	148,431
7	10/08/2015 – 09/08/2016	146,700	1	1.0118	148,431
8	10/08/2016 – 09/08/2017	146,700	1	1.0118	148,431
9	10/08/2017 – 09/08/2018	146,700	1	1.0118	148,431
10	10/08/2018 – 09/08/2019	146,700	1	1.0118	148,431
	Total	**1,467,000**			**1,484,310**
	Average	146,700			148,431

In a given year, the emission reductions realized by the project activity (ER_y) is equal to baseline GHG emissions (BE_y) minus project direct emissions and leakages during the same year:

$$ER_y = BE_y - PE_y - LE_y$$

$= BE_y - 0 - 0$
$= BE_y$

The project involves the construction of a new waste-heat utilization project and does not involve to co-firing of auxiliary fuels and therefore project emissions and leakage are zero. Hence, the emission reductions due to the project are equal to the baseline emissions. The emission reductions will be calculated *ex post* on the basis of actual power supply to the grid, using the baseline emission factor presented above in Section B.6.1.

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

Table B.14 Ex ante estimate of emission reductions due to the project

Year	Estimation of project activity emissions (tons of CO_2e)	Estimation of baseline emissions (tons of CO_2e)	Estimation of leakage (tons of CO_2e)	Estimation of overall emission reductions (tons of CO_2e)
Year 1: 10/08/2009 – 09/08/2010	0	148,431	0	148,431
Year 2: 10/08/2010 – 09/08/2011	0	148,431	0	148,431
Year 3: 10/08/2011 – 09/08/2012	0	148,431	0	148,431
Year 4: 10/08/2012 – 09/08/2013	0	148,431	0	148,431
Year 5: 10/08/2013 – 09/08/2014	0	148,431	0	148,431
Year 6: 10/08/2014 – 09/08/2015	0	148,431	0	148,431
Year 7: 10/08/2015 – 09/08/2016	0	148,431	0	148,431
Year 8: 10/08/2016 – 09/08/2017	0	148,431	0	148,431
Year 9: 10/08/2017 – 09/08/2018	0	148,431	0	148,431
Year 10: 10/08/2018 – 09/08/2019	0	148,431	0	148,431
Total (tons of CO2e)	**0**	**1,484,310**	**0**	**1,484,310**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$Q_{OE,y}$
Data unit:	MWh
Description:	Quantity of actual output/intermediate energy during year y
Source of data:	Generation plant measurement records
Measurement procedures (if any):	The project applies Method-3, Case-1 which requires the monitoring of the actual output energy which in this case consists of power supplied by the project activity to the internal power grid. The net supply of power to the internal grid by the proposed project activity is measured through national standard electricity metering instruments. The metering instruments will be calibrated annually in accordance with industry standards.
Monitoring frequency	Continuously
QA/QC procedures:	Measuring equipment will be calibrated on regular equipment annually. During the time of calibration and maintenance, alternative equipment will be used for monitoring.
Any comment	-

Data / Parameter:	$EG_{i,j,y}$ (also referred to as EG_y)

Data unit:	MWh
Description:	Quantity of electricity supplied by source i to the recipient plant j by the project activity during the year *y* in MWh. The only source of electricity in the baseline is the grid, and the only recipient is the cement production facility. Hence we have dropped the i and j suffices throughout.
Source of data:	Recipient plant(s) and generation plant measurement records
Measurement procedures (if any):	The ***net*** supply of power to the internal grid by the proposed project activity is measured through national standard electricity metering instruments. The metering instruments will be calibrated annually in accordance with industry standards. Metering results are recorded monthly. For details, see Section B.7.2.
Monitoring frequency	Continuously
QA/QC procedures:	The energy meters will undergo maintenance / calibration to the industry standards. The calibration will take place annually.
Any comment:	Data shall be measured at the recipient plant(s) and at the generation plant for cross check.

Inapplicable data and parameters

The following data and parameters are mentioned in the ACM0012 methodology as data and parameters to be monitored, but are not applicable to this particular project activity:

Data / Parameter:	$FF_{i,y}$
Data unit:	NM^3 or ton
Description:	Quantity of fossil fuel type *i* combusted to supplement waste gas in the project activity during the year *y*, in energy or mass units
Source of data:	Not applicable. The project design does not include the firing of fossil fuels. Therefore no value is applied in the calculation of emission reductions due to the project activity and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$WS_{i,j}$
Data unit:	
Description:	Fraction of total heat that is used by the recipient j in the project that in absence of the project activity would have been supplied by the i^{th} boiler.
Source of data:	Not applicable. The proposed project activity does involve supply of heat to the recipient in the baseline. Therefore no value is applied in the calculation of emission reductions due to the project activity and monitoring is not required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$Q_{WCM,y}/Q_{wg,y}$
Data unit:	Mass unit (kg)
Description:	Quantity of WECM/Waste gas used for energy generation during year y
Source of data used:	
Value applied	
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable. The proposed project activity does not involve this parameter for calculation. This parameter is not applicable and will not be monitored.
Any comment:	

Data / Parameter:	$EF_{CO2,is,j}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO_2 emission factor per unit of energy of the fossil fuel used in the baseline generation source i (i=is) providing energy to recipient j.
Source of data:	Not applicable. The only baseline generation source is grid-generated electricity. Therefore no value is applied in the calculation of emission reductions due to the project activity and monitoring is not required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EF_{CO2,COGN}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline cogeneration plant.
Source of data:	Not applicable. The proposed project activity does not involve a cogeneration plant. Therefore no value is applied in the calculation of emission reductions due to the project activity and monitoring is not required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$HG_{j,y}$
Data unit:	TJ
Description:	Net quantity of heat supplied to the recipient plant j by the project activity during the year *y* in TJ. In case of steam this is expressed as difference of energy content between the steam supplied to the recipient plant and feed water to the boiler. The enthalpy of feed water to the boiler takes into account the enthalpy of condensate returned to the boiler (if any) and any other waste heat recovery (including economiser, blow down heat recovery etc.). In case of hot water/oil generator this is expressed as difference in energy content between the hot water/oil supplied to and returned by the recipient plant(s) to element process of cogeneration plant).

Source of data:	Not applicable. The proposed project activity does not supply heat to the recipient plant. Therefore this parameter is not applicable and will not be monitored.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$MG_{i,j,y,mot}$ or $MG_{i,j,y,tur}$
Data unit:	MWh
Description:	Mechanical energy supplied to the recipient *j* by generator, that is supplied by motor *i* or steam turbine *i* in the absence of the project activity in year *y*
Source of data:	Not applicable. The proposed project activity does not supply mechanical energy to the recipient plant. Therefore this parameter is not applicable and will not be monitored.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EF_{CO2,i,j}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO_2 emission factor per unit of energy of the baseline fuel used in i^{th} boiler used by recipient j, in tCO_2/TJ, in absence of the project activity.
Source of data:	Not applicable. The proposed project activity does not involve a boiler at the recipient site in the baseline (recipient relies on electricity from the grid). Therefore this parameter is not applicable and does not need to be monitored.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EF_{CO2,j}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO_2 emission factor of fossil fuel (tCO_2/TJ) that would have been used at facility '*j*' for flaring the waste gas.
Source of data:	Not applicable. The proposed project activity does not involve the flaring of waste gas at the facility in the baseline. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$Q_{i,h}$
Data unit:	kg / h

Description:	Amount of individual fuel (and other fuel(s)) i consumed at the energy generation unit during hour h
Source of data:	Not applicable. The proposed project activity does not consume fuels at the energy generation. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EG_{tot,y}$
Data unit:	TJ / year
Description:	Total annual energy produced at the cogeneration plants, with waste gas and fossil fuel.
Source of data:	Not applicable. The proposed project activity does not involve the construction of a cogeneration plant. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$Q_{wcm,h}$
Data unit:	kg / h
Description:	Quantity of WECM recovered in hour h
Source of data:	Not applicable. The project activity does not involve the utilization of waste gas
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$NCV_{WCM,y}$
Data unit:	(TJ / kg)
Description:	Net Calorific Value annual average for each individual consumed fuel and/or WECM
Source of data:	Not applicable. The proposed project activity does not involve the utilization of waste gas. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	Cp_{wcm} or CP_i
Data unit:	TJ/kg-deg C or other suitable unit
Description:	Specific Heat of WECM or fuel
Source of data:	Not applicable. The proposed project activity does not involve the utilization of specific heat of WECM or fuel. Therefore no value is applied and no

	monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$t_{wcm,h}$ or $t_{i,h}$
Data unit:	(deg C or other appropriate unit)
Description:	The temperature of WECM (or fuel) in hour h
Source of data:	Not applicable. The proposed project activity does not involve the monitoring of the temperature of WECM or fuel and applies Method-3, Case-1 to calculate f_{cap}, $t_{wcm,h}$ or $t_{i,h}$ is not applicable to the project activity and is not used in any of the equations. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$\mathbf{t_{wcm,y}}$
Data unit:	deg C or other appropriate unit
Description:	Average temperature of Waste Energy Carrying Medium (WECM) in year *y*
Source of data:	Not applicable.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$\mathbf{P_{WCM,y}}$
Data unit:	kg/cm^2 (a) or any other appropriate unit
Description:	Average pressure of WECM in year *y*
Source of data:	Not applicable. The proposed project activity does not involve the utilization of waste pressure. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable.
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$\mathbf{H_{WCM,y}}$
Data unit:	kJ/kg or any other appropriate unit
Description:	Average enthalpy of WECM in year *y*
Source of data:	Not applicable. The proposed project activity applies Method-3, Case-1 to calculate f_{cap} and does not involve monitoring of the enthalpy of WECM, $H_{WCM,y}$ is not applicable to the project activity and is not used in any of the equations. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable.

Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$\mathbf{d_{wcm,y}}$
Data unit:	kg/m3 (or other appropriate mass/volume unit) at actual conditions
Description:	Average density of WECM at actual temperature and pressure in year *y*
Source of data:	Not applicable. The proposed project activity does not involve the utilization of the pressure. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable.
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$ST_{whr,y}$
Data unit:	kCal/kg or kJ/kg
Description:	Energy content of the steam generated in waste heat recovery boiler fed to turbine via common steam header
Source of data:	Not applicable. The proposed project activity does not involve the utilization of a common steam header with multiple sources. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$ST_{other,y}$
Data unit:	kCal/kg or kJ/kg
Description:	Energy content of the steam generated in other boilers fed to turbine via common steam header
Source of data:	Not applicable. The proposed project activity does not involve the utilization of a common steam header with multiple sources. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EF_{heat,j,y}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO_2 emission factor of the heat source that would have supplied the recipient plant j in absence of the project activity, expressed in tCO_2/TJ
Source of data:	Not applicable. The proposed project activity does not involve heat supply to the recipient plant in the baseline. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable

Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Additional electricity consumed in year *y*, for gas cleaning equipment, as a result of the implementation of the project activity.
Source of data:	Not applicable. The proposed project activity does not involve gas cleaning. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$FC_{EL,CP,k,y}$
Data unit:	Mass or volume unit
Description:	Quantity of fuel type *k* combusted in the captive power plant at the project site in year *y* where *k* are the fuel types fired in the captive power plant at the project site in year *y*
Source of data:	Not applicable. The proposed project activity does not involve captive power in the baseline scenario. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	NCV_k
Data unit:	GJ / mass or volume unit
Description:	Net calorific value of fuel type *k* where *k* are the fuel types fired in the captive power plant at the project site in year *y*
Source of data:	Not applicable. The cement facility does not have captive power generation capacity and all electricity consumption by the project will be supplied by the public electricity grid. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EF_{CO2,k}$
Data unit:	tCO_2/GJ
Description:	Emission factor of fuel type *k* where *k* are the fuel types fired in the captive power plant at the project site in year *y*
Source of data:	Not applicable. The proposed project activity does not involve captive power in the baseline scenario. Therefore no value is applied and no monitoring is

	required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EC_{CP,y}$
Data unit:	MWh
Description:	Quantity of electricity generated in the captive power plant at the project site in year *y*
Source of data:	Not applicable. The proposed project activity does not involve captive power in the baseline scenario. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$\eta_{Project\ plant,j}$
Data unit:	%
Description:	Efficiency is the overall efficiency of the new electricity generating plant (%) in year *y*
Source of data:	Not applicable. The proposed project activity does not involve monitoring of the overall efficiency of the new power plant. Therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EC_{PJ,import\ i,y}$
Data unit:	MWh
Description:	Quantity of import electricity from source *i* consumed replacing captive electricity generated in the absence of the project activity during year *y* in MWh
Source of data:	Not applicable. As this parameter is applicable for Type-2 project activities, therefore no value is applied and no monitoring is required.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	**Thermal energy produced by Type-2 project activity**
Data unit:	Any suitable unit (MWh, TJ, MCal)
Description:	Annual quantity of thermal energy produced by Type-2 project activity
Source of data:	Not applicable. The proposed project activity is not a Type-2 project activity. Therefore no value is applied and no monitoring is required.

Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data and parameters that are available at validation

The following data and parameters are mentioned in the ACM0012 methodology as data and parameters to be monitored, but are already available during validation and are hence described in Section B.6.2.

Data / Parameter:	NCV_i
Data unit:	TJ / NM³ or ton
Description:	Net calorific value of the fossil fuel *i*
Source of data:	For this and other descriptions relating to this parameter, see the description in Section B.6.2, Data and parameters that are available at validation.
Measurement procedures (if any):	Not applicable
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

Data / Parameter:	$EF_{elec,i,j,y}$ (also referred to as $EF_{elec,y}$)
Data unit:	tCO_2 / MWh
Description:	CO_2 emission factor for the electricity source i (i=gr (grid) or i=is (identified source), displaced due to the project activity, during the year *y* in tons CO_2/MWh
Source of data:	Calculated in accordance with the latest approved version of ACM0012 (which in turn refers to the “tool to calculate the emission factor for an electricity system”) on the basis of the latest available statistics and IPCC default values.
Measurement procedures (if any):	Calculated on an ex-ante basis. The emission factor will not be updated during the crediting period.
Monitoring frequency	Not applicable
QA/QC procedures:	No further QA/QC procedures are considered necessary.
Any comment:	For this and other descriptions relating to this parameter, see the description in Section B.6.2, Data and parameters that are available at validation.

Data / Parameter:	$EF_{CO2,EL,y}$ (in the context of this project activity, identical $EF_{elec,y}$)
Data unit:	tCO_2 / MWh
Description:	CO_2 emission factor for electricity consumed by the project activity in year *y*.
Source of data:	Calculated in accordance with the latest approved version of “Tool to calculate the emission factor for an electricity system” on the basis of the latest available statistics and IPCC default values.
Measurement procedures (if any):	The project only consumes electricity from the grid and the emission factor has been calculated ex-ante and will not be updated during the crediting period.
Monitoring frequency	Not applicable
QA/QC procedures:	No further QA/QC procedures are considered necessary.
Any comment:	For this and other descriptions relating to this parameter, see the description in Section B.6.2. Data and parameters that are available at validation.

Data / Parameter:	$EF_{CO2,i}$
Data unit:	Tonnes CO_2 / TJ
Description:	CO_2 emission factor per unit of energy or mass of the fuel type *i*
Source of data:	Data used are based on IPCC default values, multiplied by 44/16. See 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Measurement procedures (if any):	The CO_2 emission factor is used in the calculation of the baseline emissions. The baseline emission factor is calculated ex-ante and will not be updated during the crediting period. Therefore monitoring of this parameter is not applicable.
Monitoring frequency	Not applicable
QA/QC procedures:	Not applicable
Any comment:	

B.7.2 Description of the monitoring plan:

The objective of the monitoring plan is to ensure the complete, consistent, clear, and accurate monitoring and calculation of the emissions reductions during the whole crediting period. The project owner will be responsible for the implementation of the monitoring plan. Monitoring procedures may be adjusted from time to time but will not deviate from the principles described in the monitoring plan below.

Operational procedures:

The only parameter that needs to be actively monitored is net annual power supply by the project to the internal grid of the cement production facility.

The project is connected directly to the internal grid of the cement production facility via a 6.3kV power line. This internal grid is in turn connected to the North China Power grid. Electricity generated by the project activity will be utilized for auxiliary consumption and the remaining electricity will be transmitted to the internal grid of the cement production facility. During emergencies, start-up, maintenance, etc, the project activity can receive electricity from the internal grid of the cement production facility for auxiliary consumption.

An indicative electrical connection diagram is provided in figure B.2. The electrical connection diagram indicates the principles for positioning of metering instruments that will be used in the monitoring of emission reductions. A separate monitoring manual is prepared with detailed procedures and a detailed grid connection diagram which is updated on the basis of the actual implementation of the project's grid connection and which will serve as the basis for periodic verification. The project entity will ensure that the actual implementation of grid connection will not deviate from the procedures outlined in this section.

The project will connect to the internal grid with one or more power supply lines to deliver power from the project activity to the internal grid. Net power supply through these power lines will be recorded at metering points $M1_x$.

The project will also be connected to the internal grid through one or more auxiliary power lines that provide power during maintenance, start-up or emergencies. Net power supplied from the internal grid to the project activity will be metered at metering points $M2_x$.

These meters at metering points $M1_x$ and $M2_x$ may consist of either bidirectional metering instruments or instruments that record power supply and receipt separately. Please note that the dotted lines are optional. In case these optional power lines will be constructed all monitoring principles, frequency, calibration and other requirements will be identical to the existing power lines. An indicative grid connection diagram is provided in figure B.2.

In all cases the net supply will be recorded by the project entity.

The meters will produce hourly automatic measurements that will be recorded daily. An overview of detailed information on minimum accuracy requirements of the metering instruments, measuring intervals, recording form, calibration and available documentation is provided in Table B.15.

Determination of net power supply:

Net electricity supplied to the grid by the project ($EG_{i,j,y}$ or EG_y in section B.7.1.) is calculated on a monthly basis as:

$$EG_y = ES_y - ED_y$$

With:

- ES_y, electricity supplied by the project through the main power line(s) (in MWh) metered on the basis of metering instruments at $M1_x$.
- ED_y, electricity delivered to the project through back-up power line(s) metered on the basis of metering instruments at $M2_x$.

Figure B.2 Indicative electrical connection diagram

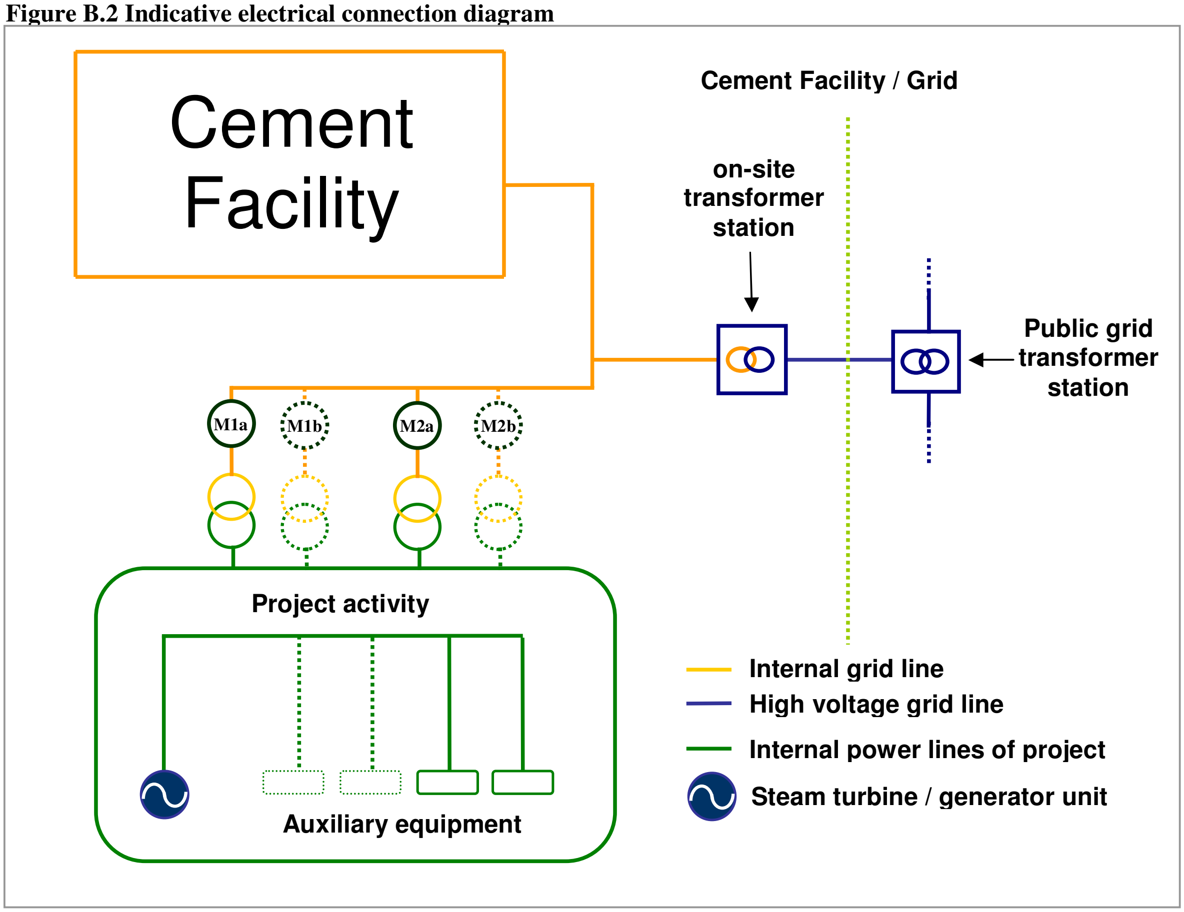


Table B.15 Details of metering instruments

Meter	Operated by	Electronic measurement	Manual logging	Recording	Calibration	Accuracy	Documentation
$M1_x$	Project entity	Continuous	Daily	Monthly	Grid Company	Accuracy Class 1or more accurate	Daily paper logs and monthly electronic spreadsheets filled in on the basis of daily logs.
$M2_x$	Project entity	Continuous	Daily	Monthly	Grid Company	Accuracy Class 1or more accurate	Daily paper logs and monthly electronic spreadsheets filled in on the basis of daily logs.

Monitoring of f_{cap}

The cap on emission reduction, f_{cap}, is determined on the basis of the theoretical maximum electrical output of the project activity, $Q_{BL,y}$ (described in section B.6.1) and the actual electrical output in year y ($Q_{OE,,y}$). Parameter $Q_{OE,,y}$ is defined as the net electricity supplied to the internal grid and therefore equal to parameter EG_y for which the monitoring procedures are described above. The same procedures will apply to parameter $Q_{OE,,y}$. The project entity will update the value of f_{cap} on the basis of the calculation method described in section B.6.1 annually.

Data management:

All electronic and hard copy records of the metering devices, relevant documentation and the results of calibration will be collected in a central place by the project entity. The net quantity of electricity supplied to the cement production facility by the project activity (EG_y) will be used in the calculation of emission reductions. Data record will be archived for a period of 2 years after the crediting period to which the records pertain.

PROCEDURES IN CASE OF DAMAGED METERING EQUIPMENT / EMERGENCIES

Damages to metering equipment:

In case metering equipment is damaged and no reliable readings can be recorded, the project entity will estimate net supply by the proposed project activity according to the following procedure:

1. The project entity will calculate total cement production over a period of 10 days prior to the moment of metering equipment damage, based on operational records of the cement production lines.
2. The project entity will calculate total net power supply by the waste heat utilization project to the internal grid over a period of 10 days prior to the moment of metering equipment damage, based on monitoring records.
3. The average net power supply per unit of cement production (in kWh/ton cement) will be calculated by dividing the result of step 2 by the result of step 1.
4. The net power supply on the days for which no record could be recorded will be estimated as follows: $EG_d = 0.75 \cdot CP_d \cdot AVEGCP$

   With:
   EG_d, estimated net power supply on day d for which no record could be recorded.
   CP_d, cement production by the cement production lines on day d.
   AVEGCP, the average net power supply per unit of cement production, calculated as described in step 3.
   A factor of 0.75 is applied to ensure conservativeness of the estimate.

The project entity will furthermore document all efforts taken to restore normal monitoring procedures.

Emergencies:

In case of emergencies[42], the project entity will not claim emission reductions due to the project activity for the duration of the emergency. The project entity will follow the following procedure for declaring the emergency period to be over:

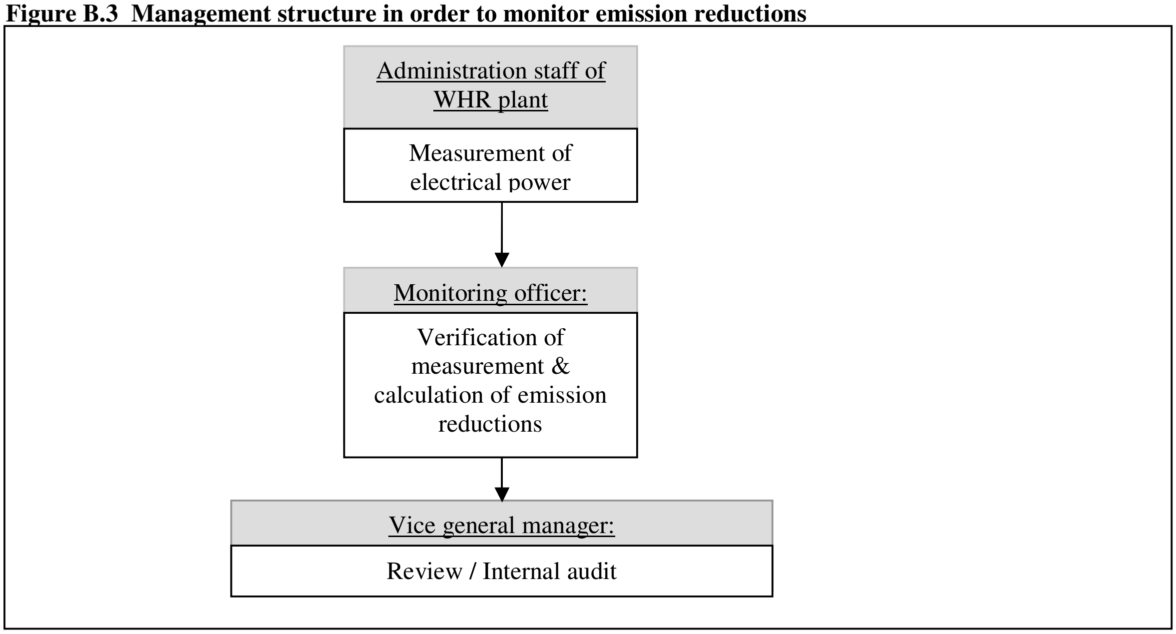
1. The project entity will ensure that all requirements for monitoring of emission reductions have been re-established.
2. The monitoring officer and the head of operations of the cement production facility will both sign a statement declaring the emergency situation to have ended and normal operations to have resumed.

OPERATIONAL AND MANAGEMENT STRUCTURE FOR MONITORING

The monitoring of the emission reductions will be carried out according to the scheme shown in Figure B.3. The overall responsibility for the monitoring process will be held by the Vice General Manager of the project entity. Some of the monitoring tasks will be delegated as indicated in figure B.3. The first step is the measurement of the electrical energy generated by the project, the measurement of the amount of electric power supplied to the internal grid and reporting of daily operations, which will be carried out by the plant manager.

The project entity will appoint a monitoring officer who will be responsible for verification of the measurement, and the calculation of the emissions reductions. The monitoring officer will prepare operational reports of the project activity, recording the daily operation of the waste heat utilization project, including operating periods, power generation, power delivered to the internal grid, equipment defects, etc. The selection procedure, tasks and responsibilities of the monitoring officer are described in detail in Annex 4. Finally, the monitoring reports will be reviewed by the Vice General Manager, who will carry the final responsibility for the monitoring report.

Figure B.3 Management structure in order to monitor emission reductions



42 Emergencies are defined as conditions under which the PO has not been able to monitor due to an unexpected accident.

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

Date of completion of the baseline study and monitoring methodology: 30/04/2009

Name of person determining the baseline study and the monitoring methodology:

Caspervandertak Consulting

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-Chang Jinyu:	Consultant:	Jinyu@caspervandertakconsulting.com
-Meskes Berkouwer:	Operations Manager Beijing:	Meskes@caspervandertakconsulting.com
-Joost van Acht:	Managing Director SE Asia:	Joost@caspervandertakconsulting.com
-Casper van der Tak:	General Director:	Info@caspervandertakconsulting.com

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Tel: +86-931-8440722 / Fax: +86-931-8440722

-Zhao Yonghong:	Consultant:	yonghong.zhao@gstonghe.com
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Caspervandertak Consulting and Gansu Tonghe Investment Project Consulting Co., Ltd. are not project participants.

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:

30/03/2007 (signing of equipment purchase contract [43])

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

20 years 0 months

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

A fixed crediting period is chosen

C.2.1. Renewable crediting period

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

Not applicable – left open on purpose

C.2.1.2. Length of the first crediting period:

Not applicable – left open on purpose

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

10/08/2009 (or date of registration, whichever is later)

C.2.2.2. Length:

10 years

[43] This date marked the start of signing the equipment purchase contract which can be considered the earliest starting date of the project activity in accordance with CDM Glossary and Terms as it was before the start of the construction activities or any other event that can be considered an irreversible decision to implement the project. See also table B.7.

SECTION D. Environmental impacts

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

The proposed WHR project activity will start operations at the same time as the cement production facility. Because the two activities are closely related, a combined Environmental Impact Assessment (EIA) has been conducted. The EIA has been approved by the Environmental Protection Bureau of Hebei Province on the 25th of May 2006. Subsequently, the planned installed capacity of the proposed project activity was corrected, and a "Statement of the waste heat recovery facility amendment" to supplement the EIA was approved on the 31st of July 2007 by the Environmental Protection Bureau of Hebei Province. A summary of the main environmental impacts is provided in section D.2

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:

SUMMARY OF ENVIRONMENTAL IMPACT ASSESSMENT

Summary of Overall Positive Impacts of the WHR project:

Reducing pollutant emission:
The project activity will make full use of available waste heat, replacing thermal-fired (mainly coal) power generation in the Hebei Power Grid and reducing pollutant emission such as of SO_2 , CO_2, NOx, dust and waste slag.

Summary of Overall Negative Impacts of the WHR project:

Air pollution:
During construction of the project, preparation, excavation, construction and transportation will cause some dust. The generation of dust is temporary and not significant. Additionally, proper measures such as watering the site will minimize the impact.

Noise:
The noise generated during the operation of the project will mainly come from the turbine and generator. To ensure living conditions of local residents will not be disrupted, the project owner will utilise screening and shock absorption among other measures to control the amount of noise within the requirement of the "Industrial Noise Standard (BG12345-90) III".

Industrial and domestic sewage:
The small quantity of sewage generated during the construction period comes mainly from the washing of construction equipment and waste water from concrete solidification process which will be spread to reduce the dust. The sewage generated during the operation period will be disposed in the cement plant sewage disposal system and then used as the water for humidification in the cement production line. So the sewage will not be directly drained out.

Solid waste:
The solid waste generated during the construction period mainly consists of domestic garbage and construction garbage (i.e. waste gravel, cement, and waste slag). The solid waste will be collected and disposed of in designated waste disposal sites.

SECTION E. Stakeholders' comments

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

The project entity carried out a separate stakeholder consultation to confirm the impacts of the project on the relevant stakeholders. The consultation lasted for one month, from the 30th of July to the 30th of August of 2007, and consisted of the following elements:

- **Establishment of a website:**
  The website contained information on the project, CDM, the stakeholder consultation process and provided an opportunity to post comments by e-mail or by telephone.
- **Organization of a stakeholder consultation meeting near project site:**
  Date / time: 9th of August 2007, from 9:00 till 11:30.
  Location: The Western meeting room of Tangshan Jidong Cement Co., Ltd.

  Agenda of the meeting:
  a. Opening of the meeting
  b. Introduction of the project
  c. Introduction of the Clean Development Mechanism
  d. Explanation of the stakeholder consultation process
  e. Round of comments by each participant
  f. Further questions and answers
  g. Closing of the meeting

The stakeholder meeting was held simultaneously with that of another project, i.e. the Tangshan Jidong Cement Fengrun District 12MW Cement Waste heat Recovery Project. This waste heat recovery project is located at the "Fengrun" cement production line, which is located next to the cement lines of the proposed project activity and is develop by the same entity. Both projects are expected to start operations around the same time and both are applying for CDM project status.

To ensure wide participation of stakeholders, announcements of the stakeholder consultation meeting and website were made through the following channels:

- Newspaper announcement in the Tangshan Labor Daily on the 30th of July 2007.
- Online announcement on Caspervandertakconsulting's website: www.cdmasia.org

In addition to the above announcements, important stakeholders received personal invitations to attend the meeting. The initial selection of residents took place by inviting 2 to 5 persons from each village in a 5km radius around the cement facility. As there are few residential areas surrounding the cement facility the radius was expanded to 10km.

See for attendance of the meeting Table E.1. A report of the main comments and outcomes of the meeting is provided in section E.2, together with the results of questionnaire survey.

Table E.1 The list of stakeholders that attended the stakeholder consultation meeting

No.	Organization	Participant	Position
1	Environment Protection Bureau of Fengrun District	Liu Mingjun	Vice director
2	Environment Protection Bureau of Tangshan City	Wang Yu	Staff member
3	Land Resource Bureau of Tangshan City	Pang Qingfeng	
4		Cui Run	Vice director
5	Development & Reform Commission Tangshan City	Li Dazheng	Director of a devision
6	Industry Promotion Organization of Fengrun district of Tangshan city	Yang Yong	Vice director of the Cement administrative office
7	Guozhuangzi Village of Jiangjiaying Town in Fengrun District of Tangshan City	Guo Zhaoyin	Local villager
8		Hong Shuyan	Local villager
9		Guo Da'an	Local villager
10		Guo Dachen	Local villager
11		Guo Songlin	Local villager
12		Tong Guangming	Local villager
13		Guo Shulin	Local villager
14		Guo Shuwen	Local villager
15		Guo Yanlong	Local villager
16	Investment Management Department of Jidong Cement Group	Li Zhanjun	director
17		Li Haihong	Vice director
18		Wu Guosheng	Vice director
19		Liu Wei	Project sponsor
20		Xuan Yongchao	Sponsor
21		Zhang Shuwei	Co-sponsor
22	General Manager's office of Jidong Cement Group	Fu Hua	
23	Caspervandertak Consulting	Joost van Acht	Chief Representative China
24		Meskes Berkouwer	consultant
25	Gansu Tonghe Investment project consulting Co., Ltd.	Zhao Yonghong	Project manager
26	Gansu Tonghe Investment project consulting Co., Ltd.	Li Yuxiu	Translator

E.2. Summary of the comments received:

Table E.2 gives the results of the questionnaire survey. A total of 15 questionnaires were distributed.

Table E.2 Results of the questionnaire survey

No.	Following impacts on locals due to the WHR project		Participant
1	What are the main economic impacts of the project?	Promoting local economic development	15
		Saving energy	15
		Other positive impact	10
		No impact	12
		Negative impact	0
2	What are the main impacts in the local society?	Increase employment opportunities	15
		Increasing incomes	11
		Other positive impact	6
		No impact	12
		Negative impact	0
3	What are the impacts in the environment?	Decrease the emission of high-temperature dust & gas	13
		Decrease amount of dust in the gas	13
		Avoid generation of pollutants	10
		Other positive impact	3
		No negative impact	12
4	What is the impact on individual living conditions?	Positive impact	9
		No impact	10
		No negative impact	12

		Have negative impact	0
5	What is you overall opinion of the project?	Support the project construction	15
		Do not support the project construction	0

Comments and opinions received at stakeholder consultation meeting:

Each attendant of the stakeholder consultation meeting expressed his or her opinion on the proposed project. During the meeting many stakeholders asked general questions regarding CDM procedures, these comments were omitted from the comments stated below. An overview of the main comments/questions expressed during the meeting is provided below.

Name: Li Dazheng
Position / Affiliation: Director of Development & Reform Commission of Tangshan City
Comments
Li Dazheng expressed that the construction of the project can alleviate power supply by the grid. At the moment, power supply is not sufficient and companies and local residents are affected by power cuts. This problem will be reduced when the cement production facility will utilize electricity generated by the waste heat recovery project.

Name: Cui Run
Position / Affiliation: Vice Director of the Land Resource Bureau of Tangshan City
Comments
Cui Run stated that the project activity is in accordance with national environmental protection policies and added no land will be expropriated.

Name: Pang Qingfeng
Position / Affiliation: Staff member of the Land Resource Bureau of Tangshan City
Comments
Pang Qingfeng stated that the project utilizes waste heat for power generation which is good for saving energy and reducing drainage of pollutants. He enquired whether the waste heat from the cement production line will meet the requirements for power generation, and if additional coal-fired power generation is required.

Response by the Li Zhanjun (Director of Investment Department Jidong Cement Group):
Li Zhanjun replied that the waste heat generated by the cement production line is sufficient for power generation. The waste heat recovery project is designed according to the quantity of waste heat and there is no need for additional coal-fired power generation.

Name: Wang Yi
Position / Affiliation: Staff member Environment Protection Bureau of Tangshan City
Comments
Wang Yi, expressed that the waste heat recovery project provides many benefits. He wanted to know whether or not the equipment of the project is advanced, and if it will increase the drainage of dust.

Response by the Li Zhanjun (Director of Investment Department Jidong Cement Group):
Li Zhanjun responded that the project will not increase the drainage of dust. Even if the waste heat generation equipment stops working, the dust will be removed through the dust-removal bag.

Comments received through website:

No comments were received by e-mail through the stakeholder consultation website or by telephone.

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

Given the generally positive (or neutral) nature of the comments received, no action will been taken to solve the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

The Project Entity:

Organization:	Tangshan Jidong Cement Co., Ltd.
Street/P.O.Box:	Linyin Road, Fengrun District,
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E-Mail:	
URL:	www.jdsn.com.cn
Represented by:	Wu Guosheng (吴国生)
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Salutation:	Mr
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Postfix/ZIP:	SE1 2AQ
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URL:	www.climatechangecapital.com
Represented by:	Climate Change Capital
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Represented by:	Climate Change Capital Limited
Title:	Investment Manager for Climate Change Capital Carbon Fund II s.à r.l
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project does not receive any public funding

Annex 3

BASELINE INFORMATION

As described in Section B.6.1, the key element in the determination of the baseline for this project is the emission factor with which the new power supply from the proposed project activity to the internal grid of the cement production facility is to be multiplied. The emission factor is the combined margin emission factor of the North China Power Grid. Below we provide baseline information used for the calculation of the combined margin emission factor of the North China Power Grid.

Combined margin emission factor calculation of the North China Power Grid

Our baseline calculation follows the methodology used in the OM and BM emission factors baseline calculation published by the office of national coordination committee on climate change on the Internet. Full information on this can be found at their website:
http://cdm.ccchina.gov.cn:80/english/NewsInfo.asp?NewsId=1891
-Baseline emission factors:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1364.pdf
-Calculation of OM:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1358.xls
-Calculation of BM:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1365.pdf

Note: Below we provide the main data used in the calculation of the baseline emission factor. Please note that all primary data are from the files downloaded and mentioned above, crosschecked against the data sources mentioned in these documents. For example, if we cite below the China Energy Statistical Yearbook, then that is the primary data source used in the published calculations. Our calculation results in a slightly lower combined margin emission factor as can be calculated based on the published OM (1.1207) and BM (0.9028) emission factors. Therefor our calculated result is conservative to use.

Below we provide the main data used in the calculation of the baseline emission factor.

Table A1. Calculation of the Combined Margin Emission Factor

	Emission factor A	Value and Source B	Weight C	Weighted value D = B * C
1	EF_{OM}	1.1207 Table A2	0.5	0.5604
2	EF_{BM}	0.9028 Table A15	0.5	0.5604
3	CM			**1.0118** D1 + D2

Table A2. Calculation of the Operating Margin Emission Factor

	Variable	2003 A	2004 B	2005 C	Total D
1	Supply of thermal power to North China grid (MWh)	425,364,906 Table A3c, C7	489,173,110 Table A3b, C7	560,751,013 Table A3a, C7	1,475,289,029 D1 = A1 + B1 + C1
2	Imports of power from North East China grid (MWh)	4,244,380 Files cited above	4,514,550 Files cited above	23,423,000 Files cited above	32,181,930 D2 = A2 + B2 + C2
3	Total power supply for	429,609,286	493,687,660	584,174,013	1,507,470,959

	calculation EF_{OM} (MWh)	A3 = A1 + A2	B3 = B1 + B2	C3 = C1 + C2	D3 = D1 + D2
4	CO2 emissions associated with thermal power generation on North China grid (tCO2)	455,557,075	549,024,041	647,649,331	1,652,230,447
		Table A4c, E	Table A4b, E	Table A4a, E	D4 = A4 + B4 + C4
5	CO2 emissions associated with power imports from North East China grid (tCO2)	4,823,462	5,299,346	27,115,393	37,238,201
		Table A9c, E	Table A9b, E	Table A9a, E	D5 = A5 + B5 + C5
6	Total CO2 emissions for calculation EF_{OM} (tCO2)	460,380,537	554,323,387	674,764,724	1,689,468,648
		A6 = A4 + A5	B6 = B4 + B5	C6 = C4 + C5	D6 = D4 + D5
7	EFOM (tCO2/MWh)	1.07163	1.12282	1.15507	1.12073
		A6 / A3	B6 / B3	C6 / C3	D6 / D3

Table A3a. Calculation of thermal power supply to North China Grid, 2005

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Beijing	20,880,000	7.73	19,265,976
2	Tianjin	36,993,000	6.63	34,540,364
3	Hebei	134,348,000	6.57	125,521,336
4	Shanxi	128,785,000	7.42	119,229,153
5	Inner Mongolia	92,345,000	7.01	85,871,616
6	Shandong	189,880,000	7.14	176,322,568
7	North China			***560,751,013***
				C7 = C1 + C2 + C3 + C4 + C5 + C6

Source: Files mentioned above, original data are from China Electric Power Yearbook 2006, p. 559-560, 568.

Table A3b. Calculation of thermal power supply to North China Grid, 2004

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Beijing	18,579,000	7.94	17,103,827
2	Tianjin	33,952,000	6.35	31,796,048
3	Hebei	124,970,000	6.5	116,846,950
4	Shanxi	104,926,000	7.7	96,846,698
5	Inner Mongolia	80,427,000	7.17	74,660,384
6	Shandong	163,918,000	7.32	151,919,202
7	North China			***489,173,110***
				C7 = C1 + C2 + C3 + C4 + C5 + C6

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2005, p. 472-474.

Table A3c. Calculation of thermal power supply to North China Grid, 2003

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Beijing	18,608,000	7.52	17,208,678
2	Tianjin	32,191,000	6.79	30,005,231
3	Hebei	108,261,000	6.5	101,224,035
4	Shanxi	93,962,000	7.69	86,736,322
5	Inner Mongolia	65,106,000	7.66	60,118,880
6	Shandong	139,547,000	6.79	130,071,759
7	North China			***425,364,906***
				C7 = C1 + C2 + C3 + C4 + C5 + C6

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2004, p.670, p.709.

Table A4a. Calculation of CO_2 emissions from fuels for thermal power production, North China Grid, 2005.

Fuel	Unit	Inner Mongolia	Shanxi	Hebei	Shandong	Beijing	Tianjin	North China Grid	NCV (TJ/unit)	Oxidation factor (Fraction)	Carbon coefficient (TC/TJ)	CO2 emissions (tCO2)
								A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	6277.23	6176.45	6726.5	10405.4	897.75	1675.2	32158.53	209.08	1	25.8	636,062,536
Clean coal	10^4 Tons	0	0	0	42.18	0	0	42.18	263.44	1	25.8	1,051,186
Other washed coal	10^4 Tons	0	373.65	167.45	108.69	6.57	0	656.36	83.63	1	25.8	5,192,725
Coke	10^4 Tons	0.21	0	0	0.11	0	0	0.32	284.35	1	29.2	9,742
Coke oven gas	10^8 m^3	0.39	21.08	0.62	0	0.64	0.75	23.48	1672.6	1	12.1	1,742,396
Other gas	10^8 m^3	18.37	9.88	38.83	0	16.09	7.86	91.03	522.7	1	12.1	2,111,027
Crude oil	10^4 Tons	0.73	0	0	0	0	0	0.73	418.16	1	20	22,385
Gasoline	10^4 Tons	0	0	0.01	0	0	0	0.01	430.7	1	18.9	298
Diesel	10^4 Tons	0.12	0	3.54	0	0.48	0	4.14	426.52	1	20.2	130,786
Fuel oil	10^4 Tons	0.06	0	0.23	0	12.25	0	12.54	418.16	1	21.1	405,690
LPG	10^4 Tons	0	0	0	0	0	0	0	501.79	1	17.2	0
Refinery gas	10^4 Tons	0	0	9.02	0	0	0	9.02	460.55	1	15.7	239,141
Natural gas	10^8 m^3	0	2.76	0	0	0.28	0.08	3.12	3893.1	1	15.3	681,417
Other petroleum products	10^4 Tons	0	0	0	0	0	0	0	383.69	1	20	0
Other coking products	10^4 Tons	0	0	0	0	0	0	0	284.35	1	25.8	0
Other E (standard coal)	10^4 Tce	7.27	69.31	32.35	118.9	8.58	0	236.41	292.7	1	0	0
Total												647,649,331
												$\Sigma(E_i)$

Data source: Fuel consumption data are from files mentioned above and crosschecked against the China Energy Statistical Yearbook 2006. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors and fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).

Table A4b. Calculation of CO_2 emissions from fuels for thermal power production, North China Grid, 2004.

Fuel	Unit	Inner Mongolia	Shanxi	Hebei	Shandong	Beijing	Tianjin	North China Grid	NCV (TJ/unit)	Oxidation factor (Fraction)	Carbon coefficient (TC/TJ)	CO2 emissions (tCO2)
								A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	4932.2	5213.2	6299.8	8550	823.09	1410	27228.29	209.08	1	25.8	538,547,477
Clean coal	10^4 Tons	0	0	0	40	0	0	40	263.44	1	25.8	996,857
Other washed coal	10^4 Tons	0	354.17	101.04	284.22	6.48	0	745.91	83.63	1	25.8	5,901,191
Coke	10^4 Tons	0.22	0	0	0	0	0	0.22	284.35	1	29.2	6,698
Coke oven gas	10^8 m^3	0.4	5.32	0.54	8.73	0.55	0	15.54	1672.6	1	12.1	1,153,187
Other gas	10^8 m^3	16.47	8.2	24.25	1.41	17.74	0	68.07	522.7	1	12.1	1,578,574
Crude oil	10^4 Tons	0	0	0	0	0	0	0	418.16	1	20	0
Gasoline	10^4 Tons	0	0	0	0	0	0	0	430.7	1	18.9	0
Diesel	10^4 Tons	0	0	4.66	0	0.39	0.84	5.89	426.52	1	20.2	186,070
Fuel oil	10^4 Tons	0	0	0.16	0	14.66	0	14.82	418.16	1	21.1	479,451
LPG	10^4 Tons	0	0	0	0	0	0	0	501.79	1	17.2	0
Refinery gas	10^4 Tons	0	0	1.42	0	0	0.55	1.97	460.55	1	15.7	52,229
Natural gas	10^8 m^3	0	0.19	0	0	0	0.37	0.56	3893.1	1	15.3	122,306
Other petroleum products	10^4 Tons	0	0	0	0	0	0	0	383.69	1	20	0
Other coking products	10^4 Tons	0	0	0	0	0	0	0	284.35	1	25.8	0
Other E (standard coal)	10^4 Tce	4.48	109.73	34.64	0	9.41	0	158.26	292.7	1	0	0
Total												549,024,041
												$\Sigma(E_i)$

Data source: Fuel consumption data are from files mentioned above and crosschecked against the China Energy Statistical Yearbook 2005. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors and fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).

Table A4c. Calculation of CO_2 emissions from fuels for thermal power production, North China Grid, 2003.

Fuel	Unit	Inner Mongolia	Shanxi	Hebei	Shandong	Beijing	Tianjin	North China	NCV	Oxidation factor	Carbon coefficient	CO2 emissions
								Grid	(TJ/unit)	(Fraction)	(TC/TJ)	(tCO2)
								A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	3949.32	4528.51	5482.64	6808	714.73	1052.74	22535.94	209.08	1	25.8	445,737,636
Clean coal	10^4 Tons	0	0	0	9.41	0	0	9.41	263.44	1	25.8	234,511
Other washed coal	10^4 Tons	0	208.21	67.28	450.9	6.31	0	732.7	83.63	1	25.8	5,796,681
Coke	10^4 Tons	2.8	0	0	0	0	0	2.8	284.35	1	29.2	85,244
Coke oven gas	10^8 m^3	0.21	0.9	0	0.02	0.24	1.71	3.08	1672.6	1	12.1	228,560
Other gas	10^8 m^3	10.32	0	10.63	1.56	16.92	0	39.43	522.7	1	12.1	914,400
Crude oil	10^4 Tons	0	0	0	29.68	0	0	29.68	418.16	1	20	910,139
Gasoline	10^4 Tons	0	0	0	0.01	0	0	0.01	430.7	1	18.9	298
Diesel	10^4 Tons	2.91	0	4	5.4	0.29	1.35	13.95	426.52	1	20.2	440,693
Fuel oil	10^4 Tons	0.65	0	1.11	10.07	13.95	0.02	25.8	418.16	1	21.1	834,672
LPG	10^4 Tons	0	0	0	0	0	0	0	501.79	1	17.2	0
Refinery gas	10^4 Tons	0	0	0.27	0.83	0	0	1.1	460.55	1	15.7	29,164
Natural gas	10^8 m^3	0	0	0	1.08	0	0.5	1.58	3893.1	1	15.3	345,077
Other petroleum products	10^4 Tons	0	0	0	0	0	0	0	383.69	1	20	0
Other coking products	10^4 Tons	0	0	0	0	0	0	0	284.35	1	25.8	0
Other E (standard coal)	10^4 Tce	0	0	0	39.21	9.83	0	49.04	292.7	1	0	0
Total												455,557,075
												$\Sigma(E_i)$

Data source: Fuel consumption data are from files mentioned above and crosschecked against the China Energy Statistical Yearbook 2004. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p.302; Oxidation factors and fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).

Table A5. Calculation of emissions associated with imports from North East China Grid

Year	Imports (MWh) A	Average emission factor (tCO2/MWh) B	Associated CO2 emissions (tCO2) C = B * A
2005	23,423,000	1.15764	27,115,393
		Table A6	
2004	4,514,550	1.17384	5,299,346
		Table A6	
2003	4,244,380	1.13644	4,823,462
		Table A6	

Table A6. Calculation of average emission factors of North East China Power Grid

		2003	2004	2005
1	Total power supply (MWh)	153,227,363	170,132,885	179,031,569
		Table A7	Table A7	Table A7
2	Total CO2 Emissions (tCO2)	174,132,944	199,708,287	207,254,040
		Table A9c	Table A9b	Table A9a
3 = 2/1	Average emission Factor (tCO2/MWh)	1.13644	1.17384	1.15764

Table A7. Calculation of total power supply on North East China Power Grid[44]

		2003	2004	2005
1	Thermal power supply (MWh)	145,975,752	158,425,475	164,164,426
		Table A8c	Table A8b	Table A8a
2	Non-thermal power supply (MWh)	7,251,611	11,707,410	14,867,143
		Table A8f	Table A8e	Table A8d
3 = 1 + 2	Total power supply (MWh)	153,227,363	170,132,885	179,031,569

Table A8a. Calculation of thermal power supply to North East China Grid, 2005

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Liaoning	83,697,000	7.03	77,813,101
2	Jilin	35,294,000	6.59	32,968,125
3	Heilongjiang	58,000,000	7.96	53,383,200
4	Northeast China			164,164,426
				C4 = C1 + C2 + C3

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2006, p. 559-560, 568.

[44] Losses for specific power generation sources are not reported as such in the China Electrical Power Yearbook 2006 and 2004. We have therefore used losses for total power generation listed in the respective yearbooks and applied them to thermal power generation (tables A8a and A8c) and hydro power and other power generation (tables A8d and A8f) in 2005 and 2003. The China Electric Power Yearbook 2005 does list specific losses for thermal power generation and hydro power generation in 2004. We have applied the losses for thermal power to thermal power generation in table A8b and apply the losses for hydro power to hydro power generation in table A8e. Losses for "other generation" in 2004 are not reported, we have therefore assumed them zero. This approach is conservative.

Table A8b. Calculation of thermal power supply to North East China Grid, 2004

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Liaoning	84,543,000	7.21	78,447,450
2	Jilin	33,242,000	7.68	30,689,014
3	Heilongjiang	53,482,000	7.84	49,289,011
4	Northeast China			158,425,475 C4 = C1 + C2 + C3

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2005, p. 472-474.

Table A8c. Calculation of thermal power supply to North East China Grid, 2003

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Liaoning	79,751,000	7.17	74,032,853
2	Jilin	29,739,000	7.32	27,562,105
3	Heilongjiang	48,493,000	8.48	44,380,794
4	Northeast China			145,975,752 C4 = C1 + C2 + C3

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2004, p. 670, p.709.

Table A8d. Calculation of non-thermal power supply to North East China Grid, 2005

	Grid	Hydropower generation (MWh) A	Other generation (MWh) B	Non-thermal power generation (MWh) C = A + B	Losses (%) D	Non-thermal power supply (MWh) E = C * (100 - D) / 100
1	Liaoning	5,726,000	245,000	5,971,000	7.03	5,551,239
2	Jilin	8,002,000	99,000	8,101,000	6.59	7,567,144
3	Heilongjiang	1,800,000	100,000	1,900,000	7.96	1,748,760
4	North East China					14,867,143 E4 = E1 + E2 + E3

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2006, p. 559-560, 568.

Table A8e. Calculation of non-thermal power supply to North East China Grid, 2004

	Grid	Hydropower generation (MWh) A	Losses (%) B	Hydro power supply (MWh) C = A * (100 - B) / 100	Other supply (MWh) D	Total non-thermal power supply E = C + D
1	Liaoning	3,947,000	1.33	3,894,505	264,000	4,158,505
2	Jilin	6,147,000	0.75	6,100,898	81,000	6,181,898
3	Heilongjiang	1,338,000	1.27	1,321,007	46,000	1,367,007
4	Northeast China			11,316,410 C4 = C1 + C2 + C3	391,000 D4 = D1 + D2 + D3	11,707,410 E4 = E1 + E2 + E3

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2005, p. 472-474.

Table A8f. Calculation of non-thermal power supply to North East China Grid, 2003

	Grid	Hydropower generation (MWh) A	Other generation (MWh) B	Non-thermal power generation (MWh) C = A + B	Losses (%) D	Non-thermal power supply (MWh) E = C * (100 - D) / 100
1	Liaoning	2,383,000	202,000	2,585,000	7.17	2,399,656
2	Jilin	4,080,000	64,000	4,144,000	7.32	3,840,659
3	Heilongjiang	1,105,000	0	1,105,000	8.48	1,011,296
4	North East China					7,251,611 E4 = E1 + E2 + E3

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2004, p. 670, p.709.

Table A9a. Calculation of CO2 emissions from fuels for thermal power production, North East China Grid, 2005.

Fuel	Unit	Heilongjiang	Liaoning	Jilin	North East China Grid	NCV	Oxidation factor	Carbon coefficient	CO2 emissions
						(TJ/unit)	(Fraction)	(TC/TJ)	(tCO2)
					A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	3,383.21	4,305.41	2,446.13	10,134.75	209.08	1	25.8	200,454,896
Clean coal	10^4 Tons	0	0	0	0.00	263.44	1	25.8	0
Other washed coal	10^4 Tons	24.16	524.74	19.26	568.16	83.63	1	25.8	4,494,940
Coke	10^4 Tons	0	0	0	0.00	284.35	1	29.2	0
Coke oven gas	10^8 m^3	0.68	1.03	3.57	5.28	1672.6	1	12.1	391,817
Other gas	10^8 m^3	0	12.62	8.37	20.99	522.7	1	12.1	486,768
Crude oil	10^4 Tons	0	1.16	0	1.16	418.16	1	20	35,571
Gasoline	10^4 Tons	0	0	0	0.00	430.7	1	18.9	0
Diesel	10^4 Tons	0.57	1.18	1.48	3.23	426.52	1	20.2	102,039
Fuel oil	10^4 Tons	1.55	9.32	2.46	13.33	418.16	1	21.1	431,247
LPG	10^4 Tons	0	0.12	0	0.12	501.79	1	17.2	3,798
Refinery gas	10^4 Tons	1.32	5.48	0	6.80	460.55	1	15.7	180,284
Natural gas	10^8 m^3	2.24	0	0.84	3.08	3893.1	1	15.3	672,681
Other petroleum products	10^4 Tons	0	0	0	0.00	383.69	1	20	0
Other coking products	10^4 Tons	0	0	0	0.00	284.35	1	25.8	0
Other E (standard coal)	10^4 Tce	0	16.18	0	16.18	292.7	1	0	0
Total									207,254,040
									$\Sigma(E_i)$

Data source: Fuel consumption data are from files mentioned above and crosschecked against the China Energy Statistical Yearbook 2006. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors and fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).

Table A9b. Calculation of CO2 emissions from fuels for thermal power production, North East China Grid, 2004.

Fuel	Unit	Heilongjiang	Liaoning	Jilin	North East China Grid	NCV	Oxidation factor	Carbon coefficient	CO2 emissions
						(TJ/unit)	(Fraction)	(TC/TJ)	(tCO2)
					A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	3,084.80	4,144.20	2,310.90	9,539.90	209.08	1	25.8	188,689,377
Clean coal	10^4 Tons	4.88	84.75	1.09	90.72	263.44	1	25.8	2,260,872
Other washed coal	10^4 Tons	61	577.67	14.26	652.93	83.63	1	25.8	5,165,589
Coke	10^4 Tons	0	0	0	0.00	284.35	1	29.2	0
Coke oven gas	10^8 m^3	0	4.83	2.91	7.74	1672.6	1	12.1	574,367
Other gas	10^8 m^3	0	57.33	4.19	61.52	522.7	1	12.1	1,426,677
Crude oil	10^4 Tons	0	0	0	0.00	418.16	1	20	0
Gasoline	10^4 Tons	0	0	0	0.00	430.7	1	18.9	0
Diesel	10^4 Tons	0.24	2.04	1.16	3.44	426.52	1	20.2	108,673
Fuel oil	10^4 Tons	2.86	12.81	1.78	17.45	418.16	1	21.1	564,536
LPG	10^4 Tons	0	2.19	0	2.19	501.79	1	17.2	69,305
Refinery gas	10^4 Tons	1.14	9.79	0	10.93	460.55	1	15.7	289,780
Natural gas	10^8 m^3	2.53	0	0.03	2.56	3893.1	1	15.3	559,111
Other petroleum products	10^4 Tons	0	0	0	0.00	383.69	1	20	0
Other coking products	10^4 Tons	0	0	0	0.00	284.35	1	25.8	0
Other E (standard coal)	10^4 Tce	0	26.97	5.07	32.04	292.7	1	0	0
Total									199,708,287
									$\Sigma(E_i)$

Data source: Fuel consumption data are from files mentioned above and crosschecked against the China Energy Statistical Yearbook 2005. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors and fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).

Table A9c. Calculation of CO2 emissions from fuels for thermal power production, North East China Grid, 2003.

Fuel	Unit	Heilongjiang	Liaoning	Jilin	North East China Grid	NCV	Oxidation factor	Carbon coefficient	CO2 emissions
						(TJ/unit)	(Fraction)	(TC/TJ)	(tCO_2)
					A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	2,763.62	3,556.51	2,006.66	8,326.79	209.08	1	25.8	164,695,313
Clean coal	10^4 Tons	3	70.83	0	73.83	263.44	1	25.8	1,839,949
Other washed coal	10^4 Tons	53.41	617.04	15.9	686.35	83.63	1	25.8	5,429,988
Coke	10^4 Tons	0	0	0	0.00	284.35	1	29.2	0
Coke oven gas	10^8 m^3	0	1.66	0	1.66	1672.6	1	12.1	123,185
Other gas	10^8 m^3	0	5.31	0	5.31	522.7	1	12.1	123,141
Crude oil	10^4 Tons	0	3.39	0	3.39	418.16	1	20	103,955
Gasoline	10^4 Tons	0	0	0	0.00	430.7	1	18.9	0
Diesel	10^4 Tons	0	0.32	0.34	0.66	426.52	1	20.2	20,850
Fuel oil	10^4 Tons	4.32	14.87	0.7	19.89	418.16	1	21.1	643,474
LPG	10^4 Tons	0	1.55	0	1.55	501.79	1	17.2	49,052
Refinery gas	10^4 Tons	0.46	4.03	0	4.49	460.55	1	15.7	119,040
Natural gas	10^8 m^3	4.47	0	0.04	4.51	3893.1	1	15.3	984,997
Other petroleum products	10^4 Tons	0	0	0	0.00	383.69	1	20	0
Other coking products	10^4 Tons	0	0	0	0.00	284.35	1	25.8	0
Other E (standard coal)	10^4 Tce	0	29.38	0	29.38	292.7	1	0	0
Total									174,132,944
									$\Sigma(E_i)$

Data source: Fuel consumption data are from files mentioned above and crosschecked against the China Energy Statistical Yearbook 2004. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors and fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (energy).

Table A10. Calculation of the BM Emission Factor, North China Grid

$EF_{thermal}$ (tCO2/MWh)	Share of thermal power in added capacity, 2005-2003	EF_{BM} (tCO2/MWh)
A	B	C = A * B
0.90936	99.28%	0.90284
Table A11	Table A14	

Table A11. Calculation of EF thermal

		λ A	EF_{adv} B	$EF_{thermal}$ calculation C = A * B
1	Coal	99.18%	0.91363	0.90611
		Table A13	Table A12	
2	Gas	0.74%	0.37556	0.00277
		Table A13	Table A12	
3	Oil	0.09%	0.56615	0.00049
		Table A13	Table A12	
4	$EF_{thermal}$			0.90936

Table A12. Calculation of Emission factors of fuel using advanced technologies

Fuel	Efficiency (%) A	Carbon coefficient (tc/TJ) B	Oxidation factor C	EF_{adv} (tCO2/MWh) D=(3.6/(A*1000))*B*C*44/12
Coal	36.53%	25.8	0.98	0.91363
Gas	45.87%	13.1	0.995	0.37556
Oil	45.87%	19.9	0.99	0.56615

Source: Files downloaded and mentioned above.

Table A13. Calculation of λs for the calculation of the BM, North China Grid.

Fuel	Unit	South China Grid	NCV	Total energy consumption South China	Oxidation factor	Carbon coefficient	CO_2 emissions
			(TJ/unit)	TJ	(Fraction)	(TC/TJ)	(tCO_2)
		A	B		C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	32158.53	209.08	6,723,705	1	25.8	636,062,536
Clean coal	10^4 Tons	42.18	263.44	11,112	1	25.8	1,051,186
Other washed coal	10^4 Tons	656.36	83.63	54,891	1	25.8	5,192,725
Coke	10^4 Tons	0.32	284.35	91	1	29.2	9,742
Other coking products	10^4 Tons	0	284.35	0	1	25.8	0
Coal, total				**6,789,800**			**642,316,189**
Coke oven gas	10^8 m^3	23.48	1672.6	47,581	1	12.1	1,742,396
Other gas	10^8 m^3	91.03	522.7	0	1	12.1	2,111,027
LPG	10^4 Tons	0	501.79	4,154	1	17.2	0
Refinery gas	10^4 Tons	9.02	460.55	12,146	1	15.7	239,141
Natural gas	10^8 m^3	3.12	3893.1	0	1	15.3	681,417
Gas total				**63,882**			**4,773,982**
Crude oil	10^4 Tons	0.73	418.16	4	1	20	22,385
Gasoline	10^4 Tons	0.01	430.7	1,766	1	18.9	298

Diesel	10^4 Tons	4.14	426.52	5,244	1	20.2	130,786
Fuel oil	10^4 Tons	12.54	418.16	0	1	21.1	405,690
Other petroleum products	10^4 Tons	0	383.69	0	1	20	0
Oil total				**7,014**			**559,160**
Total							***647,649,331***
							$\Sigma(E_i)$

Share of fuel group in total CO2 emissions	
λ coal	99.18%
λ gas	0.74%
λ oil	0.09%

Weighted average carbon coefficient (tc/TJ)	
Coal	25.8
Gas	13.1
Oil	19.9

Note: Main data are from table A4a. *λ is calculated as the share of coal, gas respectively oil in total CO_2 emissions.* The weighted average carbon coefficients of the fuel groups (coal, gas and oil) have been calculated as a weighted average with the share of total energy consumption as weights.

Table A14. Calculation of the share of thermal power in recently added capacity

Installed capacity	**2003** **A**	**2004** **B**	**2005** **C**	**Capacity added in 2003-2005** **D=C-A**	**Share in added capacity**
Thermal (MW)	84006.6	93594.9	111068.7	27062.1	99.28%
Hydropower (MW)	3266	3250.7	3216.2	-49.8	-0.18%
Nuclear (MW)	0	0	0	0	0.00%
Other (MW)	90.1	137.5	335.5	245.4	0.90%
Total (MW)	87362.7	96983.1	114620.4	27257.7	100.00%
Percentage of 2005 capacity	76.22%	84.61%	100%		

Source: China Electric Power Yearbook 2006, p. 571; China Electric Power Yearbook 2005, p. 473; and China Electric Power Yearbook 2004, p. 670, p.709

Annex 4

MONITORING INFORMATION

Selection procedure:
The monitoring officer will be appointed by the general manager of the project entity. The monitoring officer will be selected from among the senior technical or managerial staff. Before he/she commences monitoring duties, he/she will receive instructions on monitoring requirements and procedures by Caspervandertak Consulting and Gansu Tonghe Investment Project Consulting Co., Ltd.

Tasks and responsibilities:
The monitoring officer will be responsible for carrying out the following tasks

- **Supervise and verify metering and recording:**
  The monitoring officer will coordinate with the plant manager to ensure and verify adequate metering and recording of data, including power generation and net power supply to the internal grid by the project activity.
- **Collection of additional data / operational reports:**
  The monitoring officer will collect operational reports, and additional data such as reports of the periodical calibration of the metering devices.
- **Calibration:**
  The monitoring officer will coordinate with staff of the project entity to ensure that calibration of the metering instruments is carried out periodically in accordance with regulations of the grid company.
- **Calculation of emission reductions:**
  The monitoring officer will calculate the annual emission reductions on the basis of net power supply to the grid. The monitoring officer will be provided with a calculation template in electronic form by the project's CDM advisors.

Preparation of monitoring report:
The monitoring officer will annually prepare a monitoring report which will include among others a summary of daily operations, metering values of power supplied to and received from the grid, copies of sales/billing receipts, a report on calibration and a calculation of emission reductions.