



**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	The CDQ Project in Tranvic Group
Version number of the PDD	04
Completion date of the PDD	20/03/2014
Project participant(s)	Neijiang Bowei Xinyu Chemical Industry Co., Ltd. (project owner) Carbon Invcap International Trading Co., Ltd. (buyer)
Host Party(ies)	P.R. of China
Sectoral scope and selected methodology(ies)	01 Energy industries (renewable - / non-renewable sources); 04 Manufacturing industries ACM0012 (version 04.0.0) – <i>Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects</i>
Estimated amount of annual average GHG emission reductions	153,428t CO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The CDQ Project in Tranvic Group (hereafter referred to as the project) is sited within the production area of Tranvic Group, Lianjie town, Weiyuan county, Neijiang city, Sichuan province, P.R. of China, owned by Neijiang Bowei Xinyu Chemical Industry Co., Ltd., the daughter company of Tranvic Group. The purpose of the project is to install one set of 170t/h CDQ system with a capacity of 30MW steam turbine/generator unit to recover the waste heat released into the atmosphere in the absence of the project activity to generate electricity for captive use, and annual net electricity supply amounts to 209,088MWh.

The electricity generated by the Project will displace electricity which would have been supplied by the operation of grid-connected power plants and by the addition of new generation sources within the Central China Power Grid (CCPG), which is the same as the baseline scenario of the project. By recovering the waste heat generated in coke production for captive use to displace the equivalent electricity generation by the CCPG, the project leads to the reduction of CO₂ emissions into the atmosphere. The project activity will achieve average greenhouse gas (GHG) emission reductions of 153,428tCO₂e annually and totally 1,534,280 tCO₂e for the ten-year fixed crediting period under the baseline scenario.

The project will utilize the waste heat released into the atmosphere in the absence of the project activity to generate electricity. The electricity generated will displace electricity which would have been supplied by the CCPG which is dominated by fossil fuel fired power plants. The project scenario existing prior to the implementation of the project activity is same as the baseline scenario of the proposed project, that is, coke wet quenching (CWQ) system is used and waste heat is released to the atmosphere.

The project will not only use the waste heat to generate clean electricity for captive use, but also contribute to sustainable development of the local community and the host country by means of:

- ♦ effectively reducing the pollutants emission in coking production.
- ♦ helping to stimulate the development of technology of resources comprehensive utilization in coking industry in China;
- ♦ providing local long-term work positions, which improve the living standards of local residents.

A.2. Location of project activity

A.2.1. Host Party(ies)

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People's Republic of China

A.2.2. Region/State/Province etc.

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Sichuan Province

A.2.3. City/Town/Community etc.

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Lianjie Town, Weiyuan County, Neijiang City,

A.2.4. Physical/Geographical location

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The project is sited in Lianjie town, Weiyuan county, Neijiang city, Sichuan province, with geographical coordinates of the project is as follows. Figure 1 shows the location of Neijiang City and Figure 2 shows the location of the project.

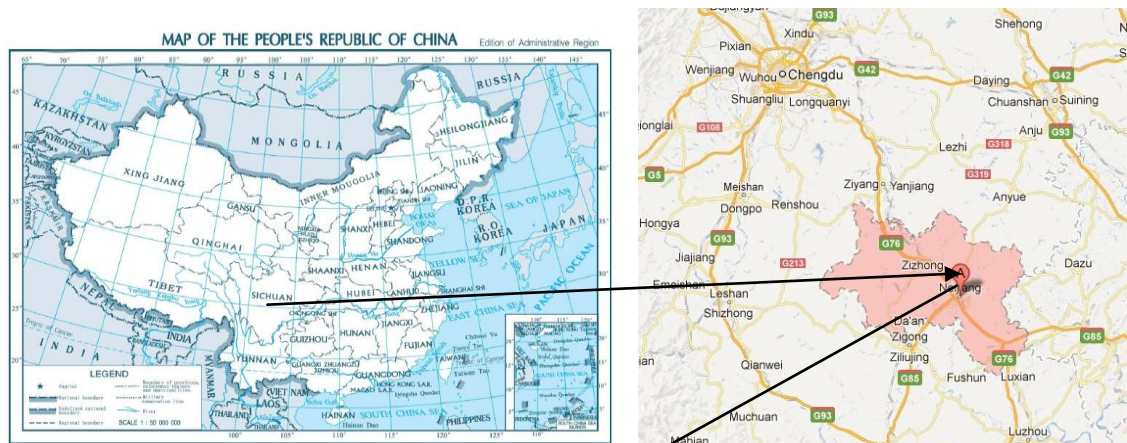


Figure 1. Map showing the location of Neijiang city



Figure 2. Map showing the location of the project

The geographical coordinates of the project

Project	East longitude	North latitude
the project	104 29'05"	29 43'11"

A.3. Technologies and/or measures

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The purpose of the project activity is to utilize the waste energy contained in the red hot coke for electricity. The project scenario existing prior to the implementation of the project activity is same as the baseline scenario of the project, that is, coke wet quenching (CWQ) system is used and waste heat is released to the atmosphere.

The coke is produced by heating low-ash, low-sulfur bituminous coal to very high temperature in a coke oven. When the red hot coke is ejected from the coke oven, it will react with oxygen contained in the air and will burn up if it is not cooled.

Neijiang Bowei Xinyu Chemical Industry Co., Ltd. currently has on-site coke production capacity which consists of three coke ovens. The quenching method applied for coke produced by these coke ovens is the CWQ method which involves transporting the red hot coke to a quenching tower and pouring water on the coke which absorbs the heat and is released into the atmosphere in the form of steam. The coke is then further quenched by water spraying. Although effective and very cheap, the CWQ method does not utilize the heat contained in red hot coke and leads to a substantial release of dust and other pollutants into the atmosphere.

Prior to the implementation of the Project, existed No.1 and No.2 coke ovens (6m, and 65 holes for each coke oven) with 1.4 million t/a coke production capacity owned by Neijiang Bowei Xinyu Chemical Industry Co., Ltd. was equipped a CWQ system for coke quenching and the waste heat with hot red coke was released into atmosphere. In the project activity, the existing CWQ system of the No.1 and No.2 coke ovens is replaced by one CDQ system, and the existing CWQ system is kept as the backup for the CDQ system.

The project will use Coke Dry Quenching technology, by which red-hot coke is quenched with low temperature inert gas in a cooling chamber. The CDQ system will recover waste heat from red-hot coke to reduce the energy loss. Based on FSR, Neijiang Bowei Xinyu Chemical Industry Co., Ltd. retrofitted the existing coke production line. One set of 170t/h Coke Dry Quenching facility was installed, while the existing coke wet quenching system was kept as a back-up system of the project.

Details of the CDQ process flow is shown below.

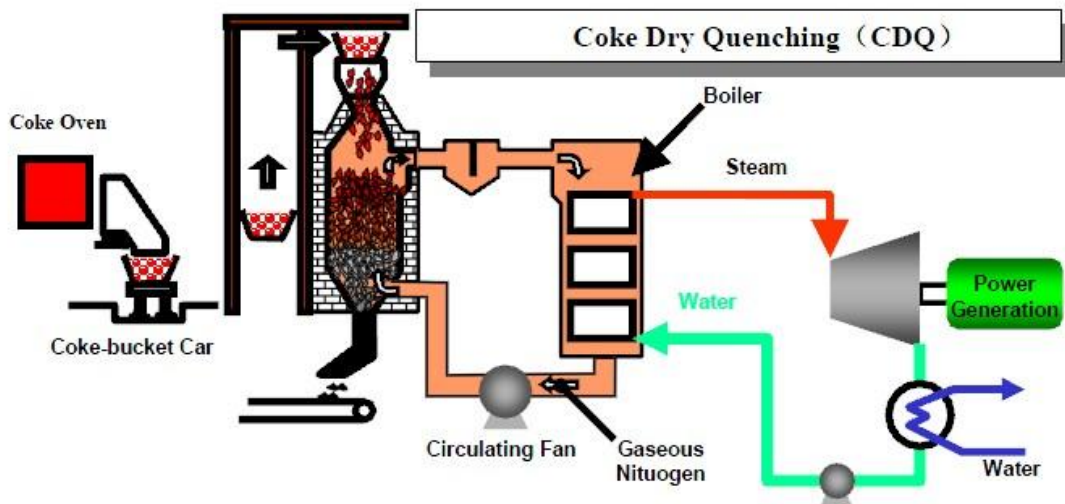


Figure 3: Coke Dry Quenching Process Flow Diagram

Prior to the implementation of the project activity, the electricity is supplied by the operation of grid-connected power plants and by the addition of new generation sources within the CCPG, and the waste heat produced in coke production would be released to atmosphere, which is the same as baseline scenario. The project will utilize the waste heat released into the atmosphere in the absence of the project activity to generate electricity. The expected annual electricity generation is 209,088MWh. The project will achieve average greenhouse gas (GHG) emission reductions of 153,428tCO₂e annually.

Major technical parameters of the key equipment employed by the project are illustrated in table 1.

Table 1 Major technical parameters of the key equipment of the project

Main Technical Data		The project
Waste Heat Boiler	Type	Q270/970-108.3-9.8/540
	Unit	1
	Capacity	108.3 t/h
	Operational Life	20
Steam Turbine	Model	Condensing
	Type	N30-8.83
	Unit	1
Generator	Type	QF ₂ W-30-2
	Unit	1
	Rated Capacity	30MW
	Operational Life	20

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
P.R. of China (host)	Neijiang Bowei Xinyu Chemical Industry Co., Ltd. (Project owner)	No
United Kingdom of Great Britain and Northern Ireland	Carbon Invcap International Trading Co., Ltd. (buyer)	No

A.5. Public funding of project activity

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There is no public funding from Appendix I Parties for this project.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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Approved consolidated baseline and monitoring methodology ACM0012 “*Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects*” (version 04.0.0) will be employed by the project.

The approved “*Tool for the Demonstration and Assessment of Additionality*” (version 07.0.0) was applied for the demonstration and Assessment of Additionality for the Project.

The approved “*Tool to calculate the emission factor for an electricity system*” (version 03.0.0) will also be employed for the calculation of emission factor.

The approved “*Tool to calculate baseline, project and/or leakage emissions from power consumption*” (Version 01) was applied for the calculation of project emissions.

The methodology and tools can be found from:

<http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

B.2. Applicability of methodology

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The project utilize the waste heat to generate electricity, and the project applies Approved consolidated baseline and monitoring methodology ACM0012 (version 04.0.0) approved by the CDM EB. The methodology ACM0012 (version 04.0.0) is applicable to the project activity as:

Table 2: the applicability of the methodology applied to the project activity

No.	Applicability	Explain
1	The consolidated methodology is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried in identified WECM stream(s) into useful energy. The WECM stream may be an energy source for: • Generation of electricity; • Cogeneration; • Direct use as process heat source; • Generation of heat in element process; • Generation of mechanical energy; or • Supply of heat of reaction with or without process heating.	The project will recover the waste heat from hot red coke for generation of electricity, so the project applies the consolidated methodology ACM0012 (version 04.0.0)
2	In the absence of the project activity, the WECM stream: (a) Would not be recovered and therefore would be flared, released to atmosphere, or remain unutilized in the absence of the project activity at the existing or Greenfield project facility; or (b) Would be partially recovered, and the unrecovered portion of WECM stream would be flared, vented or remained unutilised at the existing or Greenfield project facility.	In the absence of the project activity, all the waste heat carried in hot red coke would be released to atmosphere.

3	Project activities improving the WECM recovery may (i) capture and utilise a larger quantity of WECM stream as compared to the historical situation in existing facility, or capture and utilise a larger quantity of WECM stream as compared to a reference waste energy generating facility; and/or (ii) apply more energy efficient equipment to replace/modify/expand waste energy recovery equipment, or implement a more energy efficient equipment than the reference waste energy generating facility.	In the absence of the project activity, all the waste heat carried in hot red coke would be released to atmosphere.
4	The methodology is applicable under the following conditions: For project activities which recover waste pressure, the methodology is applicable where waste pressure is used to generate electricity only and the electricity generated from waste pressure is measurable;	The project only recovers the waste heat.
5	Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity;	No regulation requires that coking plant must recover and utilize waste energy prior to the implementation of the project activity.
6	The methodology is applicable to both Greenfield and existing waste energy generation facilities. If the production capacity of the project facility is expanded as a result of the project activity, the added production capacity must be treated as a Greenfield facility;	The project belongs to the project that recovers waste heat as energy, and the production capacity of the project facility is not expanded as a result of the project activity.
7	Waste energy that is released under abnormal operation (for example, emergencies, shut down) of the project facility shall not be included in the emission reduction calculations.	The project will not include the emission reduction from abnormal operation.
8	If multiple waste gas streams are available in the project facility and can be used interchangeably for various applications as part of the energy sources in the facility, the recovery of any waste gas stream, which would be totally or partially recovered in the absence of the project activity, shall not be reduced due to the implementation of CDM project activity. For such situations, the guidance provided in Annex 3 shall be followed.	There is no multiple waste gas streams involved in the project activity.
9	The methodology is not applicable to the cases where a WECM stream is partially recovered in the absence of the CDM project activity to supply the heat of reaction, and the recovery of this WECM stream is increased under the project activity to replace fossil fuels used for the purpose of supplying heat of reaction.	In the absence of the project activity, no waste heat from the hot red coke would be recovered.
10	This methodology is also not applicable to project activities where the waste gas/heat recovery project is implemented in a single-cycle power plant (e.g. gas turbine or diesel generator) to generate power. ³ However, the projects recovering waste energy from single cycle and/or combined cycle power plants for the purpose of generation of heat only can apply this methodology.	The project activity is a CDQ project, not implemented in single-cycle power plant.
11	The emission reduction credits can be claimed up to the end	1# and 2# coke oven would be out

	of the lifetime of the waste energy generation equipment. The remaining lifetime of the equipment should be determined using the latest version of the “Tool to determine the remaining lifetime of equipment”.	of commission in February 2037 and January 2038, which both cover the whole crediting period. The designed life was determined by Sichuan Metallurgical Design & Research Institute, which is in line with the requirements of “Tool to determine the remaining lifetime of equipment”.
12	The extent of use of waste energy from the waste energy generation facilities in the absence of the CDM project activity will be determined in accordance with the procedures provided in Annex 1 (for Greenfield project facilities) and in Annex 2 (for existing project facilities) to this methodology.	The project facilities belong to the existing facilities, so the extent of use of waste energy from the coke ovens in the absence of the CDM project activity is determined in accordance with the procedures provided in Annex 2 to methodology ACM0012 in section below.

So, the project meets all applicability conditions of the consolidated methodology ACM0012 (version 04.0.0).

Demonstration of use of waste energy in absence of CDM project activity:

According to the methodology ACM0012 version 4.0, the existing facilities means facilities where the commercial production has began at the time when the project activity is submitted for validation.

For the project, the No.1 and No.2 coke ovens are existing facilities. For the No.1 and 2 coke ovens, since the commercial operation starting date of No.1 and 2 is before the project activity is submitted for validation, it is applied for the assessment of extent of used of waste energy in the existing facility.

It shall be demonstrated that the waste energy utilized in the project activity was flared or released into the atmosphere or remained unutilised in the absence of the project activity at the existing or new facility by either one of the following methods. The DOE should supplement the analysis prescribed by following methods through the on-site checks prior to project implementation to confirm that no equipment for waste energy recovery and utilisation had been installed on the specific WECM stream (that is recovered under the project activity) prior to the implementation of the CDM project activity. In case the project activities improve the energy recovery from the already existing WECM stream(s), the DOE will make the on-site checks to confirm the above with respect to unrecovered energy.

- Providing an energy balance of the relevant sections of the facility to prove that the waste energy, that is recovered in project activity, was not a source of energy before the implementation of the project activity. For the energy balance applicable process parameters are required. The energy balance must demonstrate that the waste energy was not used and also provide conservative estimations of the amount of waste energy released.
- Energy bills (electricity, fossil fuel) to demonstrate that all the energy required for the process (e.g. based on specific energy consumption specified by the manufacturer) has been procured commercially. Project participants are required to demonstrate through the financial documents (e.g. balance sheets, profit and loss statement) that no energy was generated by waste energy and sold to other facilities and/or the grid. The bills and financial statements should be audited by competent authorities.
- Process plant manufacturer’s commissioning report from the facility could be used as an estimate of the quantity and energy content of the waste energy produced for the rated plant capacity/per unit of product produced.
- For the project activity, improving energy efficiency of existing waste heat recovery equipment, the demonstration of low energy recovery of WECM steam(s) should be done by estimating the energy efficiency of the electricity generation equipment and demonstrating the amount of captive electricity generated for at least *three years* prior

to the start of the project activity;

According to the FSR of the project, the CWQ system of the existing No.1 and 2 coke ovens are replaced by CDQ in the project. No.1 and No.2 would continue to apply CWQ for coke quenching in absence of the project, and the quenching waste heat produced by CWQ cannot be recovered and would be released to atmosphere.

The WECM is for steam production, so, the steam energy balance in the production area of Tranvic Group before the implementation of the project was provided to prove that the waste energy that is recovered in project activity was not a source of energy before the implementation of the project activity

Therefore, It is can be demonstrated that no waste energy recovery activities that were already implemented in other streams of WECM prior to the implementation of the project activity.

B.3. Project boundary

The geographical extent project boundary shall include the relevant WECM stream(s), equipment and energy distribution system in the following facilities:

- (1) The “project facility”;
- (2) The “recipient facility(ies)”, which may be the same as the “project facility”.

The spatial extent of the grid is as defined in the “Tool to calculate the emission factor for an electricity System”.

The relevant equipment and energy distribution system cover:

- In a project facility, the WECM stream(s), waste energy recovery and useful energy generation equipment, and distribution system(s) for useful project energy;
- In a recipient facility, the equipment which receive useful energy supplied by the project, and distribution system(s) for useful project energy.

The electricity generated by the project will displace electricity which would have been supplied by the operation of grid-connected power plants and by the addition of new generation sources within the CCPG, as per the latest guideline¹ issued by Chinese DNA on October 15, 2012; the CCPG is composed of Henan Power Grid, Hubei Power Grid, Hunan Power Grid, Jiangxi Power Grid, Sichuan Power Grid and Chongqing Power Grid. Therefore, the spatial extent of the project boundary also includes all the power plants physically connected into the CCPG.

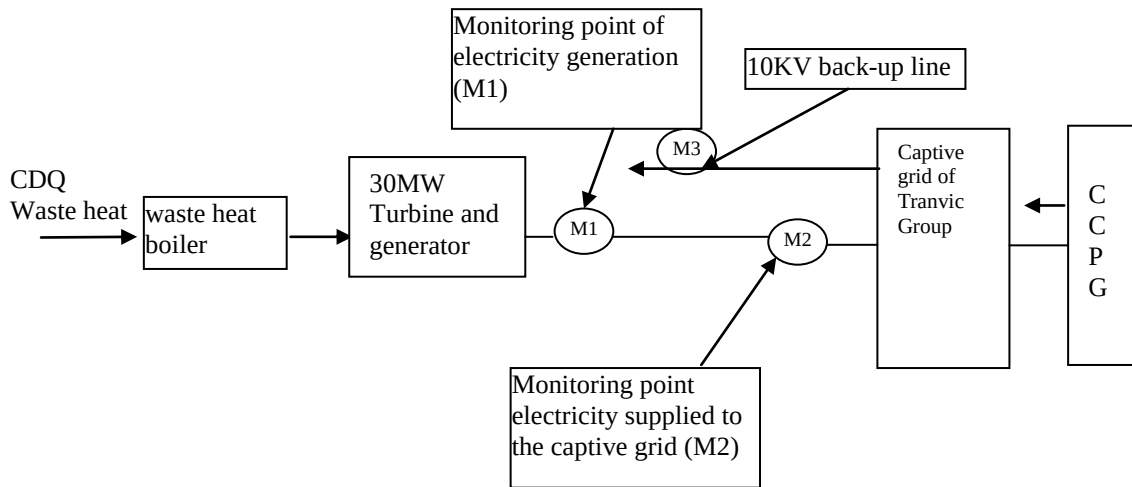
The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table 3.

Table 3: Emissions sources included in or excluded from 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 ₂ O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption in element process for thermal Energy	CO ₂	Excluded	Not applicable. The baseline of the project does not include the process of thermal energy.
		CH ₄	Excluded	Not applicable. The baseline of the project does not include the process of thermal energy.

¹ 2012 Baseline Emission Factors for Regional Power Grids in China, referring to <http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2975.pdf>

		N ₂ O	Excluded	Not applicable. The baseline of the project does not include the process of thermal energy.
	Fossil fuel consumption in cogeneration plant	CO ₂	Included	Not applicable. The baseline of the project does not include the cogeneration plant.
		CH ₄	Excluded	Not applicable. The baseline of the project does not include the cogeneration plant.
		N ₂ O	Excluded	Not applicable. The baseline of the project does not include the cogeneration plant.
	Generation of steam used in the flaring process, if any	CO ₂	Included	Not applicable. The baseline of the project does not include the flaring process.
		CH ₄	Excluded	Not applicable. The baseline of the project does not include the flaring process.
		N ₂ O	Excluded	Not applicable. The baseline of the project does not include the flaring process.
	Fossil fuel consumption for supply of process heat and/or reaction heat	CO ₂	Included	The project does not include process heat and/or reaction heat.
		CH ₄	Excluded	The project does not include process heat and/or reaction heat.
		N ₂ O	Excluded	The project does not include process heat and/or reaction heat.
Project activity	Supplemental fossil fuel consumption at the project plant	CO ₂	Excluded	There is no supplemental fossil fuel consumption at the project plant.
		CH ₄	Excluded	There is no supplemental fossil fuel consumption at the project plant.
		N ₂ O	Excluded	There is no supplemental fossil fuel consumption at the project plant.
	Supplemental electricity consumption	CO ₂	Included	Main emission source.
		CH ₄	Excluded	Excluded for simplification. This is conservative.
		N ₂ O	Excluded	Excluded for simplification. This is conservative.
	Electricity import to replace captive electricity, which was generated using waste energy in absence of project activity	CO ₂	Excluded	Not applicable.
		CH ₄	Excluded	Not applicable.
		N ₂ O	Excluded	Not applicable.
	Energy consumption for gas cleaning	CO ₂	Excluded	Cleaning of gas is not required in this case.
		CH ₄	Excluded	Cleaning of gas is not required in this case.
		N ₂ O	Excluded	Cleaning of gas is not required in this case.



* It is noted that the Project is sited with the production area of Tranvic Group, the Recipient facility. The electricity generated by the project was delivered to the captive grid of Tranvic Group, which covers the production area of Tranvic Group, including the Project. So, the electricity meters M1 M2 and M3 measure the electricity supplied to the recipient facility and from the project facility. So the electricity measurements satisfy the requirement of ACM0012.

meter	M1	M2	M3
Function	The meter of power generation	The meter of electricity supplied to the captive grid by the project	The meter of the 10KV backup line
Parameter monitored	$Q_{OE,y}$ $EG_{PJ,y}$	$EG_{PJ,y}$	$EG_{PJ,y}$
Accuracy	0.2S	0.5%	0.5%
Bi-direction	No	No	No
Location	outlet side of the generator	JH905 cabinet	JH906 cabinet

Figure 4 The flow diagram of the project boundary

B.4. Establishment and description of baseline scenario

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According to the methodology ACM0012 (version 04.0.0), the baseline scenario of the project 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 for each recipient facility if the project activity involves electricity generation for that recipient facility;

- Heat generation (process heat and/or heat of reaction) in the absence of the project activity for each recipient facility if the project activity involves generation of useful heat for that recipient facility;
- Mechanical energy generation in the absence of the project activity, for each recipient facility if the project activity involves generation of useful mechanical energy for that recipient facility.

The project does not involve thermal generation and mechanical energy, and therefore the alternatives of baseline scenarios “power generation in the absence of the project” and “waste heat energy use in the absence of the project activity” will be discussed below.

The project participant shall exclude baseline options that:

- Do not comply with legal and regulatory requirements; or
- Involve fuels (used for the generation of heat, power or mechanical energy), that are not produced or imported in the host country.

Step 1: Define the most plausible baseline scenario for the recovery of waste heat to generate of electricity using the following baseline options and combinations

Exclude the alternatives irrelevant with the recovery of waste heat from all of the alternatives in the methodology ACM0012 (version 04.0.0), and define the most plausible baseline scenario. The results and explanation are shown in table 4.

Table 4. The discussing process of defining the plausible baseline scenario

		Alternatives	Possible(?)	Reason/Explanation
waste heat	W1	WECM is directly vented to the atmosphere without incineration;	No	WECM for the Project can not be incinerated. The project involves no use of waste gas and waste pressure, and the waste heat utilized in the project would be released to the atmosphere. There are two ways to quench the coke, i.e. coke wet quenching (CWQ) and coke dry quenching (CDQ). Under the technology and finance environment of Chinese iron steel companies, if there is no external funding, traditional coke quenching method CWQ would be chosen for coke quenching system of coke ovens for its simple technology and low investment. For the common practice in China, almost all the coke ovens are constructed with CWQ first. Therefore, if the project was not constructed, the red-hot coke from the coke ovens has to be quenched by CWQ system, which used water to cool down the red-hot coke. As a result, the heat would be

Power Generation				released to the atmosphere directly, which is impossible to collect from the existing CWQ system. The baseline scenario option is in compliance with Chinese relevant laws and regulations. Therefore, for the project, the scenario W1 is a baseline alternative.
	W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released (or vented) to the atmosphere or waste pressure energy is not utilized;	Yes	In the absence of the project activity, waste heat is released (or vented) to the atmosphere.
	W3	Waste energy is sold as an energy source;	No	The waste energy in the hot red coke can not be sold as an energy source.
	W4	Waste energy is used for meeting energy demand at the recipient facility(ies);	Yes	In the absence of the project activity, all the waste heat in the hot red coke would be released to atmosphere. Therefore, this alternative is not applicable.
	W5	A portion of the quantity or energy of WECM is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/unutilised;	No	In the absence of the project activity, all the waste heat in the hot red coke would be released to atmosphere. Therefore, this alternative is not applicable.
	W6	All the waste energy produced at the facility is captured and used for export electricity generation or steam.	No	Alternative W6 is identical to W5.
	P1	Proposed project activity not undertaken as a CDM project activity;	Yes	The possibility of the project is still need to be in economic evaluation.
	P2	On-site or off-site existing fossil fuel fired cogeneration plant;	No	There is no “on-site or off site existing fossil fuel Cogeneration power plant” in Neijiang city where the project locates.
	P3	On-site or off-site Greenfield fossil fuel fired cogeneration plant;	No	According to Item 9 of Interim Provisions of Construction and Management of Cogeneration Project and Coal Gangue Utilization Project, Neijinag does not belong to the area where needs district heating due to the weather is very warm even if in winter ² . Therefore it is not possible to build coal fire cogeneration power plant in Neijiang.

² <http://baike.baidu.com/view/25208.htm>

	P4	On-site or off-site existing renewable energy based cogeneration plant;	No	There is no “On-site or off-site existing renewable energy based cogeneration plant” in Neijiang city ³ .
	P5	On-site or off-site Greenfield renewable energy based cogeneration plant;	No	Considering the possible use of renewable energy sources for congregation plant, such as biomass, solar PV and geothermal power for use in new congregation plant: • In case of biomass cogeneration plant, biomass energy can be used for electricity and heat cogeneration, but there is no enough biomass energy to construct a biomass energy cogeneration plant which could provide the equivalent annual power supplied⁴. • In the case of geothermal energy, geothermal energy can be used for electricity and heat cogeneration, but there are no enough geothermal energy to construct a geothermal energy cogeneration plant which could provide the equivalent annual power supplied⁵. • In the case of solar PV, solar PV can be used for electricity and heat cogeneration, but there is no enough solar energy to construct a solar energy cogeneration plant which could provide the equivalent annual power supplied⁶. Apart from these, the core business of the project owner is in the metallurgical industry, and not in constructing and operating renewable power supply. Therefore the scenario P5 is not feasible, and could not become the baseline scenario.
	P6	On-site or off-site existing fossil fuel based existing identified captive power plant;	No	There is no existing identified fossil fuel captive power generation capacity.

³ <http://money.163.com/09/0424/03/57KQIHBB00253B0H.html>

⁴ The characteristics and the comprehensive utilization proposal of the biomass in Wuhan City

⁵ Introduction of the Renewable Energy Power Generation, Lu Huayong, the report pointed that there are only five geothermal power plant in China, of which, the largest geothermal power plant is 25MW.

⁶ Introduction of the Renewable Energy Power Generation, Lu Huayong, the report pointed that the total installed capacity of solar PV power plant is 55MW.

	P7	On-site or off-site existing identified renewable energy or other waste energy based captive power plant;	No	There is no on-site existing identified renewable energy. Because the off-site power in Neijiang city must buy from the power company, the off-site existing identified renewable energy is not the baseline scenario option. There are on-site blast furnace gas captive power plants. But it only supplies partial captive electricity. The generation of the blast furnace gas captive power plant will not be affected at all even when the project is put into commission. Considering the possible use of renewable energy sources for power plant, such as biomass and geothermal power plant: • In the case of biomass power plants, which face some barriers such as high investment⁷, lacking of operating experience and low benefit, it is necessary to apply for CDM for retaining normal operation. • In the case of geothermal power plant, Neijiang is a city in inland area. There are not enough geothermal power resources⁸ that could provide the equivalent power generation of the project. In addition, geothermal power stations face barriers such as high investment, and it is necessary to apply for CDM for retaining normal operation. In the case of wind farms, there are not enough wind resources that could provide the equivalent power generation of this project, because the wind power potential in Sichuan Province is limited by poor wind resources⁹.
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⁷ <http://sd.people.com.cn/BIG5/166201/172830/12120973.html>

⁸ Introduction of the Renewable Energy Power Generation, Lu Huayong, the report pointed that there are only five geothermal power plant in China, of which, the largest geothermal power plant is 25MW.

⁹ Li ke, He Fanneng, Xi Jianchao. An Analysis of utilization potential distribution of wind power in Mainland China. 2010. <http://www.doc88.com/p-700929434925.html>

				• As for the water resources investigation, Neijiang is a city in inland area and is not able to provide sufficient water resource for a hydropower power plant. Therefore the electricity generated by water resources is not feasible¹⁰. • There is neither potential wave nor tidal energy in the project area because the project is located far from the sea, and solar PV is too expensive to generate equivalent annual output, and rarely employed for power generation in China.
	P8	On-site or off-site Greenfield fossil fuel based captive plant;	No	New power generation on-site with the same installed capacity as the Project activity, using coal, diesel or natural gas is not in line with Chinese regulations. According to Chinese power regulation, the construction of coal-fired power plant with a capacity of 135MW or below is prohibited in the coverage area of national grid ¹¹ .
	P9	On-site or off-site Greenfield renewable energy or other waste energy based captive plant	No	There is no plan for on-site or off-site Greenfield renewable energy or other waste energy based captive plant to displace the project.
	P10	Sourced from grid-connected power plants;	Yes	The baseline scenario option is in compliance with Chinese relevant laws and regulations, and does not have financial barriers. This scenario P10 is feasible baseline scenario.
	P11	Existing captive electricity generation using waste energy (if the project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency or lower recovery than the project activity).	No	Prior to the implementation of the Project, the waste energy for the hot red coke was not recovered.
	P12	Existing cogeneration using waste energy, but at a lower efficiency or lower recovery.	No	Prior to the implementation of the Project, the waste energy for the hot red coke was not recovered.

Conclusion of step 1:

¹⁰ <http://wenku.baidu.com/view/ca160d80e53a580216fcfe08.html>

¹¹ http://www.gov.cn/gongbao/content/2002/content_61480.htm

Therefore, the plausible alternative scenario of the project is as follows:

Waste heat	Power	Alternative baseline scenario
W2	P1	Proposed project activity is not undertaken as a CDM project activity;
	P10	Waste heat is directly vented to the atmosphere, and power is sourced from grid-connected power plants.

Step 2: Step 2 and/or Step 3 of the latest approved version of the Tool for the demonstration and assessment of additionality shall be used to identify the most plausible baseline scenarios by eliminating non-feasible options (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive).

a. Identify the fuel for the baseline choice of energy source

Power generation

The baseline scenario imports equivalent electricity from CCPG. Most of fuel in the fossil fuel fired plant of CCPG is coal, together with minor gas and oil. The fuels used are allowable in law and is available source for CCPG.

b. Investment analysis

By using step 2 of the latest *Tool for the demonstration and assessment of additionality* (version 07.0.0) approved by CDM EB, the credible baseline scenario was identified, and other impossible choice was excluded.

The intention of investment analysis in step 2 of the latest Tool for the demonstration and assessment of additionality is to determine whether the project activity is not economically or financially feasible, without the revenue from the sale of VERs. The economic analysis is implemented in Section B.5.

c. The baseline scenario of the project

There is one baseline scenario for the project. The combination of scenario W1 and P10 is the plausible alternative scenario to the project activity, that is, waste heat is released to the atmosphere and the electricity is obtained from the CCPG.

Project activity:			
Scenario	Waste heat	Power	Alternative baseline scenario
Baseline Scenario -1	W2	P10	Waste heat is directly vented to the atmosphere, and power is sourced from grid-connected power plants.

The baseline scenario of the project belongs to the baseline scenario-1 of separate generation of electricity, mechanical energy or heat in methodology ACM0012 (version 04.0.0).

STEP 3: If more than one credible and plausible alternative scenario remain, the alternative with the lowest

baseline emissions shall be considered as the most likely baseline scenario.

Not applicable. According to the analysis above, the combination W1 and P10 is the only credible and plausible alternative scenario.

B.5. Demonstration of additionality

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Evidences supporting the prior consideration for carbon revenue

The carbon revenue was a key factor in the investment decision making for the project. The project owner has seriously considered the CDM revenue, but due to the poor CER price, the project owner diverts to seek to obtain GS VER revenue. :

Table 5: Main events for construction and CDM development of the project

Milestone Date	Event	Document
05/2010	The FSR of the project was completed, which indicates that the project is not financially attractive without CDM revenue.	The FSR of the project
10/06/2010	The project was approved.	The project approval
17/06/2011	The EIA Form of the Project was approved.	The EIA approval
20/03/2012	The board of the project owner decided to invest the project with VER revenue.	The investment decision of Project with the VER revenue consideration by the Board meeting
01/06/2012	The EPC contract was signed.	The EPC contract for the project
29/04/2013	the project owner decided to develop the project as a GS VER project	The GS VER development resolution by the Board meeting
23/07/2013	the draft PDD and passport was first submitted to GS	the emails
29/07/2013	The invitation emails of Stakeholder feedback round meeting were sent	the emails
20/08/2013	Stakeholder feedback round meeting was held.	the photos and videos
20/08/2013	The on-site visiting of the validator was done after the SFR meeting	
20/01/2014	The documents of requesting registration were uploaded on to the GS registry.	the emails

Demonstration and assessment of additionality

Determine whether the Project is additional by using *Tool for the demonstration and assessment of additionality* version 07.0.0.

Step 0. Demonstration whether the proposed project activity is the first-of-its-kind;

Not applicable. The step can be skipped.

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

The objective of Step 1 is to define realistic and credible alternatives to the project activity that can be (part of) the baseline scenario through the following sub-steps:

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

According to the methodology of ACM0012 version 04.0.0, the baseline scenario of the project is defined, and the alternatives to the project are analyzed in Section B.4: *Define the most plausible baseline scenario for the recovery of waste heat to generate of electricity using the following baseline options and combinations*. In Section B.4, the credible alternative of the project would be:

Waste heat	Power	Alternative baseline scenario
W2	P1	Proposed project activity is not undertaken as a CDM project activity;
	P10	Waste heat is directly vented to the atmosphere, and power is sourced from grid-connected power plants.

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

The alternatives W2/P1 (Proposed project activity is not undertaken as a CDM project activity) are in compliance with Chinese relevant mandatory laws and regulations;

The alternatives W2/P10 (Waste heat is directly vented to the atmosphere, and power is sourced from grid-connected power plants) are in compliance with Chinese relevant mandatory laws and regulations.

Step 2. Investment Analysis

The objective of Step 1 is to determine whether the project is not economically or financially feasible, without the revenue from the sale of VERs.

To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

The *Tool for the demonstration and assessment of additionality* version 07.0.0 suggests three analysis methods: simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III). Because the electricity generated by the project displaces the equivalent electricity generation by the CCPG, which reduce the electricity purchase cost. Therefore, the simple cost analysis (Option I) is not appropriate. Investment comparison analysis (Option II) is only applicable to projects whose alternatives are similar investment projects. But the alternative baseline scenario of the project includes the provision of equivalent amount of annual electricity by the CCPG. So, Option I and Option II is not suitable for the project.

Therefore, benchmark analysis (Option III) is selected for the project in accordance with *Guidelines on the assessment of investment analysis* version 05 (annex 5, EB62).

Sub-step 2b. Benchmark Analysis Method (Option III)

The major business of Neijiang Bowei Xinyu Chemical Industry Co., Ltd. is coking production. According to *Economical Evaluation Methods and Parameters for Construction Projects* issued by National Development and Reform Commission and Ministry of Construction (version 3), the sectoral equity benchmark for the projects in the industry is 13.00% (after tax). The equity IRR of 13.00% as the benchmark is adopted by the project for the project equity IRR. On the basis of the above benchmark, the calculation and comparison of financial indicator(s) are carried out in sub-step 2c.

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

Basic parameters for the calculation of financial indicator of the project are shown in Table 6.

Table 6. Basic parameters for calculation of financial indicator

Parameter	Unit	value	Source of data
Installed capacity	MW	30	FSR
Annual net electricity supply	MWh	209,088	FSR
tariff	CNY/KWh	0.55	FSR
Project lifetime(including one year construction period)	Year	21	FSR
Static total investment	Million CNY	346.0088	FSR
Fluid capital	Million CNY	4.50	FSR
Ratio of equity to debt in total investment		40%:60%	FSR
Depreciation rate	%	6.33	FSR
Interest rate of long-term loan	%	5.94	FSR
Rate of VAT	%	17	FSR
Rate of water	%	13	FSR
Rate of income tax	%	25	FSR
City maintenance and construction tax rate	%	5	FSR
Surtax rate of education	%	4	FSR
Residual value rate of fixed asset	%	5	FSR
Depreciation period	Year	15	FSR

Based on the data above, without the revenue from VERs sales, the equity IRR is 6.23% (after tax) which is lower than the benchmark (13.00%) (after tax). The project is thus not financially attractive.

On the basis of an estimated CNY 60/tCO₂e with a renewable 10-year crediting period, revenue from VERs sales can enhance the project equity IRR to reach 13.33% (after tax). This is higher than the benchmark of 13.00%, which shows that revenue from VERs sales can significantly improve the financial indicators.

Table 7. Comparison of financial indicators

	Equity IRR		
	Without revenue from VERs sales	Benchmark	With revenue from VERs sales
The project	6.23%	13.00%	13.33%

Sub-step 2d. Sensitivity analysis

To further demonstrate whether the conclusion that project activity is not economic attractive if the key assumptions changes in a reasonable range is still valid, sensitivity analysis will be conducted.

(1) Justification of fluctuation range

As per the *Guidelines on the assessment of investment analysis* version 05 (annex 5, EB62), the sensitivity analysis should at least cover a range of +10% and -10%. So, the fluctuation range $\pm 10\%$ follows the guidance.

(2) Justification of parameter selection

As per *Guidelines on the assessment of investment analysis* version 05 (annex 5, EB62), only variables that constitute more than 20% of either total project costs or total project revenues should be subjected to sensitivity analysis. For the project, the following four financial parameters were taken for sensitive analysis of financial attractiveness:

- ♦ Static total investment
- ♦ Annual operation costs
- ♦ Annual net electricity supply
- ♦ Tariff

Sensitivity analysis of the financial indicators of the project is shown in table 9.

Table 8. Sensitivity analysis of the financial indicators of the project
(Equity IRR without VER sales revenues)

Range Parameter	-10%	-5%	0	+5%	+10%
benchmark	13.00%	13.00%	13.00%	13.00%	13.00%
Static total investment (%)	8.89%	7.57%	6.23%	4.77%	3.30%
Annual operation costs (%)	10.81%	8.26%	6.23%	3.92%	1.45%
Annual net electricity supply (%)	-0.45%	3.00%	6.23%	9.00%	11.64%
Tariff (%)	-0.83%	2.80%	6.23%	9.16%	11.95%

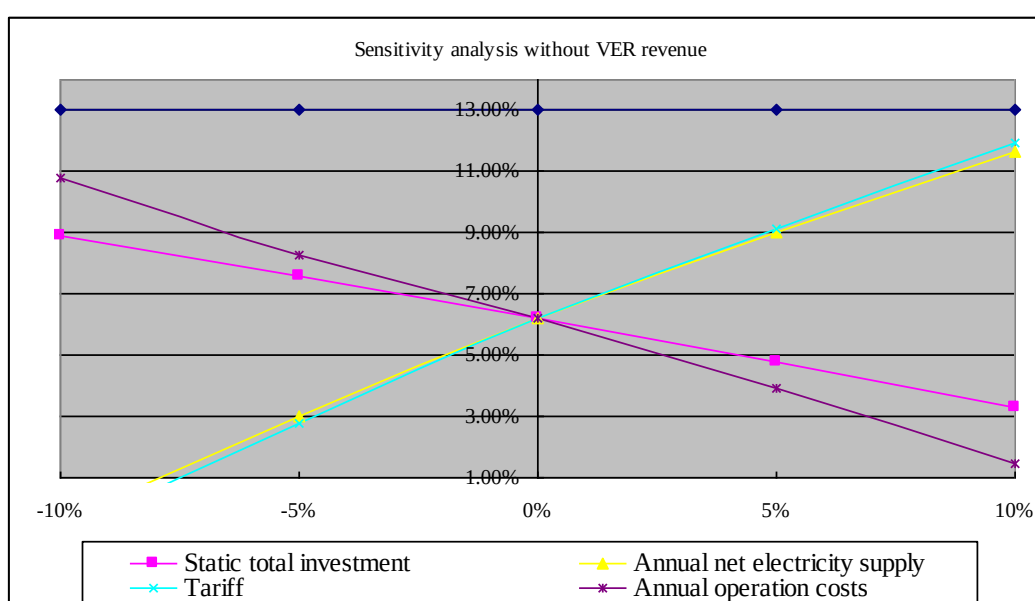


Figure 5. Sensitivity analysis of the financial indicators of the Project
(Without VER sales revenues)

Critical value analysis

If the static total investment of the project decreases by 25.28%, the equity IRR would reach 13.00%. As per *China statistical yearbook 2012* issued by the National Bureau of Statistics of China, the average Price Index for Investment in Fixed Assets (PII) from 2006 to 2011 is 103.62¹², which means the Investment price in Fixed Assets keeps growing these years. So, it is nearly impossible that the static total investment of the project decreases by 25.28%.

If the quantity of annual net electricity supply of the project increases by 12.63%, the equity IRR could reach 13.00%. However, a large variation of annual net electricity supply is almost impossible. As per the FSR, the calculation of the electricity is based on the data of the heat that recovered and the efficiency of the whole power system. The annual operation hour of the project is up to 7920h. If the quantity of annual net electricity supply increases by 12.63%, the operation hour would reach 8920h, that is, the PLF of the project will be over 100%, which is impossible for a power generation project. Therefore, it is not credible to assume that annual net electricity supply from the project would be increased by 12.63% or more over the lifetime of the project, which would make the equity IRR reach the benchmark of 13.00%.

As for the tariff, when it increases by 11.92%, i.e., CNY 0.6156/kWh, the equity IRR can reach 13.00%. The tariff that applies in the PDD, 0.55 CNY/kWh, was from the FSR of the Project.

As per “Notice on the tariff adjustment in Central China Power Grid” (document no. NDRC price [2009]2925) issued by NDRC (which is effective since 20/11/2009 and is most recent available sales prices for Sichuan Province of CCPG that is regulated by NDRC when preparing the FSR of the Project), the industrial purchasing price of electricity for large industry company, such as Tranvic Group, is 0.5263 RMB/kWh (including VAT).
http://www.ndrc.gov.cn/zfwz/zfdj/jggg/dian/200911/t20091120_314531.html

As per “Notice on the tariff adjustment in Central China Power Grid” (document no. NDRC price [2011]2623) issued by NDRC (which is effective since 01/12/2011 and is most recent available sales prices for Sichuan Province of CCPG that is regulated by NDRC before the start of the Project), the industrial purchasing price of electricity for large industry company, such as Tranvic Group, is 0.5595 RMB/kWh (including VAT).

http://www.ndrc.gov.cn/zfwz/zfdj/jggg/dian/201112/t20111201_448627.html

[http://wenku.baidu.com/link?url=L4wNyarfeYOC05hzn3CqnpL-](http://wenku.baidu.com/link?url=L4wNyarfeYOC05hzn3CqnpL-0t8383sxFdIvyIZilnskb_P1TxAboreinljHg3Qdp98SqgnWl3QSoNoCJyBbXUL8BvGezqEvNVnKmo8F5_)

[0t8383sxFdIvyIZilnskb_P1TxAboreinljHg3Qdp98SqgnWl3QSoNoCJyBbXUL8BvGezqEvNVnKmo8F5_](http://wenku.baidu.com/link?url=L4wNyarfeYOC05hzn3CqnpL-0t8383sxFdIvyIZilnskb_P1TxAboreinljHg3Qdp98SqgnWl3QSoNoCJyBbXUL8BvGezqEvNVnKmo8F5_)

Up to now, the industrial purchasing price of electricity for large industry company, such as Tranvic Group is 0.5595 RMB/kWh (including VAT), referring to

<http://www.deyang.gov.cn/xxgk/PublicView.asp?newsid=758687>

As per Guidance 6 of “Guidelines on the assessment of investment analysis” Version 05 (Annex 5, EB62):

Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant.

The tariff in the FSR was determined considering the future tariff increase, it is valid and applicable at the time of the investment decision.

¹² Section 9-1 of *China statistical yearbook 2012*. The PII for preceding year is considered as 100.

Thus, it is not credible to assume that the tariff of the project would be increased 11.92%, which would make the equity IRR reach the benchmark of 13.00%.

If the annual operation cost decreases by 17.45%, the equity IRR can only reach 13%. The annual operation cost mainly includes maintenance costs, insurance costs, material costs, salary and welfare, and miscellaneous costs. According to *China statistical yearbook 2012* issued by China Statistics Bureau¹³, the average annual growth rate for the employee salary indexes from 2007-2011 is 119.8, while the average annual growth rate for purchase price indexes of industrial producer from 2007-2011 is 104.9, which means there is a increasing tendency for the employee salary and the material price, thus, it is nearly impossible for the operating costs decreasing by 17.45%.

In conclusion, the project is not financially feasible without the revenue of VERs sales and thus is additional.

Outcome of step 2: The additionality of the project is robust and reliable.

Step 3 Barrier analysis

Barrier analysis is not employed for the project, for Step 2 has fully demonstrated the project's additionality.

Step 4 Common practice analysis

Sub-step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The project has an installed capacity of 30MW, therefore the range of capacity between 15MW and 45MW is chosen.

Sub-step 2: Identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

- (a) The projects are located in the applicable geographical area;
- (b) The projects apply the same measure as the proposed project activity;
- (c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
- (d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
- (e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
- (f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the project activity.

For (a), Sichuan Province is selected as the applicable geographical area for the common practice analysis. The reasons are detailed below:

·The investment environment for each province in China is different¹⁴. This is due to a variation of available the economic development level, the industrial structure, the fundamental infrastructure, development strategy and the policy framework, these all affect the final investment decision.

·Many other important economic factors vary from province to province. These include the cost of electricity

¹³ The average annual growth rate for the employee salary indexes is from Section 4-10 of *China statistical yearbook 2012*. The employee salary indexes from 2007-2011 respectively are 121.5, 119.7, 114.2, 117.3 and 126.8. The average annual growth rate for purchase price indexes of industrial producer is from section 9-1 *China statistical yearbook 2012*. The average annual growth rate for purchase price indexes of industrial producer from 2007-2011 is 104.4, 110.5, 92.1, 109.6 and 109.1. The PII for preceding year is considered as 100.

¹⁴ <http://www.shihang.org/zh/news/2006/11/11/chinese-cities-vary-widely-local-government-effectiveness-investment-climate-quality-life>.

purchase and other utilities such as water, the cost of labour and services and the types of loan that can be obtained.

For (b), the project belongs to (b), Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies (example: energy efficiency improvements, power generation based on renewable energy);

For (c), only those projects that use waste heat as energy can be considered.

For (d), only those projects that generate power can be considered.

For (e), the range of capacity between 15MW and 45MW is chosen.

For (f), the most recent available data/information source up to now is Compilation of Statistics of the Electric Power Industry of 2011 that issued by China Electricity Council in 07/2012, which provide the information of commercial operation plant at the end of 2011. The information of commissioned projects between 01/2012-06/2012 was not accessible and thus was excluded from the analysis as per “Tool for the demonstration and assessment of additionality”.

Therefore, the similar projects that satisfied the above conditions are the waste heat recovery projects for power generation (both CDM and non-CDM) between 15MW to 45MW with commercial operation date before the start date of the project.

No similar projects can be found according to the information of Compilation of Statistics of the Electric Power Industry of 2011.

Sub-step 3: Within the projects identified in Step 2, identify those that are neither registered CDM projects activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all} .

There are no similar projects that operate before the start date of the project, therefore, $N_{all} = 0$.

Sub-step 4: Within the similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity, Note their number N_{diff} .

Because $N_{all} = 0$, therefore, $N_{diff} = 0$.

Sub-step 5: Calculate factor $F = 1 - N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure /technology similar to the measure/ technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

The proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all} - N_{diff}$ is greater than 3.

As shown in step 4, $N_{diff} = N_{all}$, therefore: $F = 1 - N_{diff}/N_{all} = 1 - 1 = 0 < 0.2$, and $N_{all} - N_{diff} = 0 < 3$.

According to the “Tool for the Demonstration and Assessment of Additionality” (version 07.0.0), if the factor F is greater than 0.2 and $N_{all} - N_{diff}$ is greater than 3, then the proposed project activity is a “common practice”.

Conclusion: Through analysis of all steps of the latest *Tool for the demonstration and assessment of additionality* version 07.0.0, the project is not a baseline scenario, so the project activity fully meets the requirement of additionality.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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This section includes the following parts:

- Calculate the baseline GHG emissions;
- Calculate the project GHG emissions;
- Calculate the project leakage;
- Calculate the emission reductions.

I. Calculate the baseline GHG emissions

In accordance with the methodology ACM0012 (04.0.0), the baseline emissions are calculated with formulas below.

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

Where:

BE_y The total baseline emissions during the year y in tCO₂

$BE_{En,y}$ The baseline emissions from energy generated by the project activity during the year y in tCO₂

$BE_{flst,y}$ 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 (tCO₂e per year). As the project only involves the utilization of waste heat, hence, $BE_{flst,y} = 0$.

Therefore, $BE_y = BE_{En,y}$. (2)

As methodology ACM0012 (version 04.0.0) “Scenario-1” has been selected as the project’s baseline scenario,

$BE_{En,y}$ can be calculated by the following formula:

$$BE_{En,y} = BE_{Elec,y} + BE_{Ther,y} \quad (3)$$

Where:

$BE_{Elec,y}$ Baseline emissions from electricity power during the year y (in tCO₂).

$BE_{Ther,y}$ Baseline emissions from thermal energy (due to heat generation by elemental process) during the year y (in tCO₂).

As the Project utilizes waste heat for electricity power generation only, no thermal supply involved in the project,

$BE_{Ther,y} = 0$.

1.1 Baseline emissions from electricity (AER_y) generation

$$BE_{Elec,y} = f_{cap} \times f_{wcm} \times \sum_j \sum_i (EG_{i,j,y} \times EF_{Elec,i,j,y}) \quad (4)$$

Where:

$BE_{Elec,y}$ Baseline emissions due to displacement of electricity during the year y (tCO₂)

$EG_{i,j,y}$ The quantity of electricity supplied to the recipient j by generator, which in the absence of the project activity would have been sourced from source i (the grid or an identified source) during the year y in MWh

$EF_{Elec,i,j,y}$ The CO₂ emission factor for the electricity source i (is for the grid, and is for an identified source), displaced due to the project activity, during the year y (tCO₂/MWh)

f_{wcm} Fraction of total electricity generated by the project activity using waste energy. This fraction is 1 if the electricity generation is purely from use of waste energy.

f_{cap} Factor that determines the energy that would have been produced in project year y using waste energy generated at a historical level, expressed as a fraction of the total energy produced using waste source in year y . The ratio is 1 if the waste energy generated in project year y is the same or less than that generated at a historical level.

Since the electricity supply of identified baseline scenario come from CCPG, and the project only involves the utilization of waste heat, hence, formula (4) changes to:

$$BE_{Elec,y} = f_{cap} \times f_{wcm} \times EG_{PJ,y} \times EF_{grid,CM,y} \quad (5)$$

Where:

$EG_{PJ,y}$ Quantity of net electricity supply for captive use as a result of the implementation of the project activity in year y (MWh);

$EF_{grid,CM,y}$ Combined Margin CO₂ emission factor in year y in CCPG (tCO₂/MWh);

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, 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 project activity we apply the "Case-1" approach as the project involves the capture of waste heat in waste heat recovery equipment (boilers) that converts the energy into electricity. 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:

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} \quad (6)$$

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. For the project activity, total electricity that can be theoretically generated by the project is applied for this parameter. It is estimated based on specifications of the equipments and coke production lines.

$Q_{OE,y}$ is the quantity of actual output/intermediary energy during the year y (in appropriate unit). For the project activity, the actual total electricity generated by the project during year y is applied for this parameter.

Heat conversion of the WHR boilers

Based on design specification of the waste heat boilers in the project, the heat converted by the boilers is determined as below:

Item	Unit	Data
Volume of the inert gas N ₂ (V)	Nm ³ /h	240000
Inlet inert gas N ₂ temperature (T in)	°C	970
Outlet flue gas temperature (T out)	°C	180
Specific heat of N ₂ under 970°C (c)	kJ/m ³ °C	1.29884
Specific heat of N ₂ under 180°C (c) *	kJ/m ³ °C	1.38804
Heat conversion (E)	kJ/h	2.67025824 × 10 ⁸

Note: The heat conversion is calculated as: $E = V \times (T_{in} \times c_1 - T_{out} \times c_2)$

* The formula and the specific heat of flue gas please refer to Calculation method and utilization guides for waste heat resource's quantity of industrial boiler's and flame heating furnace's exhaust gas (GB/T 17719-2009).

Total available waste energy is the only energy used for the boilers to produce steam, but not all available waste energy can be recovered by waste heat utilization technologies, as part of the waste energy will be released into the

atmosphere because of the leakage and heat emission before the flue gas entering into the WHR boilers, and part of the waste energy will not be utilized and still released into the atmosphere.

Detailed determination of the theoretical maximum electrical output

For determining the $Q_{OE,BL}$, the power generation efficiency η is assumed to be 43.30%¹⁵.

Therefore, the calculation of $Q_{OE,BL}$ is further presented below:

$$Q_{OE,BL} = \frac{\sum E \times \eta}{3600} \times t$$

$$= 2.67025824 \times 10^8 \times 43.30\% \div 3600 \times 7920 = 254368799.9 \text{ kWh}$$

According to above calculation of $Q_{OE,BL}$ that was calculated based on designed specification of the coking production lines and waste heat recovery boilers, the theoretical annual final output energy produced for the project is 254368799.9 kWh,

The designed operation hour is 7920, so, the power generation of the Project is $30 \times 7920 = 237600 \text{ MWh}$.

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} = 254368799.9 / 237600000 = 1.07$$

As per the methodology, set $f_{cap} = 1$ in the PDD.

As per the methodology ACM0012 version 04.0.0, *Tool to calculate the emission factor for an electricity system* Version 03.0.0 is applied to calculate the baseline emission factor.

According to the methodological tool, the baseline emission factor is calculated in the following six steps:

STEP 1. Identify the relevant electricity system

The electricity generated by the Project will be supplied to the CCPG, in the absence of the project activity, the installed capacity of the CCPG for both the existing power plants and the power plants to be built in a foreseeable future would supply electricity comparable to that supplied by the Project. As per *2012 Baseline Emission Factors for Regional Power Grids in China* published by China DNA on October 15, 2012, the CCPG includes provincial grid spatial extent of Henan Power Grid, Hubei Power Grid, Hunan Power Grid, Jiangxi Power Grid, Sichuan Power Grid and Chongqing Power Grid.

The CCPG has imported electricity from the Northwest Power Grid (NWPG) and the North China Power Grid (NCPG), as per *Tool to calculate the emission factor for an electricity system* (Version 03.0.0), the option (c) The simple operating margin (OM) emission rate of the exporting grid, determined as described in step 4 (a) below was selected to determine the CO₂ emission factor for net electricity imports ($EF_{grid,import,y}$) from the NWPG and the NCPG.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional)

¹⁵ The power generation cycle efficiency is $\eta = \eta_{gd} \times (1 - \lambda) \times \eta_t \times \eta_{oi} \times \eta_j \times \eta_d = 99\% \times (1 - 1\%) \times 50\% \times 92\% \times 98\% \times 98\% = 43.30\%$, of which the η_{gd} is pipeline efficiency, λ is boiler heat radiation loss, η_t is Rankine Cycle efficiency, η_{oi} is turbine thermal efficiency, η_j is turbine mechanical efficiency, and η_d is generator efficiency, and the data are from the FSR.

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

The Option I was selected for the Project.

STEP 3. Select a method to determine the operating margin (OM)

The *Tool to calculate the emission factor for an electricity system* (Version 03.0.0) offers four options for the calculation of the Operating Margin emission factor(s) ($EF_{grid,OM,y}$). Low-cost/must run resources¹⁶ constitute of total amount of grid generating output from 2006 to 2010 is 28.44%, 28.81%, 32.87%, 30.72% and 29.99% respectively, which is less than 50% of the total electricity generation in the generating resources in the CCPG, referred to *2012 Baseline Emission Factors for Regional Power Grids in China*, Method (a) Simple OM was selected.

According to the methodological tool, following data vintages was selected:

Ex ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

STEP 4. Calculate the operating margin emission factor according to the selected method

The simple OM emission factor($EF_{grid,OMsimple,y}$) is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the CCPG, not including low-cost/must-run power/units. The *Tool to calculate the emission factor for an electricity system* (Version 03.0.0) offers two options for the calculating of the Simple OM.

^a Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit¹⁷, or

^b Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the Project electricity system.

Option B can only be used if:

- (a) The necessary data for Option A is not available; and
- (b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known;
- (c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

Option A should be preferred and must be used if fuel consumption data is available for each power plant/unit. As the fuel consumption data for each power plant/unit is not available in China, Option A is not reasonable. While total net electricity generation of all power plants serving the CCPG and the fuel types and total fuel consumption of the CCPG are available from *China Electric Power Yearbook* and *China Energy Statistical Yearbook*, and satisfy that

¹⁶ Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

¹⁷ Power units should be considered if some of the power units at the site of the power plant are low-cost/must-run units and some are not. Power plants can be considered if all power units at the site of the power plant belong to the group of low-cost/must-run units or if all power units at the site of the power plant do not belong to the group of low-cost/must-run units.

- (b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
- (c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

So, the Project uses Option B for calculating the simple OM emission factor as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y} \quad (7)$$

Where:

$EF_{grid,OMsimple,y}$ Simple operating margin CO₂ emission factor in year y (tCO₂/MWh);

$FC_{i,y}$ Amount of fossil fuel type i consumed in the CCPG in year y (mass or volume unit);

$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit);

$EF_{CO2,i,y}$ CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ);

EG_y Net electricity generated and delivered to the grid by all power sources serving the CCPG, not including low-cost/must-run power plants/units, in year y (MWh);

i All fossil fuel types combusted in power sources in the CCPG in year y;

y The relevant year as per the data vintage chosen in Step 3, for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) .

$$EG_y = GEN_y \times (1 - AER_y) \quad (8)$$

Where:

GEN_y Electricity generated by all power sources serving the CCPG, not including low-cost/must-run power plants/units, in year y (MWh);

AER_y The average auxiliary electricity consumption rate(%) of all power sources serving the CCPG, not including low-cost/must-run power plants/units, in year y.

Referred to *2012 Baseline Emission Factors for Regional Power Grids in China*, the simple operating margin CO₂ emission factor ($EF_{grid,OMsimple,y}$) of the CCPG is 0.9944tCO₂/MWh (see Appendix 4 for details).

STEP 5. Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants choose Option 1:

Option 1: For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

The sample group of power units used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

- (a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);
- (b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET \geq 20\%}$, in MWh);
- (c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case, ignore steps (d), (e) and (f).

However, under the current circumstances in China, the power plants consider the Build Margin data as important business data and will not have them published. Therefore, it is difficult to obtain the data of five power plants that have been put into operation most recently or the newly built power plant capacity additions in the electricity system that comprise 20% of the system generation. In allusion to the situation, the CDM EB accepts the following deviation in the application of the methodology¹⁸.

- 1) Use of capacity additions during the last 1~3 years for estimating the Build Margin emission factor for grid electricity.
- 2) Use of weights estimated using installed capacity in place of annual electricity generation, being approximately conservative.

And it is suggested to use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

The build margin emissions factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (9)$$

Where:

$EF_{grid,BM,y}$ Build margin CO₂ emission factor in year y (tCO₂/MWh);

$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh);

$EF_{EL,m,y}$ CO₂ emission factor of power unit m in year y (tCO₂/MWh);

m Power units included in the build margin;

y Most recent historical year for which power generation data is available.

As per the methodology deviation approved by EB, China DNA published the BM calculation method as follow:

¹⁸ Request for clarification on use of approved methodology AM0005 for several projects in China.

<http://cdm.unfccc.int/Projects/Deviations/>

Because current statistics data can't separate installed capacity of coal, oil and gas fueled power generation, the method adopted for BM calculation as follow:

firstly make use of the latest energy balance data to calculate all sorts of emission scale in total emission from coal, oil and gas fueled power generation; then based on the emission factor under the business best technology, calculated the fueled power emission factor of the grid; last multiply the fuelled power emission factor and fuelled power proportion of the total power, it's the BM of the grid.

Detailed step and formula as follow:

Sub-step 1. Calculation of the share of CO₂ emissions from solid, liquid and gaseous fuels

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (10)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (11)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (12)$$

Where:

$F_{i,j,y}$ The consumption of fuel i in province j in year y (mass or volume unit);

$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type i in year y (GJ/t for solid and liquid, GJ/m³ for gas);

$EF_{CO_2,i,y}$ CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ);

Coal, Oil and Gas is the foot-index for solid fuels, liquid fuels and gas fuels.

Sub-step 2. Calculation of the emission factor of thermal power

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (13)$$

$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are emission factors of the best efficiency commercial available coal-fired, oil-fired and gas-fired generation technologies.

Sub-step 3. Calculation of the BM in the Grid

$$EF_{grid,BM,y} = \frac{\Delta CAP_{Thermal}}{\Delta CAP_{Total}} \times EF_{Thermal,y} = \frac{CAP_{Thermal,y} - CAP_{Thermal,y-N}}{CAP_{Total,y} - CAP_{Total,y-N}} \times EF_{Thermal,y} \quad (14)$$

$CAP_{Total,y}$ is the total installed capacity in the CCPG in year y , $CAP_{Thermal,y}$ is the total installed capacity of thermal power in the CCPG in year y . N is the shortest vintage that the added installed capacity nearest to 20% of total installed capacity in the CCPG.

Based on 2012 *Baseline Emission Factors for Regional Power Grids in China* published by China DNA, the Build Margin Emission Factor ($EF_{grid,BM,y}$) of the CCPG could be obtained to be 0.4733tCO₂/MWh. (see Appendix 4 for details)

STEP 6. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated based on weighted average, the combined margin emissions factor as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \quad (15)$$

Where:

$EF_{grid,CM,y}$ Combined margin CO₂ emission factor in year y (tCO₂/MWh);

W_{OM} Weighting of operating margin emissions factor;

W_{BM} Weighting of build margin emissions factor.

According to the methodological tool, W_{OM} and W_{BM} are by default 0.5 and 0.5 respectively in the first crediting period. Therefore the combined baseline emission factor:

$$EF_{grid,CM,y} = 0.9944 \times 0.5 + 0.4733 \times 0.5 = 0.7338 \text{ tCO}_2/\text{MWh}$$

II Calculate the project GHG emissions

Project Emissions include emissions due to (1) combustion of auxiliary fuel to supplement waste gas/heat and (2) electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of energy or other supplementary electricity consumption.

$$PE_y = PE_{AF,y} + PE_{EL,y} \quad (16)$$

Where:

PE_y Project emissions due to the project activity (tCO₂)

$PE_{AF,y}$ Project activity emissions from on-site consumption of fossil fuels by the unit process(es) and/or co-generation plant(s) if they are used as supplementary fuels due to non-availability of waste energy to the project activity or due to any other reason (tCO₂). For the project, $PE_{AF,y} = 0$

$PE_{EL,y}$ Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption (tCO₂).

According to *Tool to calculate baseline, project and/or leakage emissions from power consumption* Version 01, the project emission from power consumption is the following:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

$PE_{EC,y}$ is the project emissions from consumption of power in gas cleaning equipment of project activity or other supplementary project power consumption (t CO₂/yr)

$EC_{PJ,j,y}$ is the additional power consumed in year y as a result of the implementation of the project activity source j (MWh)

$EF_{EL,j,y}$	Emission factor for power generation for source j in year y (tCO_2/MWh), in this case it is grid emission factor of Central China Grid.
$TDL_{j,y}$	Average technical transmission and distribution losses for providing power to source j in year y . A default value of 20% has been adopted.

For the project, the default value of $EC_{PJ,j,y}$ is 0, so, $PE_{EC,y} = 0$

Therefore, $PE_y = 0$.

III. Calculate Leakage GHG emissions

As per the methodology ACM0012 (version 04.0.0), no leakage needs to be considered in the project, $LE_y = 0 tCO_2e$.

IV. Calculate the emission reductions

The emission reduction (ER_y) during a given year y is calculated as follows:

$$ER_y = BE_y - PE_y \quad (17)$$

Where:

ER_y Total emissions reductions during the year y in tons of CO_2 ;

BE_y Emissions from the project activity during the year y in tons of CO_2 ;

PE_y Baseline emissions for the project activity during the year y in tons of CO_2 .

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$FC_{i,y}$
Unit	mass or volume unit
Description	Amount of fossil fuel type i consumed in the CCPG in year y .
Source of data	<i>China energy statistical yearbooks, 2009-2011</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China energy statistical yearbook</i> , satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

Data / Parameter	$NCV_{i,y}$
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type i in year y .
Source of data	<i>China energy statistical yearbook, 2009-2011</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China energy statistical yearbook</i> , satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO_2,i,y}$
Unit	tCO ₂ /GJ
Description	CO ₂ emission factor of fossil fuel type i in year y .
Source of data	<i>2006 IPCC guidelines on national GHG inventories, Volume 2 Energy, Chapter 1, table 1.3-table 1.4</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	Regional or national average default values are unavailable, so IPCC default values at the lower limit of the uncertainty at a 95% confidence interval are used, satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	GEN_y
Unit	MWh
Description	Electricity generated by all power sources serving the CCPG, the NCPG and the NWPG, not including low-cost/must-run power plants/units in year y .
Source of data	<i>China electric power yearbook, 2009-2011</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China electric power yearbook</i> , satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

Data / Parameter	AER_y
Unit	%
Description	Auxiliary electricity consumption rate of all power sources serving the CCPG, the NCPG, and the NWPG.

Source of data	<i>China electric power yearbook, 2009-2011</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China electric power yearbook</i> , satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

Data / Parameter	$Eff_{Coal,Adv,y}$
Unit	%
Description	Electricity supply efficiency of the most efficient, commercially available coal-fired generation technology.
Source of data	<i>2012 baseline emission factors for regional power grids in China</i> published by China DNA
Value(s) applied	39.65
Choice of data or Measurement methods and procedures	The data obtained from the China DNA, satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$Eff_{Oil,Adv,y}$
Unit	%
Description	Electricity supply efficiency of the most efficient, commercially available oil-fired generation technology.
Source of data	<i>2012 baseline emission factors for regional power grids in China</i> published by China DNA
Value(s) applied	51.93
Choice of data or Measurement methods and procedures	The data obtained from the China DNA, satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$Eff_{Gas,Adv,y}$
Unit	%
Description	Electricity supply efficiency of the most efficient, commercially available gas-fired generation technology.

Source of data	2012 baseline emission factors for regional power grids in China published by China DNA
Value(s) applied	51.93
Choice of data or Measurement methods and procedures	The data obtained from the China DNA, satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$CAP_{Total,y}$
Unit	MW
Description	Total installed capacity in the CCPG in year y
Source of data	<i>China electric power yearbook, 2009-2011</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China electric power yearbook</i> , satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	For calculating the added capacity comprised 20% of the CCPG.

Data / Parameter	$CAP_{Thermal,y}$
Unit	MW
Description	Total installed capacity of thermal power in the CCPG in year y
Source of data	<i>China electric power yearbook, 2009-2011</i>
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China electric power yearbook</i> , satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system version 03.0.0</i> .
Purpose of data	Calculation of baseline emissions
Additional comment	For calculating the added capacity comprised 20% of the CCPG.

Data / Parameter	f_{wcm}
Unit	
Description	Fraction of total energy generated by the project activity using waste gas
Source of data	The FSR of the project
Value(s) applied	1
Choice of data or	The methodology ACM0012 (version 04.0.0) prescribes that this fraction is 1 if the electricity generation is purely from use of the waste energy resource (i.e.

Measurement methods and procedures	waste heat).
Purpose of data	
Additional comment	-

Data / Parameter	f_{cap}
Unit	Fraction
Description	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.
Source of data	<i>Calculated in accordance with Method-3, Case-1 as described in the ACM0012 methodology.</i>
Value(s) applied	1
Choice of data or Measurement methods and procedures	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 waste heat when the coking production line is operated under normal load factors and projected power output.
Purpose of data	See section B.6.1 for details on the calculation method. 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 current baseline conditions.
Additional comment	

Data / Parameter	$Q_{OE, BL}$
Unit	MWh
Description	Output/intermediate energy that can be theoretically produced, to be determined on the basis of maximum recoverable energy from the WECM, which would have been wasted in the absence of the project.
Source of data	<i>The FSR of the Project</i>
Value(s) applied	254368.7999
Choice of data or Measurement methods and procedures	The value was calculated by applying Method 3, Case-1 of methodology ACM0012 (version 04.0.0).
Purpose of data	-
Additional comment	

B.6.3. Ex ante calculation of emission reductions

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I. Calculate the project GHG emissions

The project is waste heat recovery project, and the project emissions should not be considered as B6.1, $PE_y = 0 \text{ tCO}_2\text{e}$.

II. Calculate the baseline GHG emissions

1. Calculate the baseline emission factor

According to the methodological tool, W_{OM} and W_{BM} are by default 0.5 and 0.5 respectively in the first crediting period. Therefore the combined baseline emission factor:

$$EF_{grid,CM,y} = 0.9944 \times 0.5 + 0.4733 \times 0.5 = 0.7338 \text{ tCO}_2/\text{MWh}$$

2. Calculate baseline GHG emissions

$$BE_y = BE_{Elec,y} = f_{cap} \times f_{wcm} \times EG_{PJ,y} \times EF_{grid,CM,y}$$

$$= 1 \times 1 \times 209,088 \text{ MWh} \times 0.7338 \text{ tCO}_2/\text{MWh}$$

$$= 153,428 \text{ tCO}_2$$

III. Estimate project leakage emissions:

As per the methodology ACM0012 (version04.0.0), no leakage needs to be considered in the project, $LE_y = 0 \text{ tCO}_2\text{e}$.

IV. Estimate emission reductions

As per formula in section B.6.1, the annual emission reductions of the project are as follows:

$$ER_y = 153,428 - 0 = 153,428 \text{ tCO}_2\text{e}$$

B.6.4. Summary of ex ante estimates of emission reductions

It is expected that the project activity will generate emission reductions 153,428 tCO₂e per year over the first 10-year renewable crediting period from 01/07/2013 to 30/06/2023.

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
01/07/2013-30/06/2014	153,428	0	0	153,428
01/07/2014-30/06/2015	153,428	0	0	153,428
01/07/2015-30/06/2016	153,428	0	0	153,428
01/07/2016-30/06/2017	153,428	0	0	153,428
01/07/2017-30/06/2018	153,428	0	0	153,428
01/07/2018-30/06/2019	153,428	0	0	153,428
01/07/2019-30/06/2020	153,428	0	0	153,428
01/07/2020-30/06/2021	153,428	0	0	153,428
01/07/2021-30/06/2022	153,428	0	0	153,428
01/07/2022-30/06/2023	153,428	0	0	153,428
Total (tCO₂e)	1,534,280	0	0	1,534,280
Total number of crediting years	10			
Annual average over the	153,428	0	0	153,428

crediting period				
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B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

The project adopts the ex-ante calculation of emission factor of the grid, so quantity of net electricity generation supplied by the project to the grid need be monitored during the crediting period.

Data / Parameter	$EG_{PJ,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project for captive use
Source of data	The value in the PDD is from the FSR, the real value will be monitored by electricity meters.
Value(s) applied	209,088
Measurement methods and procedures	Directly measured by the electricity meter (M2).
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The electricity meters are calibrated regularly.
Purpose of data	Calculation of baseline emissions
Additional comment:	-

Data / Parameter	$Q_{OE,y}$
Unit	MWh
Description	Quantity of actual output energy during year y, i.e. the total power generation of the WHR power plant
Source of data	Generation plant measurement records
Value(s) applied	237,600
Measurement methods and procedures	The project applies Method-3, Case-1 of methodology ACM0012 (version 04.0.0) which requires the monitoring of the actual output energy which in this case consists of total power generation of the project activity. The total power generation of the project activity is measured by the meter at the outlet side of the generator, i.e. at the metering point (M1) which is indicated in Figure 4, through national standard electricity metering instruments. The data will be continuously monitored during the crediting period. The metering instruments will be calibrated annually in accordance with industry standard <i>Technical Administrative Code of Electric Energy Metering (DL/T448- 2000)</i> .
Monitoring frequency	
QA/QC procedures	Measuring equipment will be calibrated annually.
Purpose of data	Calculation of baseline emissions
Additional comment:	-

Data / Parameter	$EC_{PJ,y}$
Unit	MWh
Description	The additional power consumed in year y as a result of the implementation of the project activity source j



Source of data	The value in the PDD is from the FSR, the real value will be monitored by electricity meters.
Value(s) applied	0
Measurement methods and procedures	Directly measured by the electricity meter (M3) in the 10KV Backup line.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The electricity meters are calibrated regularly.
Purpose of data	Calculation of project emissions
Additional comment:	-

Data / Parameter	$TDL_{j,y}$
Unit	
Description	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data	The most recent available <i>Statistics Collections for Power Sector</i> issued by China Electricity Council .
Value(s) applied	-
Measurement methods and procedures	Check the most recent available <i>Statistics Collections for Power Sector</i> issued by China Electricity Council
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	If <i>Statistics Collections for Power Sector</i> issued by China Electricity Council is not available, default value of 20% will be applied.

Data / Parameter	Abnormal operation of the project facility including emergencies and shut down
Unit	h
Description	The hours of abnormal operation of parts of project facility that can have an impact on waste energy generation and recovery
Source of data	Operation of project facility
Value(s) applied	-
Measurement methods and procedures	Record the abnormal operation of project facility via plant accident log, including accident and machine halt.
Monitoring frequency	Daily, aggregated annually
QA/QC procedures	-
Purpose of data	This parameter has to be monitored to demonstrate that no emission reduction is claimed for the hours during the abnormal operation of the part of project facility which have impact on waste energy generation and recovery. The abnormality can be in terms of violation of operational parameters, poor quality product, emergencies or shutdown.
Additional comment:	-

B.7.2. Sampling plan

>>

Not applicable, left blank intentionally.

B.7.3. Other elements of monitoring plan

>>

Since the baseline emission factor of the project is determined ex-ante, the quantity of net electricity generation, waste heat generated and waste heat recovered by the project to the grid are defined as the key data to be monitored.

Management Structure of the Monitoring Plan

For details regarding the management structure of the monitoring plan, please refer to Figure 6.

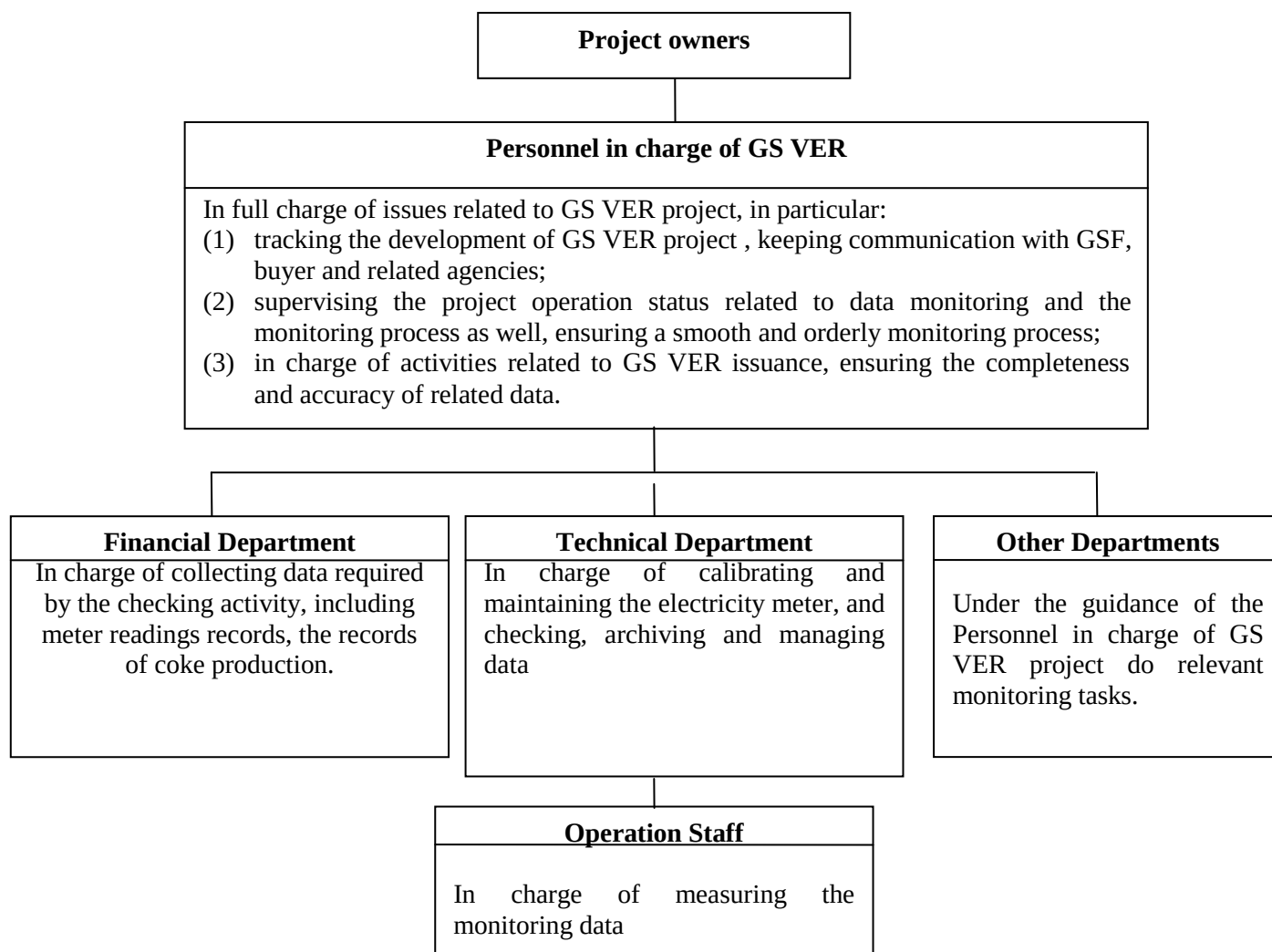


Figure 6. Management Structure of Monitoring Plan

Monitoring Measures

M1 meter measures the power generation of the Project, M2 meter measures quantity of net electricity generation supplied by the project for captive use, and M3 meter measure the self use electricity form the 10KV backup line.

**Installation of monitoring devices**

The electricity meters of the project will be installed according to the *Technical administrative code of electric energy metering* (DL/T 448-2000). Before the operation of the project, the project owner will check and accept those electricity meters as per the Technical Norm.

Calibration of Meters & Metering

The regular calibration and on-site verification should be implemented as per the *Technical administrative code of electric energy metering* (DL/T 448-2000) to ensure the precision of electricity meters. Electricity meters should be calibrated every year. After calibration, the electricity meters must be sealed.

Quality Assurance and Quality Control

The quality assurance and quality control procedures consist of data recording; maintaining and archiving. The quality assurance and quality control procedures should be improved according to the CDM EB regulation and the real operating conditions during the project operation period.

Data Management System

Specific staff will be appointed by the project owner to take on the overall responsibility for monitoring greenhouse gas emission reductions and keeping all the data collected as part of monitoring. Data shall be archived electronically and be kept at least for 2 years after the end of the last crediting period or the last issuance of VERs, whichever occurs later.



SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

01/06/2012

C.1.2. Expected operational lifetime of project activity

>>

20yrs and 0 month (not including the construction period)

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

The project selects the fixed 10-year crediting period.

C.2.2. Start date of crediting period

>>

01/07/2013

C.2.3. Length of crediting period

>>

10yrs and 0 month



SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

According to the EIA Report and EIA Approval of the project, the environmental impacts arising from the project, control measures and the control effects are analyzed separately for the construction period and the operation period.

Construction period

The project is located in the production area of Tranvic Group, no any impact on the local residential during its construction period. There might be some dust arising from excavating, construction and transportation, but the project owner will keep down dust by sprinkling. All the industrial waste water resulted from the project during its construction period is used as water for sprinkling to keep down dust after sediment, or for concrete mixing, and thus no industrial waste water will be discharged; while the household waste water be discharged into the existing sewer for further treatment. The solid waste from the project during the construction period will be used as construction materials, and the remaining useless will be periodically cleaned by the sanitation department. The construction noise intensity of the project is so small that there is no impact on the construction workers basically.

Operation period

Waste

The main pollutant in the waste gas is dust. A set of dust removal facility will be installed to reduce the dust emission. Its dust removal efficiency is more than 99.9%. Waste gas emission of the Project meets the requirement of standard II of Emission Standard of Air Pollutants, which is much higher the baseline scenario. Dust collected by the will be regularly transported out by trucks for comprehensive utilization.

Waste water

There is almost no pollutant in direct cooling water of equipment, which, cooled by the cooling tower, will enter into the cistern, and then the water will be re-cycle after further treatment through the ion electrostatic water processor; a small amount of collected water discharged will be discharged into the coke powder sedimentation tank as dust removal water. The household waste water will be discharged into the existing sewer for further treatment.

Compared with CWQ system, the project reduces the discharge of waste water to a large extent.

Noise

Equipments with small power and low noise shall be elected at the premise of process design satisfaction. Topography, sound source directivity, noise size between workshops as well as greening, etc. will be considered to make reasonable layout and play the function of reducing noise. With the help of the above measures, the noise value at the boundary meets the requirements of standard III of Standard of noise at boundary of industrial enterprises, i.e. less than 65dB (A) at day and less than 55dB (A) at night.

Solid waste

Dust collected by the will be regularly transported out by trucks for comprehensive utilization. The household garbage will be regularly cleared out by sanitary department.

In summary, the project will not have significant impacts on the environment.

D.2. Environmental impact assessment

>>

On 17 June, 2011, the EIA Form of the Project was approved.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

According to the area impacted by the project, the workers of Tranvic Group and local villagers around the project site are identified as the stakeholders of the project.

In order to obtain stakeholders' comments regarding the project, the project owner, by means of putting up public notice from September, 2012, the workers of Tranvic Group and local villagers who were interested in the project to fill the questionnaire. A total of 55 people received the questionnaires and returned them with their responses.

The questionnaires mainly focus on the following issues:

- What's the attitude of the stakeholders on the construction and operation of the project?
- What might be the positive impacts as a result of the implementation of the project in the view of stakeholders?
- What might be the negative impacts as a result of the implementation of the project in the view of stakeholders?
- Collect the suggestions made by the local villagers regarding the project design, construction and operation model.

E.2. Summary of comments received

>>

Totally 55 questionnaires returned with 100% response rate. A summary of the key findings based on 52 returned questionnaires is as follows:

- Among the respondents, 34 people are male, and 21 people are female.
- Among the respondents, 3 people are between 21 and 30, 20 people are between 31 and 40, 17 people are between 41 and 50, and 15 people are above the age of 50.
- Among the respondents, 11 people finished the education of primary school, 21 people finished the education of junior high school, 10 people finished the education of senior high school/technical secondary school, 5 people finished the education of junior college, 8 people finished the education of undergraduate college.

It can be seen that respondents are representative of the public opinions in terms of their gender, age and educational levels. Therefore, it can be considered that responses to the survey have comprehensively reflected the attitudes towards the project of the villagers possibly affected by the project.

- Among the respondents, 37 people (67.27%) knew very well about the project, 18 people (32.73%) knew the project.
- 55 people (100%) surveyed support the implementation of the project.

In a word, people surveyed considered that positive impacts of the implementation of the project including:

- 55 people (100%) considered the implementation of the project will reduce air pollution.
- 48 people (87.17%) considered the implementation of the project will increase electricity supply;
- 21 people (38.18%) considered the implementation of the project will decrease the electricity charge;
- 25 people (45.45%) considered the implementation of the project will increase the income;
- 39 people (70.91%) considered the implementation of the project will increase employment opportunities;
- 33 people (60.00%) considered the implementation of the project will improve living standards.

No respondents consider that negative impacts as a result of the project implementation

E.3. Report on consideration of comments received

>>

The survey shows that most of the stakeholders at the project site consider that the construction of the project has plenty of positive impacts.



The project owner has given full consideration to the comments and suggestions from stakeholders in the process of project construction. Local residents and government are all very supportive to the implementation of the project. According to the collected comments received from local stakeholders, it is not necessary to modify the project.



SECTION F. Approval and authorization

>>

The project is a GS VER project, approval and authorization from DNA is not necessary.

**Appendix 1: Contact information of project participants**

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Website	
Contact person:	Zhao Bin
Title:	The director of safety and Environment Protection
Salutation:	
Last Name:	Zhao
Middle Name:	
First Name:	Bin
Department:	
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Organization name	Carbon Invcap International Trading Co., Ltd.
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Title	General Manager
Salutation	Ms.
Last name	Tang
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Direct fax	+86-(0)10-62682682
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Appendix 2: Affirmation regarding public funding

Not applicable, left blank intentionally.



Appendix 3: Applicability of selected methodology

Not applicable, left blank intentionally.



Appendix 4: Further background information on ex ante calculation of emission reductions

BASELINE INFORMATION

To determine the simple OM emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$) of the Project, data recommended in the 2012 *Baseline Emission Factors for Regional Power Grids in China* for the Central China Power Grid are adopted.

The following tables summarise the numerical results from the equations listed in the approved methodological tool-*Tool to calculate the emission factor for an electricity system* (version 03.0.0). The information provided by the tables includes data, data sources and the underlying calculations.

Table A1. Thermal Electricity generation and Electricity delivered to the grid of the Central China Power Grid

Year	2008			2009			2010		
Province	EG	AER	EDG	EG	AER	EDG	EG	AER	EDG
	(MWh)	(%)	(MWh)	(MWh)	(%)	(MWh)	(MWh)	(%)	(MWh)
Jiangxi	40,500,000	6.50	37,867,500	44,500,000	5.80	41,919,000	53,700,000	6.00	50,478,000
Henan	189,000,000	7.22	175,354,200	198,500,000	6.62	185,359,300	219,800,000	6.23	206,106,460
Hubei	55,300,000	6.62	51,639,140	63,000,000	6.21	59,087,700	77,100,000	6.30	72,242,700
Hunan	53,700,000	6.46	50,230,980	63,400,000	6.39	59,348,740	72,500,000	6.27	67,954,250
Chongqing	28,600,000	0.00	28,600,000	30,600,000	0.00	30,600,000	33,100,000	0.00	33,100,000
Sichuan	40,100,000	10.21	36,005,790	50,400,000	7.92	46,408,320	56,500,000	7.52	52,251,200
Total			379,697,610.00			422,723,060.00			482,132,610.00

Data source: China Electric Power Yearbook 2009-2011

EG- Electricity generation, AER- Auxiliary electricity consumption Rate, EDG-Electricity delivered to the grid.

Table A2. Calculation of simple OM emission factor of the Central China Power Grid in 2008

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
								G=sum(A:F)	(kgCO ₂ /TJ)	(%)	(MJ/t,km ³)	(tCO ₂ e)



		A	B	C	D	E	F	G	H	I	J	K
Raw coal	10 ⁴ t	2137.08	9480.74	2852.29	2620.44	1421.42	2727.61	21239.58	87,300	100%	20,908	387,679,342
Clean coal	10 ⁴ t		1.68			3.27		4.95	87,300	100%	26,344	113,842
Other washed coal	10 ⁴ t	0.04	80.54		2.06	101.75		184.39	87,300	100%	8,363	1,346,213
briquettes	10 ⁴ t				6.12		0.01	6.13	87,300	100%	20,908	111,889
Coke	10 ⁴ t		0.78		0.92			1.7	95,700	100%	28,435	46,261
Coke oven gas	10 ⁸ m ³	0.1	4.19	0.37	0.24	6.66	0.01	11.57	37,300	100%	16,726	721,829
Other gas	10 ⁸ m ³	23.67	41.36		3.31	0.37	0.01	68.72	37,300	100%	5,227	1,339,814
Crude oil	10 ⁴ t		0.17					0.17	71,100	100%	41,816	5,054
Gasoline	10 ⁴ t							0	67,500	100%	43,070	0
Diesel	10 ⁴ t	0.88	7.02	2.82	3.41	1.59		15.72	72,600	100%	42,652	486,775
Fuel oil	10 ⁴ t	0.07	1.45		1.29		3.14	5.95	75,500	100%	41,816	187,848
LPG	10 ⁴ t							0	61,600	100%	50,179	0
Refinery gas	10 ⁴ t	0.21	3.91	2.78	0.71		0.01	7.62	48,200	100%	46,055	169,153
Natural gas	10 ⁸ m ³		4.02	0.16		0.05	12.92	17.15	54,300	100%	38,931	3,625,430
Other petroleum products	10 ⁴ t			0.59				0.59	72,200	100%	41,816	17,813
Other coking products	10 ⁴ t						0.01	0.01	95,700	100%	28,435	272
Other E (standard coal)	10 ⁴ Tce	18.16	68.11	62.35	11.42	64.87		224.91	0	0	0	0
							CO ₂ Emission				Total	395,851,534

CCPG imported net electricity from NWPG (MWh) in 2008	3,144,070
Average EF of NWPG in 2008	0.98254
CCPG imported net electricity from NCPG (MWh) in 2008	33,200
Average EF of NCPG in 2008	1.00495
Total emission (tCO ₂) in 2008	398,974,078
Total Power supply (MWh) in 2008	382,874,880



EF	1.04205
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$K = G \times H \times I \times J / 100,000$ (unit of quality) OR $K = G \times H \times I \times J / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2009

2006 IPCC Guideline for National Greenhouse Gas Inventories, Volume 2

Table A3. Calculation of simple OM emission factor of the Central China Power Grid in 2009

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
								G= sum(A:F)	(kgCO ₂ /TJ)	(%)	(MJ/t, km ³)	(tCO ₂ e)
		A	B	C	D	E	F	G	H	I	J	K
Raw coal	10 ⁴ t	2184.31	9339.64	2888.29	2810.69	1413.64	2817.31	21453.88	87,300	100%	20,908	391,590,892
Clean coal	10 ⁴ t		3.35					3.35	87,300	100%	26,344	77,044
Other washed coal	10 ⁴ t		59.93			136.75	97.94	294.62	87,300	100%	8,363	2,150,991
briquettes	10 ⁴ t				2.63			2.63	87,300	100%	20,908	48,005
Coke	10 ⁴ t		1.08	0.06	0.09			1.23	95,700	100%	28,435	33,471
Coke oven gas	10 ⁸ m ³	0.09	6.04	1.2		1.03		8.36	37,300	100%	16,726	521,564
Other gas	10 ⁸ m ³	30.76	56.64		4.23	7.57		99.2	37,300	100%	5,227	1,934,074
Crude oil	10 ⁴ t		0.1					0.1	71,100	100%	41,816	2,973
Gasoline	10 ⁴ t							0	67,500	100%	43,070	0
Diesel	10 ⁴ t	0.69	4.28	1.23	1.55	1.19		8.94	72,600	100%	42,652	276,830
Fuel oil	10 ⁴ t	0.02	1.44	0.48	1.27	0.06	4	7.27	75,500	100%	41,816	229,522
LPG	10 ⁴ t							0	61,600	100%	50,179	0
Refinery gas	10 ⁴ t	0.25	2.18	0.82	1.91			5.16	48,200	100%	46,055	114,544
Natural gas	10 ⁸ m ³		7.69	0.27		0.14	21.84	29.94	54,300	100%	38,931	6,329,176
Other petroleum products	10 ⁴ t			0.29				0.29	72,200	100%	41,816	8,755
Other coking products	10 ⁴ t							0	95,700	100%	28,435	0



Other ^E (standard coal)	10 ⁴ Tce	12.47	76.3	26.69	14.96	84.8		215.22	0	0	38,931	0
							CO ₂ Emission				Total	403,317,841

CCPG imported electricity from NWPG in 2009 (MWh)	3,262,010
Average EF of NWPG in 2009 (tCO ₂ /MWh)	1.00759
CCPG imported electricity from NCPG in 2009 (MWh)	2,233,290.00
Average EF of NCPG in 2009 (tCO ₂ /MWh)	0.96418
Total emission in 2009 (tCO ₂)	408,757,899
Total Power supply in 2009 (MWh)	428,218,360
EF	0.95455

$K = G \times H \times I / 100,000$ (unit of quality) OR $K = G \times H \times I / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2010

2006 IPCC Guideline for National Greenhouse Gas Inventories, Volume 2

Table A4. Calculation of simple OM emission factor of the Central China Power Grid in 2010

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
								$G = \text{sum}(A:F)$	(kgCO ₂ /TJ)	(%)	(MJ/t, km ³)	(tCO ₂ e)
		A	B	C	D	E	F	G	H	I	J	K
Raw coal	10 ⁴ t	2648.31	9925.73	3474.75	3318.57	1542.19	2667.82	23577.37	87,300	100%	20,908	430,350,284
Clean coal	10 ⁴ t		331.4					331.4	87,300	100%	26,344	7,621,641
Other washed coal	10 ⁴ t		205.66			145.37	116.96	467.99	87,300	100%	8,363	3,416,748
Briquettes	10 ⁴ t				1.82			1.82	87,300	100%	20,908	33,220
Coke	10 ⁴ t							0	95,700	100%	28,435	0
Coal gangue	10 ⁴ t	48.8	256.37	78.86	36.85	237.58		658.46	87,300	100%	8,363	4,807,350
Coke oven gas	10 ⁸ m ³	0.3	3.76	0.07	0.19	1.12		5.44	37,300	100%	16,726	339,391
BFG	10 ⁸ m ³	45.81	61.58	131.21	46.32	7.19		292.11	219,000	100%	3,763	24,072,697
LDG	10 ⁸ m ³	1.49			4.42	0.18		6.09	145,000	100%	7,945	701,583



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Other gas	10 ⁸ m ³		0.02		0.13			0.15	37,300	100%	5,227	2,925
Crude oil	10 ⁴ t		0.08					0.08	71,100	100%	41,816	2,378
Gasoline	10 ⁴ t					0.01		0.01	67,500	100%	43,070	291
Diesel	10 ⁴ t	0.65	31.41	1.2	0.91	1.12		35.29	72,600	100%	42,652	1,092,767
Fuel oil	10 ⁴ t	0.06	1.14	0.27	1.86	0.05	1.51	4.89	75,500	100%	41,816	154,383
Naphtha	10 ⁴ t							0	72,600	100%	41,816	0
Lubricating Oil	10 ⁴ t							0	71,900	100%	28,435	0
Paraffin	10 ⁴ t							0	72,200	100%	43,906	0
Solvent Oil	10 ⁴ t							0	72,200	100%	41,398	0
Petroleum asphalt	10 ⁴ t							0	69,300	100%	39,934	0
Petroleum coke	10 ⁴ t		5.82					5.82	82,900	100%	31,947	154,137
LPG	10 ⁴ t							0	61,600	100%	50,179	0
Refinery gas	10 ⁴ t	0.15	1.45	1.05	1.11			3.76	48,200	100%	46,055	83,466
Natural gas	10 ⁸ m ³		13.76	0.15		0.05	11.97	25.93	54,300	100%	38,931	5,481,481
Other petroleum products	10 ⁴ t				2.75			2.75	72,200	100%	41,816	83,026
Other coking products	10 ⁴ t							0	95,700	100%	28,435	0
Other E (standard coal)	10 ⁴ Tce	41.43	266.07		8.12	2.4		318.02	0	-	-	0
							CO ₂ Emission				Total	478,397,767

CCPG imported electricity from NWPG (MWh)	12,386,810
Average EF of NWPG (tCO ₂ /MWh)	0.98529
CCPG imported electricity from NCPG (MWh)	2,684,680.00
Average EF of NCPG (tCO ₂ /MWh)	1.03326
Total emission (tCO ₂)	493,376,271
Total Power supply (MWh)	497,204,100
EF	0.99230

$K = G \times H \times I \times J / 100,000$ (unit of quality) OR $K = G \times H \times I \times J / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2011

2006 IPCC Guideline for National Greenhouse Gas Inventories, Volume 2



According to *Tool to calculate the emission factor for an electricity system* (version 03.0.0), the simple operating margin emission factor in year 2008, 2009 and 2010 are calculated, the three years weighted average simple operating margin emission factor is calculated as 0.9944tCO₂/MWh, see Table A1~Table A4 for details.

Calculation of simple OM emission factor of the Northwest China Power Grid

Table A5. Thermal Electricity generation and Electricity delivered to the grid of the Northwest China Power Grid

Year	2008			2009			2010		
Province	EG	AER	EDG	EG	AER	EDG	EG	AER	EDG
	(MWh)	(%)	(MWh)	(MWh)	(%)	(MWh)	(MWh)	(%)	(MWh)
shaanxi	71,500,000	6.95	66,530,750	77,400,000	7.24	71,796,240	95,800,000	7.23	88,873,660
gansu	46,800,000	6.40	43,804,800	44,100,000	6.88	41,065,920	59,100,000	6.73	55,122,570
qinghai	10,700,000	7.14	9,936,020	10,700,000	7.01	9,949,930	10,900,000	6.58	10,182,780
ningxia	44,000,000	7.57	40,669,200	44,700,000	7.76	41,231,280	57,200,000	0.00	57,200,000
xinjiang	39,700,000	0.00	39,700,000	45,200,000	5.16	42,867,680	53,900,000	8.70	49,210,700
Total			200,640,770			206,911,050			260,589,710

Data source: China Electric Power Yearbook 2009-2011

Table A6. Calculation of simple OM emission factor of the Northwest China Power Grid in 2008

Fuel	Unit	shaanxi	gansu	qinghai	ningxia	xinjiang	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
							F=sum(A:E)	(kgCO ₂ /TJ)	(%)	(MJ/t,km ³)	(tCO ₂ e)
		A	B	C	D	E	F	G	H	I	J
Raw coal	10 ⁴ t	3620	2216.9	507.44	2330.72	1924.9	10599.96	87,300	100%	20,908	193,477,720
Clean coal	10 ⁴ t						0	87,300	100%	26,344	0
Other washed coal	10 ⁴ t	9.22			53.85	8.2	71.27	87,300	100%	8,363	520,335
briquettes	10 ⁴ t						0	87,300	100%	20,908	0
Coke	10 ⁴ t						0	95,700	100%	28,435	0
Coke oven gas	10 ⁸ m ³	0.35	0.74			0.13	1.22	37,300	100%	16,726	76,113



Other gas	10 ⁸ m ³	18.38	0.2				18.58	37,300	100%	5,227	362,249
Crude oil	10 ⁴ t						0	71,100	100%	41,816	0
Gasoline	10 ⁴ t	0.05				0.01	0.06	67,500	100%	43,070	1,744
Diesel	10 ⁴ t	1.03	0.44	0.26	0.05	1.64	3.42	72,600	100%	42,652	105,902
Fuel oil	10 ⁴ t		0.86	0.04		0.02	0.92	75,500	100%	41,816	29,045
LPG	10 ⁴ t						0	61,600	100%	50,179	0
Refinery gas	10 ⁴ t					7.25	7.25	48,200	100%	46,055	160,939
Natural gas	10 ⁸ m ³	0.94	0.24	2.99		7.2	11.37	54,300	100%	38,931	2,403,565
Other petroleum products	10 ⁴ t					0.01	0.01	72,200	100%	41,816	302
Other coking products	10 ⁴ t						0	95,700	100%	28,435	0
Other E (standard coal)	104 Tce	93.67	10.58		21.24		125.49	0	0	0	0
										Total	197,137,915

Total emission (tCO ₂)	197,137,915
Total Power supply (MWh)	200,640,770
EF	0.98254

$J = F \times G \times H \times I / 100,000$ (unit of quality) or $J = F \times G \times H \times I / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2009

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Table A7. Calculation of simple OM emission factor of the Northwest China Power Grid in 2009

Fuel	Unit	shaanxi	gansu	qinghai	ningxia	xinjiang	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
							F = sum(A:E)	(kgCO₂/TJ)	(%)	(MJ/t, km³)	(tCO₂e)
		A	B	C	D	E	F	G	H	I	J
Raw coal	10 ⁴ t	3949.22	2060	467.05	2350.13	2380	11206.4	87,300	100%	20,908	204,546,878
Clean coal	10 ⁴ t						0	87,300	100%	26,344	0



Other washed coal	10 ⁴ t	8.34			56.01	6.66	71.01	87,300	100%	8,363	518,437
briquettes	10 ⁴ t						0	87,300	100%	20,908	0
Coke	10 ⁴ t						0	95,700	100%	28,435	0
Coke oven gas	10 ⁸ m ³	0.49	0.8			0.12	1.41	37,300	100%	16,726	87,967
Other gas	10 ⁸ m ³	18.37	0.44				18.81	37,300	100%	5,227	366,733
Crude oil	10 ⁴ t						0	71,100	100%	41,816	0
Gasoline	10 ⁴ t	0.02					0.02	67,500	100%	43,070	581
Diesel	10 ⁴ t	0.6	0.52	0.2	0.07	0.7	2.09	72,600	100%	42,652	64,718
Fuel oil	10 ⁴ t		0.25	0.08		0.06	0.39	75,500	100%	41,816	12,313
LPG	10 ⁴ t	0.02					0.02	61,600	100%	50,179	618
Refinery gas	10 ⁴ t					8.56	8.56	48,200	100%	46,055	190,019
Natural gas	10 ⁸ m ³	0.91	0.07	3.93		7.83	12.74	54,300	100%	38,931	2,693,177
Other petroleum products	10 ⁴ t						0	72,200	100%	41,816	0
Other coking products	10 ⁴ t						0	95,700	100%	28,435	0
Other E (standard coal)	10 ⁴ Tce	73.76	18.52		18.08		110.36	0	0	0	0
										Total	208,481,441

Total emission (tCO ₂)	208,481,441
Total Power supply (MWh)	206,911,050
EF	1.00759

$J = F \times G \times H \times I / 100,000$ (unit of quality) or $J = F \times G \times H \times I / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2010

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Table A8. Calculation of simple OM emission factor of the Northwest China Power Grid in 2010

Fuel	Unit	shaanxi	gansu	qinghai	ningxia	xinjiang	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
							$F = \frac{\text{sum}(A:E)}{\text{sum}(A:E)}$	(kgCO ₂ /TJ)	(%)	(MJ/t, km ³)	(tCO ₂ e)



		A	B	C	D	E	F	G	H	I	J
Raw coal	10 ⁴ t	4850.49	2771.89	483.72	2916.46	2494.9	13517.46	87,300	100%	20,908	246,729,926
Clean coal	10 ⁴ t				1.05		1.05	87,300	100%	26,344	24,148
Other washed coal	10 ⁴ t	11.01			42.96	6.82	60.79	87,300	100%	8,363	443,822
Briquettes	10 ⁴ t						0	87,300	100%	20,908	0
Coke	10 ⁴ t						0	95,700	100%	28,435	0
Coal gangue	10 ⁴ t	355.13	37.86		163.58	2.85	559.42	87,300	100%	8,363	4,084,269
Coke oven gas	10 ⁸ m ³	1.97	0.89			0.7	3.56	37,300	100%	16,726	222,101
BFG	10 ⁸ m ³	18.24	4.06			5.28	27.58	219,000	100%	3,763	2,272,860
LDG	10 ⁸ m ³		0.31				0.31	145,000	100%	7,945	35,713
Other gas	10 ⁸ m ³						0	37,300	100%	5,227	0
Crude oil	10 ⁴ t						0	71,100	100%	41,816	0
Gasoline	10 ⁴ t	0.01		0.03		0.01	0.05	67,500	100%	43,070	1,454
Diesel	10 ⁴ t	0.67	0.42	0.21	0.23	0.39	1.92	72,600	100%	42,652	59,453
Fuel oil	10 ⁴ t		0.17	0.09	0.1	0.7	1.06	75,500	100%	41,816	33,465
Naphtha	10 ⁴ t						0	72,600	100%	43,906	0
Lubricating Oil	10 ⁴ t						0	71,900	100%	41,398	0
Paraffin	10 ⁴ t						0	72,200	100%	39,934	0
Solvent Oil	10 ⁴ t						0	72,200	100%	42,945	0
Petroleum asphalt	10 ⁴ t						0	69,300	100%	38,931	0
Petroleum coke	10 ⁴ t						0	82,900	100%	31,947	0
LPG	10 ⁴ t						0	61,600	100%	50,179	0
Refinery gas	10 ⁴ t					12.2	12.2	48,200	100%	46,055	270,822
Natural gas	10 ⁸ m ³	0.87		2.48	0.3	8.54	12.19	54,300	100%	38,931	2,576,909
Other petroleum products	10 ⁴ t					0.01	0.01	72,200	100%	41,816	302
Other coking products	10 ⁴ t						0	95,700	100%	28,435	0
Other E (standard coal)	10 ⁴ Tce	1.76	2.68				4.44	0	-	-	0
										Total	256,755,243



Total emission (tCO ₂)	256,755,243
Total Power supply (MWh)	260,589,710
EF	0.98529

$J = F \times G \times H \times I / 100,000$ (unit of quality) or $J = F \times G \times H \times I / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2011

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Calculation of simple OM emission factor of the North China Power Grid

Table A9. Thermal Electricity generation and Electricity delivered to the grid of the North China Power Grid

year	2008			2009			2010		
Province	EG	AER	EDG	EG	AER	EDG	EG	AER	EDG
	(MWh)	(%)	(MWh)	(MWh)	(%)	(MWh)	(MWh)	(%)	(MWh)
Beijing	24,300,000	7.14	22,564,980	24,100,000	6.55	22,521,450	26,300,000	6.20	24,669,400
Tianjin	39,700,000	7.05	36,901,150	41,300,000	6.80	38,491,600	55,600,000	6.63	51,913,720
Hebei	158,000,000	6.90	147,098,000	173,300,000	6.92	161,307,640	199,800,000	6.73	186,353,460
Shanxi	176,200,000	8.22	161,716,360	185,000,000	8.10	170,015,000	210,800,000	8.03	193,872,760
Inner Mongolia	200,800,000	7.96	184,816,320	213,500,000	7.82	196,804,300	240,700,000	7.74	222,069,820
Shandong	268,900,000	7.14	249,700,540	285,800,000	7.43	264,565,060	306,400,000	6.98	285,013,280
Total			802,797,350			853,705,050			963,892,440

Data source: China Electric Power Yearbook 2009-2011

Table A10. Calculation of simple OM emission factor of the North China Power Grid in 2008

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
								$G = \sum(A:F)$	(kgCO ₂ /TJ)	(%)	(MJ/t, km ³)	(tCO ₂ e)
		A	B	C	D	E	F	G	H	I	J	K
Raw coal	10 ⁴ t	755.75	1800.12	7353.33	7854.39	12607.82	12360.75	42,732.16	87,300	100%	20,908	779,976,613
Clean coal	10 ⁴ t						23.88	23.88	87,300	100%	26,344	549,200
Other washed	10 ⁴ t	5.05		134.52	582.39	66.2	691.21	1,479.37	87,300	100%	8,363	10,800,731



coal												
briquettes	10 ⁴ t	5.66			32.49		45.38	83.53	87,300	100%	20,908	1,524,647
Coke	10 ⁴ t			0.02			6.07	6.09	95,700	100%	28,435	165,723
Coke oven gas	10 ⁸ m ³	0.11	0.86	8.37	24.55	3.55	16.2	53.64	37,300	100%	16,726	3,346,491
Other gas	10 ⁸ m ³	10.4	9.08	187.54	36	34.32	29.76	307.10	37,300	100%	5,227	5,987,440
Crude oil	10 ⁴ t					0.02		0.02	71,100	100%	41,816	595
Gasoline	10 ⁴ t							-	67,500	100%	43,070	-
Diesel	10 ⁴ t	0.15		3.08		0.35		3.58	72,600	100%	42,652	110,856
Fuel oil	10 ⁴ t	2.56		0.25				2.81	75,500	100%	41,816	88,715
LPG	10 ⁴ t							-	61,600	100%	50,179	-
Refinery gas	10 ⁴ t	0.44		2.93				3.37	48,200	100%	46,055	74,809
Natural gas	10 ⁸ m ³	11.09	0.7		0.97	2.12		14.88	54,300	100%	38,931	3,145,563
Other petroleum products	10 ⁴ t	1.45						1.45	72,200	100%	41,816	43,777
Other coking products	10 ⁴ t	7.97		7.61				15.58	95,700	100%	28,435	423,968
Other ^E (standard coal)	10 ⁴ Tce	4.9	2.34	61.02	466	63.72	141.71	739.69	-	0%	-	-
						CO ₂ Emission					Total	806,239,126
Thermal electricity delivered to the NCPG in 2008 (MWh)												802,797,350
Net electricity imported from NEPG to NCPG in 2008 (MWh)												5,286,140
Average EF of NEPG in 2008 (tCO ₂ /MWh)												1.10489
Total electricity supply to NCPG in 2008 (MWh)												808,083,490
Total emission of NCPG in 2008 (tCO ₂)												812,079,707
Emission factor of the North China Power Grid in 2008 (tCO ₂ /MWh)												1.00495

$K = G \times H \times I \times J / 100,000$ (unit of quality) or $K = G \times H \times I \times J / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2009

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Table A11. Calculation of simple OM emission factor of the North China Power Grid in 2009

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
								G= sum(A:F)	(kgCO ₂ /TJ)	(%)	(MJ/t,km ³)	(tCO ₂ e)
		A	B	C	D	E	F	G	H	I	J	K
Raw coal	10 ⁴ t	665.16	1870.36	7623.94	8024.02	12538.57	12654.05	43,376.1	87,300	100%	20,908	791,730,246
Clean coal	10 ⁴ t						11.7	11.7	87,300	100%	26,344	269,080
Other washed coal	10 ⁴ t	6.15		247.51	586.04	104.69	862.02	1,806.41	87,300	100%	8,363	13,188,417
briquettes	10 ⁴ t	3.73					31.83	35.56	87,300	100%	20,908	649,065
Coke	10 ⁴ t						10.43	10.43	95,700	100%	28,435	283,824
Coke oven gas	10 ⁸ m ³	0.13	1.27	8.72	19.48	3.35	11.69	44.64	37,300	100%	16,726	2,784,999
Other gas	10 ⁸ m ³	10.23	13.43	228.32	35.89	48.35	37.21	373.43	37,300	100%	5,227	7,280,656
Crude oil	10 ⁴ t					0.13		0.13	71,100	100%	41,816	3,865
Gasoline	10 ⁴ t						0.01	0.01	67,500	100%	43,070	291
Diesel	10 ⁴ t	0.1		2.38		2.64	3.07	8.19	72,600	100%	42,652	253,606
Fuel oil	10 ⁴ t	0.82		0.19		0.02	2.63	3.66	75,500	100%	41,816	115,550
LPG	10 ⁴ t							-	61,600	100%	50,179	-
Refinery gas	10 ⁴ t	0.83		3.95			3.44	8.22	48,200	100%	46,055	182,472
Natural gas	10 ⁸ m ³	13.55	0.63		4.39	2.03	0.03	20.63	54,300	100%	38,931	4,361,086
Other petroleum products	10 ⁴ t	1.52					23.18	24.7	72,200	100%	41,816	745,721
Other coking products	10 ⁴ t	6.62		7.79			5.52	19.93	95,700	100%	28,435	542,341
Other ^E (standard coal)	10 ⁴ Tce		2.11	62.14	570.3	90.63	137.68	862.86	-	100%	-	-
						CO ₂ Emission					Total	822,391,221



Thermal electricity delivered to the NCPG in 2009 (MWh)	853,705,050
Net electricity imported from NEPG to NCPG in 2009 (MWh)	6,982,610
Average EF of NEPG in 2009 (tCO ₂ /MWh)	1.06915
Total electricity supply to NCPG in 2009 (MWh)	860,687,660
Total emission of NCPG in 2009 (tCO ₂)	829,856,644
Emission factor of the North China Power Grid in 2009 (tCO ₂ /MWh)	0.96418

$K = G \times H \times I \times J / 100,000$ (unit of quality) or $K = G \times H \times I \times J / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2010

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Table A12. Calculation of simple OM emission factor of the North China Power Grid in 2010

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total	Fuel carbon coefficient	Oxidation factor	NCV	CO ₂ emissions
								$G = \text{sum}(A:F)$	(kgCO ₂ /TJ)	(%)	(MJ/t, km ³)	(tCO ₂ e)
		A	B	C	D	E	F	G	H	I	J	K
Raw coal	10 ⁴ t	688.66	2499.57	8896.45	9347.83	13864.67	13605.64	48,902.8	87,300	100%	20,908	892,607,720
Clean coal	10 ⁴ t						0.87	0.9	87,300	100%	26,344	20,009
Other washed coal	10 ⁴ t	5.38		131.11	620.21	88.54	646.71	1,491.95	87,300	100%	8,363	10,892,576
Briquettes	10 ⁴ t	1.53					41.98	43.51	87,300	100%	20,908	794,174
Coke	10 ⁴ t							-	95,700	100%	28,435	-
Coal gangue	10 ⁴ t			252.29	2120.95	601.17	898.03	3,872.44	87,300	100%	8,363	28,272,293
Coke oven gas	10 ⁸ m ³	0.04	1.75	17.2	20.41	4.4	11.86	55.66	37,300	100%	16,726	3,472,515
BFG	10 ⁸ m ³	12.89	18.53	295.02	41.74	49.56	203.79	621.53	219,000	100%	3,763	51,220,101
LDG	10 ⁸ m ³			8.48	0.07			8.55	145,000	100%	7,945	984,981
Other gas	10 ⁸ m ³							-	37,300	100%	5,227	-
Crude oil	10 ⁴ t							-	71,100	100%	41,816	-
Gasoline	10 ⁴ t							-	67,500	100%	43,070	-



Diesel	10 ⁴ t	0.1		2.27		0.55	2.66	5.58	72,600	100%	42,652	172,787
Fuel oil	10 ⁴ t	0.49		0.17		0.01	3.24	3.91	75,500	100%	41,816	123,443
Naphtha	10 ⁴ t							-	72,600	100%	41,816	-
Lubricating Oil	10 ⁴ t							-	71,900	100%	28,435	-
Paraffin	10 ⁴ t							-	72,200	100%	43,906	-
Solvent Oil	10 ⁴ t							-	72,200	100%	41,398	-
Petroleum asphalt	10 ⁴ t							-	69,300	100%	39,934	-
Petroleum coke	10 ⁴ t	6.97	12.47				2.82	22.26	82,900	100%	31,947	589,535
LPG	10 ⁴ t							-	61,600	100%	50,179	-
Refinery gas	10 ⁴ t	1.37		2.12			2.41	5.9	48,200	100%	46,055	130,971
Natural gas	10 ⁸ m ³	16.08	0.57	0.22	6.16	0.18	0.16	23.37	54,300	100%	38,931	4,940,309
Other petroleum products	10 ⁴ t	0.85					28.14	28.99	72,200	100%	41,816	875,241
Other coking products	10 ⁴ t			7.99			3.4	11.39	95,700	100%	28,435	309,948
Other E (standard coal)	10 ⁴ Tce	20.42	17.07	45.53	34.66	20.8	38.56	177.04	-	-	-	-
						CO ₂ Emission					Total	995,406,604
Thermal electricity delivered to the NCPG in 2010 (MWh)												963,892,440
Net electricity imported from NEPG to NCPG in 2010 (MWh)												8,815,880
Average EF of NEPG in 2010 (tCO ₂ /MWh)												1.10573
Net electricity imported from NWPG to NCPG in 2010 (MWh)												2,048,870
Average EF of NWPG in 2010 (tCO ₂ /MWh)												0.98529
Total electricity supply to NCPG in 2010 (MWh)												974,757,190
Total emission of NCPG in 2010 (tCO ₂)												1,007,173,290
Emission factor of the North China Power Grid in 2010 (tCO ₂ /MWh)												1.03326

$K = G \times H \times I \times J / 100,000$ (unit of quality) or $K = G \times H \times I \times J / 10,000$ (unit of volume)

Data sources: China Energy Statistical Yearbook 2011

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The section B.6.1 detailed the calculation of BM emission factor of Central China Power Grid, the following tables summarize the numerical results from the equations listed in *2012 Baseline Emission Factors for Regional Power Grids in China*.



Sub-step 1: Calculation of the share of CO₂ emissions from solid, liquid and gaseous fuels.

Calculated with the data provided in Table A4 and equations (4), (5) and (6), $\lambda_{Coal,y} = 93.28\%$, $\lambda_{Oil,y} = 0.31\%$, $\lambda_{Gas,y} = 6.41\%$.

Sub-step 2: Calculated the emission factor of thermal power based on the emission factors of the best efficient and commercial coal-fired, oil-fired and gas-fired generation technologies as follow:

Table A13. CO₂ emission factor for best efficient and commercially available thermal power technologies in China

Thermal Power Technologies	variable	Electricity supply efficiency	Emission factor of fuel(kgCO ₂)	Oxidation	Emission factor(tCO ₂ /MWh)
		A	B	C	D=3.6/A/1,000,000*B*C
Coal fired power plants	$EF_{Coal,Adv,y}$	39.65%	87,300	1	0.7926
Oil fired power plants	$EF_{Oil,Adv,y}$	51.93%	75,500	1	0.5234
Gas fired power plants	$EF_{Gas,Adv,y}$	51.93%	54,300	1	0.3764

$$\begin{aligned}
 EF_{Thermal,y} &= \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \\
 &= 93.28\% \times 0.7926 + 0.31\% \times 0.5234 + 6.41\% \times 0.3764 \\
 &= 0.7651 \text{ tCO}_2/\text{MWh}
 \end{aligned}$$

Sub-step 3: Calculation BM in the grid by multiply the fuelled power emission factor and fuelled power proportion of the total power.

Table A14. Installed capacity of the Central China Power Grid in 2010

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal power	MW	12,940	46,870	18,150	16,090	6,740	12,580	113,370
Hydropower	MW	4,040	3,650	30,850	12,990	4,880	30,700	87,110
Nuclear	MW	0	0	0	0	0	0	0
Windpower and Others	MW	82	50	63	38	50	0	283
Total	MW	17,062	50,570	49,063	29,118	11,670	43,280	200,763

Data source: China Electric Power Yearbook 2011.

Table A15. Installed capacity of the Central China Power Grid in 2009

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal power	MW	11,500	43,100	15,670	15,900	6,800	12,270	105,240
Hydropower	MW	3,770	3,650	30,010	11,460	4,530	25,810	79,230



Nuclear	MW	0	0	0	0	0	0	0
Windpower and Others	MW	60	50	10	2	10	0	132
Total	MW	15,330	46,800	45,690	27,362	11,340	38,080	184,602

Data source: China Electric Power Yearbook 2010.

Table A16. Installed capacity of the Central China Power Grid in 2008

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal power	MW	9,340	42,680	14,210	14,430	6,660	12,770	100,090
Hydropower	MW	3,710	3,020	29,050	10,650	4,060	22,240	72,730
Nuclear	MW	0	0	0	0	0	0	0
Windpower and Others	MW	30	30	10	0	0	0	70
Total	MW	13,080	45,730	43,270	25,080	10,720	35,010	172,890

Data source: China Electric Power Yearbook 2009.

Table A17. Installed capacity of the Central China Power Grid in 2007

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal power	MW	9,270	38,540	13,040	13,360	6,370	12,000	92,580
Hydropower	MW	3,570	2,740	24,020	9,220	2,240	19,860	61,650
Nuclear	MW	0	0	0	0	0	0	0
Windpower and Others	MW	0	0	10	17	24	0	51
Total	MW	12,840	41,280	37,070	22,597	8,634	31,860	154,281

Data source: China Electric Power Yearbook 2008.

Table A18. Calculation of BM emission factor of the Central China Power Grid

	2007	2008	2009	2010	Capacity added in 2007-2010 ¹	Capacity added in 2008-2010 ²	Share in added capacity
	A	B	C	D	E	F	G
Thermal (MW)	92,580.00	100,090.00	105,240.00	113,370.00	34,850	22,580.0	61.85%
Hydropower (MW)	61,650.00	72,730.00	79,230.00	87,110.00	21,260	10,180.0	37.73%
Nuclear (MW)	-	-	-	-	-	-	0.00%
Windpower & Other (MW)	51.00	70.00	132.00	283.00	232	213	0.41%



Total (MW)	154,281.00	172,890.00	184,602.00	200,763.00	56,342.0	32,973.0	100.00%
Percentage of 2010 capacity					28.06%	16.42%	

1,2: The newly added installed capacity was calculated based on total incremental capacity, retired capacity and newly added installed capacity for pumping and storing energy.

$$EF_{grid,BM,y} = 0.7651 \times 61.85\% = 0.4733 \text{ tCO}_2/\text{MWh}$$

Combined margin emission factor:

Table A19. Calculation of Combined margin emission factor of the Central China Power Grid

	value	weight	CM
OM (tCO ₂ /MWh)	0.9944	0.50	0.7338
BM (tCO ₂ /MWh)	0.4733	0.50	



Appendix 5: Further background information on monitoring plan

Not applicable, left blank intentionally.



Appendix 6: Summary of post registration changes

Not applicable, left blank intentionally.

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Registration		