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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Hekou 23MW Hydropower Project
Version：02
Date: 26/11/2010

Version of PDD	Date
Version 01 (published for GSP)	12/07/2010
Version 02 (revised)	26/11/2010

A.2. Description of the project activity:

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The Hekou 23MW Hydropower Project (hereinafter refer as ‘the Project Activity’) is located at the lower reaches of the Xiluo River, Puge County, Sichuan Province, in the P.R.China. The Project Activity is developed by SiChuan PuGe YongYu Hydropower Development Ltd (the “Project Entity”).

The Project Activity falls within sectoral scope 1: Energy Industries (hydropower generation). The project employs water diversion technology; it is a new run-of-river hydropower project with a reservoir of 46,000m^2 and has a power density of 500W/m^2. The Project Activity will install two turbines (2×11.5MW) with average annual electricity generation of 103,500MWh and expect annual net electricity delivered to the grid of 91,013MWh.

The Project Activity will utilize the hydrological resource of the Xiluo River to generate zero GHG emission electricity connecting to the Central China Power Grid (CCPG). The Project Activity will generate GHG emission reductions by displacing electricity in CCPG, which in the baseline scenario would otherwise be supplied by the CCPG which is dominated by fossil fuel fired power plants. The Project Activity is expected to achieve emission reductions of GHG by an estimated amount of 77,621tCO_2e per year during the first crediting period.

The baseline scenario of the Project Activity is the same as the scenario prior to the start of the implementation of the project.

The Project Activity will benefit local sustainable development in the following ways:

- To improve the local and regional economy by providing electricity to meet increasing demands;
- To support the development of the local economy by increasing job opportunities and build infrastructure such as access roads and bridges;
- To make greater use of hydropower renewable energy generation resources for sustainable energy production;

- To abate local air pollution (NO_x, SO_x) caused from fossil fuel-fired power plants by supplying zero-emission renewable energy to the CCPG.

A.3. Project participants:

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Name of Party involved (*)((host) indicates a host Party)	Private and/or public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as Project participant (Yes/No)
The People's Republic of China (host)	SiChuan PuGe YongYu Hydropower Development Ltd	No
The United Kingdom of Great Britain and Northern Ireland	Trading Emissions PLC	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

Please see Annex I for detailed contact information.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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The People's Republic of China

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

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Sichuan Province

A.4.1.3. City/Town/Community etc:

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Puge County, Liangshan Yi Autonomous Prefecture

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

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The Project Activity is located in Puge County, Liangshan Yi Autonomous Prefecture of Sichuan Province. It is 8km far from the centre of Puge County. The geographical coordinates of this project shown as follows:

Ref: (FSR)	North latitude	East longitude
Dam	102°35′31″E	27°27′21″N
Powerhouse	102°33′36″E	27°23′49″N

Figure A-1: Location of the Project activity

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

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Sectoral Scope 1: Energy Industries (renewable sources)
- Electricity generation from renewable energy (hydropower)

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

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The project is a new run-of-river hydropower plant; the main project components include the dam on the river, diversion tunnel, penstock, powerhouse and substation. There are 2 water-turbine generator units in the powerhouse with a total capacity of 23 MW (2×11.5MW). The water pressure drives the turbine to rotate through diverting water from the intake to the powerhouse, the turbine drives the generator to rotate, and thus the water energy is changed into electric energy.

Prior to the start of implementation of the project activity, there is no power generation unit at the site of the proposed project, and the electricity was supplied by the Central China Power Grid, which is a fossil fuel dominated power grid. The baseline scenario of the proposed project is the electricity supply of equal amount as the proposed project from the Central China Power Grid.

The baseline scenario of the proposed project is the same as the scenario prior to the start of the implementation of the project activity.

The proposed project involves the installation of 2 hydro turbines with capacities of 11.5 MW each, which amount to a total installed capacity of 23MW. The key technical specifications of the main equipments are listed in Table A-1 below:

Table A-1 Key technical specifications

	Parameters Name	Unit	Data	Data Source
Turbine	Model	/	HLD267-LJ-142	FSR
	Quantity	/	2	FSR
	Rated Output	MW	12.105	FSR
	Rated Rotation Speed	r/min	500	FSR
	Rated head	m	73	FSR
	Rated flow	m^3/s	18.16	FSR
	Efficiency	%	93.1	FSR
Generator	Model	/	SF11.5-12/3250	FSR
	Quantity	/	2	FSR
	Rated Capacity	MW	11.5	FSR
	Rated Voltage	kV	10.5	FSR
	Rated Current	kA	790	FSR
	Frequency	Hz	50	FSR
	Power factor	/	0.8	FSR

Environmentally Safe Technology:

The strict environmental protection measures will be taken for the project activity according to EIA report, so the project is environmental friendly.

Technology Transfer:

The project will install standard hydro power technology and equipments which will be domestically manufactured, therefore no technology transfer involved in the Project Activity.

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

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The Project activity is expected to generate an estimated annual emission reduction of 77,621 tCO_2e and 543,344tCO_2e in total during the first crediting period of the Project Activity.

Year	Annual estimation of emission reductions (tCO_2 e)
Year1	77,621
Year2	77,621
Year3	77,621
Year4	77,621
Year5	77,621
Year6	77,621
Year7	77,621
Total estimated reductions (tCO_2e)	543,344
Total number of crediting years	7 years 0 month
Annual average of estimated reductions over the crediting period(tCO_2e)	77,621

A.4.5. Public funding of the project activity:

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There is no public funding from Annex I Parties for the project.

SECTION B. Application of a baseline and monitoring methodology

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

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The applied methodology in the PDD is:

ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002/ Ver 11, Sectoral Scope: 1)[1]

[1] http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

This methodology also refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system (version 02);
- Tool for the demonstration and assessment of additionality (version 05.2).

Please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html for more information regarding the Methodology and the Tools.

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

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The Project activity meets all applicability conditions of the methodology ACM0002 as follows:

- The Project Activity is a new run of river hydropower project and the electricity generated by the project will be delivered to the CCPG. Therefore, the project is a grid connected hydropower project.
- The Project Activity results in a new reservoir. The installed capacity of the Project Activity is 23MW and the surface area at full reservoir capacity is 46,000m^2. The power density is therefore calculated as 500W/m^2, which is greater than 4 W/m^2.
- The geographical and system boundaries for the CCPG can be clearly identified and information on the characteristics of the grid is available.
- The Project Activity does not involve switching fossil fuels to renewable energy at the site of the project.

The following reasons justify the applicability of the methodological tools:

Tools for ACM0002 (version 11)	Applied in the PDD ?	Justification
Tool to calculate the emission factor for an electricity system (version 02);	Yes	This tool applied to estimate the OM, BM and CM when calculating baseline emissions for the Project Activity that substitutes grid electricity.
Tool for the demonstration and assessment of additionality (version 05.2);	Yes	This tool is included in the approved methodology ACM0002 (version 11) in order to assessing and demonstrating the project additionality. Thus, it is mandatory.
Combined tool to identify the baseline scenario and demonstrate additionality (version 05.2);	No	This tool is only applicable to project activities that make modifications to an existing installation that is operated by project participants. The proposed project is a newly built hydropower plant; therefore, this tool is not applied in the PDD.
Tool to calculate project or leakage CO2 emissions from fossil fuel combustion.	No	This tool is to calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. The proposed project is a newly built hydropower project whose power density is

		500W/m^2, according to the adopted methodology ACM0002 (version 11), the project emission PE_y is zero, and fossil fuel combustion $PE_{FF,y}$ is also zero. So this tool is not applicable to the proposed project.

As a result, the approved consolidated baseline methodology, ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" is applicable to the proposed Project activity.

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

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According to ACM0002 version 11, the spatial extent of this Project Activity boundary includes the project activity power plant and all power plants connected physically to the electricity system[2]. The electricity system of this Project Activity is CCPG, which includes Henan, Hubei, Hunan, Jiangxi, Sichuan and Chongqing city[3].

The greenhouse gases and emission sources included or excluded from the project activity boundary are shown in the following table:

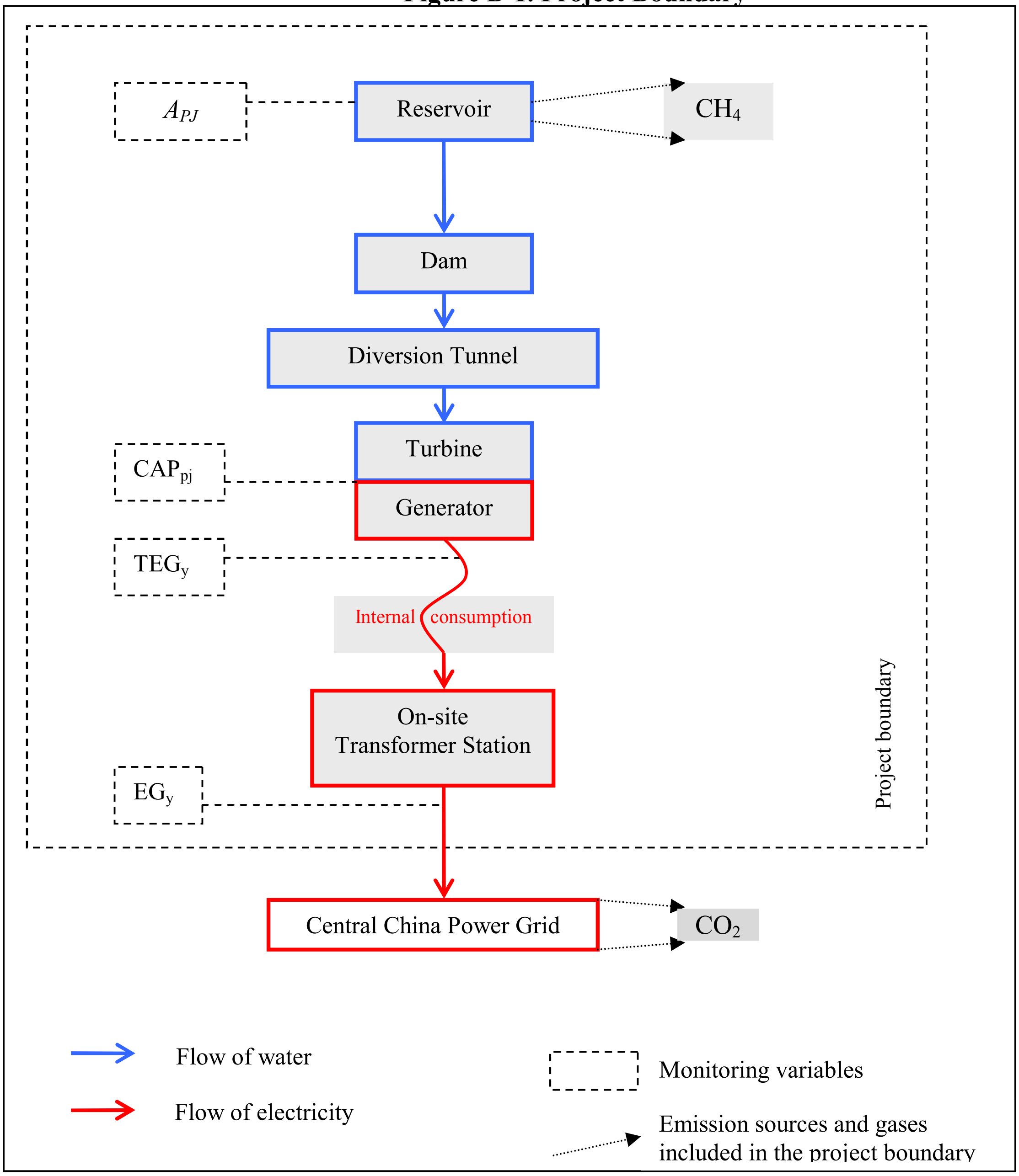
	Source	Gas	Included?	Justification/Explanation
Baseline	All power plants connected to the CCPG	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	The project activity –Reservoir Emission	CO_2	No	Zero-emissions grid-connected electricity generation from renewable energy
		CH_4	No	The power density of Project Activity is 500W/m^2 which is greater than 4 W/m^2. Therefore, CH_4 emission will not be considered.
		N_2O	No	Zero-emissions grid-connected electricity generation from renewable energy

The project activity boundary is shown in the following figure:

[2] Grid/Project activity electricity is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the Project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

[3] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2333.pdf

Figure B-1. Project Boundary



The Central China Power Grid imports electricity from the Northwest China Power Grid and exports. Accordingly, we have selected the Northwest China Power Grids as the connected electricity system. For ease of reference, when we refer throughout this PDD to Central China Power Grid, this will take account of the emissions associated with the imports of power from the connected electricity system (i.e. the Northwest China Power Grid).

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

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The project activity involves the installation of a new grid connected renewable power plant/unit. According to the description in the approved baseline methodology ACM0002, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculated described in the "Tool to calculate the emission factor for an electricity system (version 02)".

The baseline scenario boundary of the Project is the Central China Grid, so the project boundary for calculating *EF OM* and *EF BM* will be limited to the Central China Grid.

In conclusion, the baseline scenario of the proposed project is the electricity supply of equal amount as the proposed project from the Central China Power Grid. The GHG emission reduction as a result of the project activity will be calculated based on *EF OM* and *EF BM* of the Central China Grid and the amount of annual feed-in electricity supplied by the Project.

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

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CDM Consideration Milestones

CDM was seriously considered in the development of the project activity. A detailed implementation process of the project activity development can be found in the following time table:

Table B-1 Project timeline

Date	Milestone
6 Dec 2006	Environmental Impact Assessment Approval (EIA Approval)
Dec 2008	Feasibility Study Report (FSR) was published and recommended the development of the project under CDM to make the project feasible.
29 Dec 2008	Board meeting in which CDM was considered as a key factor in the investment decision.
5 Apr 2009	Signed CDM Exclusivuty Agency Agreement with R&J International
20 Jul 2009	FSR approval
04 Aug 2009	Project Final Approval
13 Aug 2009	Emission Reduction Purchase Agreement (ERPA) signed with the CER Buyer
20 Aug 2009	Construction Contract
25 Aug 2009	Construction Commencement
14 Sep 2009	Grid connection approval
10 Nov 2009	Main Equipment Purchase Agreement
30 Dec 2009	CDM Notification to NDRC
28 Jan 2010	Prior Consideration Form submitted to UNFCCC
8 Feb 2010	Receipt of the Notification from NDRC
24 Jun 2010	NDRC meeting regarding Host Nation Approval
5 Jul 2010	Validation contract with DOE

27 Jul 2010	Power Purchase Agreement (PPA)
Sep 2010	Host Nation Approval
Dec 2011 (expected)	Start operation

Decision on the starting date of the Project activity

The Construction Contract signature date was taken as the project start date, which is 23 Apr 2010. This is in line with the CDM Glossary. As per the CDM Glossary of Term ver.4 ('the Glossary'), the starting date of a CDM project activity is the earliest date at which either the implementation or construction or a real action of a project activity begins.

In light of the above definition, the starting date of a CDM project activity is further clarified in the Glossary as the date on which the project activity participant has committed to the expenditures related to the implementation or related to the construction of a project activity.

The Construction Contract date is on the 20 Aug 2009, Construction Commencement date is on the 25 Aug 2009, and the Equipment Purchase Agreement date is on the 10 Nov 2009. Therefore, the date (20 Aug 2009) of the Construction Contract signing date shall be regarded as the start date of the Project Activity, as it was the first date for the project activity to commit to the expenditures related to the implementation of the project activity.

The project activity uses the *Tool for the Demonstration and Assessment of Additionality* (version 05.2, which was revised in EB 39, to demonstrate its additionality. The tool includes the following steps:

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

Define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

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

This step is to identify realistic and credible alternative(s) available to the project activity participants or similar project activity developers that provide outputs or services comparable with the proposed CDM project activity. In the absence of the proposed project, the following alternatives are considered:

a) The proposed project activity undertaken without being registered as a CDM project activity;
b) Construction of a coal-fired power plant with equivalent installed capacity or annual electricity generation.
c) Construction of a new power plant with the same annual power generation from other renewable sources such as wind, solar, biomass and tidal.
d) Continuation of the current situation, the same service/electricity generation provided by the CCPG.

Outcome of Step 1a: Identify realistic and credible alternative scenario(s) to the project activity

These alternatives are in accordance with the description of the methodology (the additionality tool requires that the proposed project activity be included as an alternative, without the benefit from CDM).
Coal-fired power generation is the dominant power supply option in China. In the case of the Central China Power Grid, both coal-fired power generation and hydropower are common options. In 2007, coal-

fired power accounted for 64.5% of total power generation and Hydropower accounted for 35.4% of power generation.[4]

Hekou 23MW Hydropower Project has sufficient water resources while limited resources in wind, solar, biomass and tidal power[5]. Therefore, construction of a new power plant from other renewable sources other than hydropower is not feasible due to the resources reality; the alternative **(c)** is **excluded**.

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

By considering the alternative (b) stated in the sub-step1a:

The installed capacity of fossil fuel fired power plant which provides equivalent/ comparable annual electricity generation as the proposed project is less than 135MW. However, according to the regulation issued by General Office of the State Council in 2002, for a fossil fuel fired power plants of less than 135MW, if without special permission, are prohibited for construction in the areas covered by large grids[6]. So Alternative b) is not in compliance with legal and regulatory requirements and thus not a realistic alternative.

Alternative (a) and (d) is in compliance with legal and regulatory requirements.

Outcome of Step 1b:

Based on the above analysis, alternative (a) and (d) can be seen as the realistic and credible alternative scenario. Therefore the proposed project activity is not the only alternative among the ones identified that is in compliance with legal and regulatory requirements.

Step 2. Investment Analysis

The purpose of investment analysis is to determine whether the proposed project activity is economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

The *Tools for the Demonstration and Assessment of Additionality (version 05.2)* recommends three analysis methods, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

Option I: Simple cost analysis. This analysis method can be used if the project activity produces no economic benefits other than CDM related income. However, this option is not applicable to the project because the project activity generates the revenue from the sale of electricity generation.

Option II: Investment comparison analysis. This analysis method can be only used if the alternatives to the project are similar investment projects. However, this option is not applicable to the project because

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[4] China Electrical Power Yearbook 2008, p733
[5] http://baike.baidu.com/view/377792.htm
[6] Notice on Strictly Prohibiting the Installation of Fuel-fired Generators with the Capacity of 135MW or below Issued by General Office of State Council on 15 Apr 2002. Decree No [2002]-6.

the alternative to the proposed project is equivalent annual electricity supplied by CCPG which is not a concrete investment project.

Option III: Benchmark analysis. According to Guidance on the Assessment of Investment Analysis (Version 02), "if the alternative to the project activity is the supply of electricity from a grid, this is not to be considered, an investment and a benchmark approach is considered appropriate.", so the only applicable analysis method to the project is the benchmark analysis (Option III).

Sub-step 2b. Option III. Apply benchmark Analysis

In accordance with the *Economic Evaluation Code for Small Hydropower Projects* (SL16-95)[7] published by the Ministry of Water Resources of the P. R. China in 1995 (and still valid[8], the ongoing validity of this official document is further confirmed by the Ministry of Water Resources of the P. R. China in 2006[9]). For any hydropower project less than 25MW (or below/equal to 50MW in the rural area), the benchmark IRR (after tax) is 10%. Therefore, the 10% benchmark is applied in the PDD.

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

1) Parameters needed for calculation of key financial indicators

According to the feasibility study of proposed project activity, parameters needed for calculation of key financial indicators are as follows:

Table B-2 Parameters for calculation of key financial indicators

Items	Unit	Value	Reference
Installed capacity	MW	23	FSR
Annual net electricity delivered to the grid	MWh	91,013	FSR
Operation life time	Year	30	FSR
Annual operation hours	hr	4500	FSR
Total Static Investment	Million RMB	184.31	FSR
Annual Operation and Maintenance Cost	Million RMB	4.97	Calculated[10]
Electricity Tariff (exc. VAT)	RMB/kWh	0.246	FSR
Electricity Tariff (inc. VAT)	RMB/kWh	0.288	Fagai price[2005]No.667
VAT	%	17	FSR
Income tax	%	25	FSR
City maintenance & Construction tax (% of VAT)	%	5	FSR
Education surtax (% of VAT)	%	3	FSR

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[7] http://apps.lib.whu.edu.cn/12/test/gfbz/2/j/xsdpj.html

[8] http://www.cws.net.cn/guifan/bzdt/bzgg.asp

[9] http://www.chinawater.net.cn/jishujiandu/CWSNews_View.asp?CWSNewsID=24696

[10] All the data used to calculate the IRR come from the (government-approved) FSR and are used in the FSR for the calculation of the IRR.

2) Comparison of IRR for the proposed project activity and the financial benchmark

In accordance with benchmark analysis (Option III), if the financial indicators of the proposed project activity, such as the project IRR[11], are lower than the benchmark, the proposed project is not considered to be financially attractive.

Table B-3 Project IRR of the proposed project activity

	IRR
Without CERs	6.91%
Benchmark	10%
With CERs	10.83%

Table B-3 shows the project IRR of the proposed Project Activity with and without CERs revenue. The Project IRR without CERs revenue is 6.91%, which is lower than the financial benchmark. Thus, the proposed project activity is not considered to be financially attractive.

However, taking into account the CDM revenues, the project IRR increases to 10.83%, which is higher than the financial benchmark. Therefore, the CDM revenues enable the project activity to overcome the investment barrier and demonstrate its addtionality.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis shall show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. For the project activity, four parameters were selected as sensitive factors to check out the financial attractiveness. The selection of the chosen parameters and variations (±10%) of sensitivity analysis is based on the Sensitivity Analysis Guidance of '*Tool for the Demonstration and Assessment of Additionality (version 05.2)'* and '*Guidance on the Assessment of Investment Analysis (version 03)'*:

1) Total Static Investment

2) Annual O&M Cost

3) Electricity Tariff

4) Annual Power Supply

The results of sensitive analysis are shown in Table B-4 and Figure B-2 below.

Table B-4 Sensibility analysis of the project activity

	-10.00%	**-5.00%**	**0.00%**	**5.00%**	**10.00%**
Total Static Investment	8.07%	7.47%	6.91%	6.41%	5.93%
Annual power supply	5.92%	6.42%	6.91%	7.39%	7.85%
Electricity Tariff	5.92%	6.42%	6.91%	7.39%	7.85%
Annual O&M cost	7.12%	7.02%	6.91%	6.80%	6.69%

[11] For the benchmark analysis, the IRR shall be calculated as project IRR.

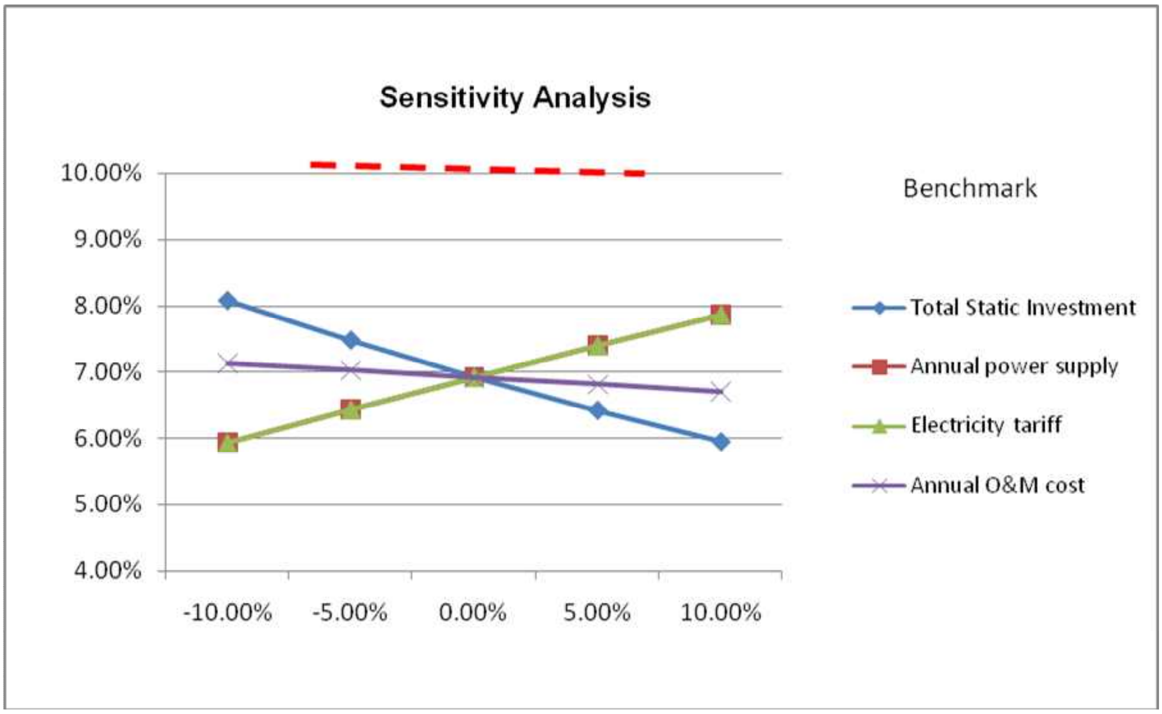

Figure B-2 Sensibility analysis of the Project activity

The project IRR of the project activity varies to different degrees in accordance with the fluctuation of three parameters within the range of negative 10 percent to positive 10 percent. It can be seen that the project IRR remains below the benchmark within the variations and thus unattractive to the investors.

The IRR of the proposed project activity exceeds or reaches the benchmark in the following scenarios:

- Total static investment is 29% below the assumption

  The total static investment of the proposed project is derived from the FSR. The FSR was completed by a Certified Design Institute, thus considered to be a reliable resource to reflect the actual economic situation of the proposed project at the time of investment decision.

  In addition, price for construction materials increased dramatically, according to the National Bureau of Statistics of China, the *Price of Industry Products*[12], *Purchasing Price Indices for Raw Materials, Fuels and Power*[13] and *Price Indices for Investment in Fixed Assets*[14] all indicate an increasing trend. Thus, the total static investment is unlikely to be 29% lower than the estimation in the FSR.

- Annual O&M cost

  The component of O&M cost such as Materials fee, Labour cost, Reservoir maintenance fee, Water resource fee, Repair and Other fees were selected according to the official regulation

[12] http://www.stats.gov.cn/tjsj/ndsj/2008/html/I0814e.htm

[13] http://www.stats.gov.cn/tjsj/ndsj/2008/html/I0815e.htm

[14] http://www.stats.gov.cn/tjsj/ndsj/2008/html/I0816e.htm

document[15]. Furthermore, the staff salary keeps increasing in the past few years according to the report from National Bureau of Statistics. Therefore, the IRR of the Project Activity would never each 10%, even when the annual O&M cost 100% lower than the estimation in the FSR.

- Electricity Tariff is 36.20% higher than the assumption

  The tariff adopted in the PDD is from the Chinese NDRC tariff document of ''Fa Gai Price [2005] No.667', which stated that the tariff for newly built hydropower plant in Sichuan Province is 0.288RMB/kWh (inc.VAT). This tariff policy has further confirmed by Sichuan Province with an official document of 'Chuanjiafa[2006]No.145' and 'Chuanjiadianfa[2009]No.59'. Those documents are only available official tariff documents regarding hydropower plant before and after the investment decision-making stage.

  From 2005 to now[16], the electricity tariff is remains stable (0.288RMB/kWh inc.VAT), as the electricity tariff is strictly controlled by the central and local government in order to stabilize the power system, known as the "Electricity System Reform Program' published by the State Council in Feb 2002[17]. Thus, the 36.20% increase of electricity tariff is unlikely to occur, which suggests the project would not reach the benchmark.

- Annual net power supply is 36.20% higher than the assumption
  The electricity output of the Project Activity is determined by the operational hours. The annual net electricity generation delivered to the grid adopted in the PDD was calculated on the basis of annual operation hour of 4500 provided in the FSR. This annual operation hour was calculated from Ningnan Station hydrographical data covering 45 years from 1959 to 2003. The hydrological data is reliable and would not vary significantly during project lifetime. In addition, the installed capacity would not change during the project lifetime. Therefore, it is very unlikely to expect the operation hour of the project activity realize an average annual increase of 36.20% in terms of the water resources.

To conclude, the sensitivity analysis shows that without CER revenue, the project IRR after tax is unlikely to reach the benchmark, which further demonstrates the additionality of the project activity.

Step 4. Common practice analysis

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

According to the *Tool for the demonstration and assessment of additionality (version 05.2)*: '*projects are considered similar if they are in the same country/ region and/ or rely on a broadly similar technology,*

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[15] NDRC (Aug 2006)*Methods and Parameters for Economic Assessment of Construction Projects (version 3)*, China Planning Press.

[16](2005) http://www.pzhjg.gov.cn/ShowArticleContent.asp?InfoId=1115
(2006) http://www.scpi.gov.cn/zcfg/zcfg-content.asp?id=1972
(2007) http://www.shp.com.cn/news/info/2007/8/6/1410022838.html
(2008) http://www.scpi.gov.cn/newzcfg/zcfg-content.asp?id=3158
(2009) http://www.sc.gov.cn/zwgk/gggs/wj/200911/t20091120_854602.shtml

[17] State Council Notice on Electricity System Reform Program (State Council[2002]No.5) or: http://www.ndrc.gov.cn/xwfb/t20050708_28096.htm

are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.'. Therefore, Hydropower projects which less than 50MW and started operation since 2002 in Sichuan Province have been considered as similar to the proposed project activity.

In China, there are significant differences between policies, regulations and economic conditions, as well as great variation in geological and hydrological conditions between different provinces[18]. Thus, hydropower projects in different provinces have different operational environments. The Project Activity is located in Sichuan province of the P.R.China. Therefore, in line with standard practice for Chinese CDM projects, Sichuan province is considered as the boundary for common practice analysis which in the same country/region, and could give comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.

As mentioned earlier, the state council implemented the 'Electricity System Reform Program' in 2002 (please see footnote 16 for reference). Since then, it has substantially changed the regulatory framework and investment environment for power industry. The major changes included reforming ownership of power plants and power grids, initiating a competitive bidding mechanism for new entities (such as private electricity enterprises) wishing to supply power to the grid and building a competitive market. Therefore, in the common practice analysis only considers power plants built since 2002.

Furthermore, project above 50MW are excluded in accordance with the *SL252-2000 Standard for Classification and Flood Control of Water Resources and Hydroelectric Project* which classifies projects above 50MW as large- and middle-scale.

Based on above conditions, 8 similar hydropower projects which listed in the China Hydropower Yearbook (2006) have been selected as common practice analysis, more detailed information are shown in the table below:

B-5 listed Sichuan Hydropower Projects for common practice

Project name	**Starting time**	**Capacity (MW)**	**Company Characteristic**	**Unit investment cost** (RMB/kW)	**Annual operation hours**	**IRR (%)**
Niujiaowan III Hydropower Station	2003	25	State holding enterprises [19]	3,650[20]	6,782h[21]	16.99[22]
Gongjiaheba Hydropower Station	May 2004	20	State-owned enterprise[23]	5,556[24]	N/A	n/a
Lamagou Hydropower	Jun. 2003	21	State-owned	4,734[26]	5,500[27]	21.74[28]

[18] http://www.hydrochina.com.cn/zgsd/zgsd_zy.jsp

[19] http://www.cnstock.com/ssnews/2004-4-9/qitaban/t20040409_544754.htm;
http://www.sse.com.cn/cs/zhs/scfw/gg/ssgs/2009-03-31/600505_20090331_4.pdf

[20] http://www.cnstock.com/ssnews/2004-4-9/qitaban/t20040409_544754.htm

[21] http://www.chinapower.com.cn/article/1004/art1004225.asp

[22] http://www.gfhfzq.com.cn/start/Info_Content.aspx?fromTable=GSTZQKSM&guid=%7B22FFE439-AB73-11D7-965B-00A0C92674A3%7D

[23] http://7j.sinohydro.com/Article_Show.asp?ArticleID=11616

[24] http://www.jobui.com/job/36562821/

Station			enterprise[25]			
Zhaza Hydropower Station	Nov. 2008	32	State-owned enterprise[29]	12,584[30]	4,281[31]	n/a
Tongkou Hydropower Station	2002	45	State-owned enterprise[32]	7,777[33]	5,111h [34]	18[35]
Sanjiang Hydropower Station	2002	45	Foreign capital[36]	5,556[37]	4,735[38]	15[39]
Shazui Hydropower Station	2002	38	Private enterprise[40]	4,289[41]	6,374h[42]	n/a
Huilongqiao Hydropower Station	2002	50	Private enterprise[43]	5000[44]	n/a	n/a

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

As can be seen from the above table, there are some major distinctions between the proposed project and the first 6 projects listed in table B-5. They are built by large state-owned and state holding enterprises or

[25] http://finance.ifeng.com/roll/20090629/854598.shtml

http://www.chan-quan.com/Projects/chanquan/2008/6710.shtm

[26] http://company.zhaopin.com/P2/CC3140/9241/CC314092416.htm

[27] http://finance.ifeng.com/roll/20090629/854598.shtml

[28] http://www.cs.com.cn/cqzk/05/200805/t20080526_1471178.htm

[29] http://www.eiacn.com/news/gsdc/hpgs/2217.html,

http://www.china-cdt.com/aboutdatang/memberenterprise/sichuancompany/377696.html

[30] http://www.eiacn.com/news/gsdc/hpgs/2217.html

[31] http://www.eiacn.com/news/gsdc/hpgs/2217.html

[32] http://www.scol.com.cn/nsichuan/bsxw/20030618/200361812815_sc.htm

[33] http://www.scol.com.cn/nsichuan/bsxw/20030618/200361812815_sc.htm

[34] http://www.scol.com.cn/nsichuan/bsxw/20030618/200361812815_sc.htm

[35] http://www.chinaqw.com/node2/node116/node120/node334/node336/userobject6ai4672.html

[36] http://www.iac.org.cn/default.asp?pg=21&channel_id=20&item_id=128&info_id=1526

[37] http://www.iac.org.cn/default.asp?pg=21&channel_id=20&item_id=128&info_id=1526

[38] http://www.iac.org.cn/default.asp?pg=21&channel_id=20&item_id=128&info_id=1526

[39] http://www.chinaqw.com/node2/node116/node120/node334/node336/userobject6ai4672.html

[40] http://www.gzz.gov.cn/qy/58/index.html

http://www.viphr.com/Html/Company/11340.html

[41] http://www.gzz.gov.cn/qy/58/index.html

[42] http://www.gzz.gov.cn/qy/58/index.html

[43] http://www.chinarein.com/qkhc/detail.asp?id=3984

[44] http://www.chinarein.com/qkhc/detail.asp?id=3984

joint venture companies. The owner of Niujiaowan III is the Sichuang Xichang Electric Power Co., Ltd which is large state-owned listed company[45]. Gongjiaheba belongs to SINOHYDRO Bureau 7 Co., Ltd and SINOHYDRO is a State-Owned Enterprise under the supervision of State-Owned Assets Supervision and Administration Commission (SASAC) of the State Council[46]. Zhaza belongs to China Datang Corporation which is an extra large scaled power generation enterprise group, a solely state-owned corporation directly managed by the CPC Central Committee and the experimental state-authorized investment and state share-holding enterprise ratified by the State Council[47], can easily get access to investment and other financial incentives (e.g. preferential enterprise income tax[48]) from national and local government, and have stronger ability against financial risk. Sanjiang belongs to Meiya Power Company Limited which is a leading independent power producer in north Asia and owned by Standard Chartered Private Equity Limited, Standard Chartered IL & FS Asia Infrastructure Growth Fund Company Pte Limited and certain investment funds managed by Noonday Asset Management Asia Pte. Ltd and Farallon Capital Management, L.L.C[49].

Compared with private investors, large state-owned and state holding enterprises or joint venture companies have essential distinctions and obvious superiority. First of all, it is the capital access ability. Joint-venture companies have much stronger financing capabilities and risk resistance capacities; large state-owned and state holding enterprises have strong capital access ability because of their large capital reserves and operational capacity. Secondly, in the actual operating experience and management level, state-owned and state holding enterprises or joint venture companies have conducted many practical projects of different sizes and accumulated rich experiences in Hydro construction and operation. That's not comparable for private investors. And also state-owned and state holding enterprises have stronger negotiating power with the grid companies about the amount of net power supply to the grid. Joint venture companies enjoy the preferential enterprise income tax.

Meanwhile, the investment per kW of Niujiaowan III, Gongjiaheba, Lamagou, Sanjiang, Shazui and Huilongqiao project are 3,650RMB, 5,556RMB, 4,734RMB, 5,556RMB, 4,289 RMB and 5000RMB, while the proposed project is 8,013RMB, so it is not comparable to the proposed project.

Furthermore, the operation hour of Niujiaowan III, Lamagou, Tongkou and Shazui project are 6,782h, 5,500h, 5,111h and 6,374h, these projects have higher operating hours (compared with project activity of 4500h) which would results better financial return.

To summarize, it can be confirmed that the project activity is additional and not (part of) baseline scenario. It has been shown that the proposed project is not financially attractive. In addition, the proposed project did not enjoy the preferential policies and tariffs for the similar projects discussed in the Common Practice Analysis. Without the CDM revenues, the project activity would not be implemented due to the financial barrier and the equivalent electricity service will then be provided by the CCPG. As a result, the reduction of GHG emissions would not be realized. The above additionality analysis provides

[45] http://www.hudong.com/wiki/%E8%A5%BF%E6%98%8C%E7%94%B5%E5%8A%9B

[46] http://eng.sinohydro.com/en/idems/profile.asp

[47] http://www.china-cdt.com/en/index.html

[48] http://www.sc-n-tax.gov.cn/portal/site/site/portal/sc/New_common_c.portal%5BcontentId=100531%5D%5BcategoryId=4298%5D%5BcategoryCode=001002001001%5D

[49] http://www.meiyapower.com/mpcweb/en/tls/mpcweb/about

sufficient evidence that the registration of the CDM revenues can enable the project activity to overcome the barriers it faces.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the approved methodology ACM0002 (version 11): consolidated baseline methodology for grid-connected electricity generation from renewable resources, the emission reduction (ER_y) of the project during a given year y is the difference between the baseline emission (BE_y) and the project emission (PE_y). The emission reduction ER_y during a given year *y* is calculated as follows:

$$ER_y = BE_y - PE_y \quad (1)$$

The steps to calculate PE_y, BE_y and to confirm ER_y are detailed in the following:

STEP 1: estimate the Project Emission PE_y

As the methodology defined, the project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (2)$$

Where:

PE_y =Project emissions in year y (tCO_{2e}/yr)

$PE_{FF,y}$ =Project emissions from fossil fuel consumption in year y (tCO_2/yr)

$PE_{GP,y}$ =Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO2e/yr)

$PE_{HP,y}$ =Project emissions from water reservoirs of hydro power plants in year y (tCO2e/yr)

The proposed project is a newly built hydropower project without fossil fuel consumption onsite, thus, $PE_{FF,y}$ and $PE_{GP,y}$ is not applicable to the project activity. $PE_{FF,y}$=0, $PE_{GP,y}$=0.

The main emission in hydropower projects is methane caused by inundation when the reservoir is formed. The inclusion of these emissions is determined by the project's power density. The formula is shown below:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (3)$$

PD =power density of the project activity (W/m^2）;

Cap_{PJ} =installed capacity of the hydro power plant after the implementation of the project activity (W);

Cap_{BL} =installed capactity of the hydro power plant before the project activity (W); For new hydro power plants, this value is zero;

A_{PJ} =Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2);

A_{BL} =Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new projects the value is zero.

Referring to the FSR, when nominal water level reached the surface of reservoir is 46,000m^2 and the installed capacity is 23MW. Thus the power density is 500W/m^2. According to the methodology, if the power density (PD) of the project activity is greater than 10W/m^2, $PE_{HP,y}$=0, thus, **PE_y=0.**

STEP 2: estimate the Baseline Emission (*BE_y*)

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad (4)$$

Where,

BE_y =Baseline emissions in year *y* (tCO_2/yr).

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh); calculated using the 'Tool to calculate the emission factor for an electricity system (version02)'.

The calculation of $EG_{PJ,y}$ is different for (a) Greenfield plants, (b) retrofits and replacements, and (c) capacity additions. The Project Activity is the installation of a new grid-connected hydropower plant at a site where no renewable power plant was operated prior to the implementation of the project activity, thus case *(a) Greenfield renewable energy power plants* is appropriate for the project activity:

$$EG_{PJ,y} = EG_{facility,y} \quad (5)$$

Where,

$EG_{facility,y}$ =Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

The Project Activity is likely to import the electricity from CCPG in case of equipment shutdown or overhaul, so the quantity of net electricity supplied to the grid will be calculated as follows:

$$EG_{PJ,y} = EG_{facility,y} = EG_{facilitytogrid,y} - EG_{gridtofacility,y} \quad (6)$$

Where,

$EG_{facility\ to\ grid,y}$=Quantity of net electricity supplied by the project plant/unit to the grid in year y (MWh/yr)

$EG_{grid\ to\ facility,y}$ = Quantity of electricity supplied by the grid to the project plant/unit in year y (MWh/yr)

The *Tool to calculate the emission factor for an electricity system (version 02)* provides for a step-wise approach to calculate the $EF_{grid,CM,y}$. These steps include:

Step 1. Identify the relevant electricity systems
Step 2. Choose whether to include off-grid power plants in the project electricity system (optional).
Step 3. Select a method to determine the operating margin (OM)

Step 4. Calculate the operating margin emission factor according to the selected method
Step 5. Identify the group of power units to be included in the build margin (BM)
Step 6. Calculate the build margin emission factor
Step 7. Calculate the combined margin (CM) emission factor

Substep 1. Identify the relevant electricity system

The project employs the delineation of the project electricity system and connected electricity system published by Chinese DNA. The electricity generated by the project is connected to the CCPG which includes the provincial grids of: Henan, Hubei, Hunan, Jiangxi, Sichuan and Chongqing grid. Therefore, the CCPG is identified as the project electricity system of the Project Activity.

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

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.

Based on the actual situation of China, off-grid power plants are not significant as electricity grids under government control are dominant power supplier. Therefore, option Ⅰ has been chosen for the calculation.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM;

(b) Simple adjusted OM; or

(c) Dispatch Data Analysis OM; or

(d) Average OM.

The Simple OM method (option a) can only be used where low operating cost/ must-run resources constitute less than 50% of total grid generation. In recent 5 years (Table B-6), electricity generated by the hydropower of CCPG and other renewable energy is less than 50% of the total power generation. Simple OM method is then employed.

Table B-6 Percentage of low-cost/must run resources in CCPG during year 2003～2007[50]

Year	2003	2004	2005	2006	2007
Percentage (%)	34.43	38.54	38.18	35.30	35.46

For data vintage, the *Ex ante* option is selected. The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emission 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.

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

[50] China Electric Power Yearbook 2004～2008

The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

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.

As the fuel consumption data is unavailable for each power plant/unit, Option A cannot be used.

For Option A, In China, all power grids and power plants keep their specific net electricity generation and the fuel consumption data as business secrets, so these data is not publicly available, thus Option B is adopted to calculate Simple OM.

Where Option C is adopted, the simple OM emission facto is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y})}{EG_y} \tag{7}$$

Where,

$EF_{grid,OMsimple,y}$ = the simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh).

$FC_{i,y}$ = Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit).

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

$EF_{co_2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ).

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

i = All fossil fuel types combusted in power sources in the project electricity system in year *y*.

y = the three most recent years

According to the calculation of the Chinese DNA, adopting *ex ante* calculation, the $\boldsymbol{EF_{grid,OM,y}}$ **is 1.1255 tCO2e/MWh**, for calculation details see Annex 3.

Substep 5. Identify the group of power units to be included in the build margin

The sample group of power units *m* used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently; or

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

We choose sample group (b) to calculate the build margin as the power units described in (b) comprises the larger annual generation.

In terms of vintage of data, Option 1 is adopted by the proposed project for build margin calculation, which is defined as follow:

'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.'

Substep 6. Calculate the build margin emission factor
The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \tag{8}$$

Where,

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

Because the generation capacities of coal, oil and gas fueled power cannot be separated from the current statistic data, the following steps are adopted in the calculation: firstly the PDD 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; then based on the emission factor under the level of best commercialized technical efficiency, calculate the fuelled power emission factor of the grid; finally multiply the fuelled power emission factor and fuelled power proportion of the total power, then resulting the BM of the grid.

The detailed procedure and formula are as follows:

1. **Calculate the specific proportions of CO_2 emission induced by solid, liquid and gaseous fuels in local grid with the following formulas:**

$$\lambda_{Coal,y} = \frac{\sum_{i \in Coal,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \tag{9}$$

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

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

Where,

λ_{Gas}, λ_{Oil} and λ_{Coal} = respectively the percentages of CO_2 emissions from the gas-fired, oil-fired, coal-fired power plants in CO_2 emissions from total thermal power plants;
$F_{i,j,y}$ =The amount of fuel *i* consumed by province *j* in year(s) *y;*
$NCV_{i,y}$ =Net calorific value of fuel *i* in year *y* (GJ/t for solid and liquid fuel, GJ/m^3 for gas fuel);
$EF_{CO2,i,j,y}$ =Emission factor of fuel *i* in *j* province in year(s) *y*;

Coal, Oil and Gas refer to the solid, liquid and gaseous fuel.

2. Calculated the emission factor of fossil fuel plants

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \qquad (12)$$

Where,

$EF_{Thermal,y}$ =Emission factor of thermal power plants;
$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ refers to the emission factors of advanced coal-fired, oil-fuelled and gas-fuelled power generation technology.

3. Calculate the $EF_{grid,BM,y}$ of the grid

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \qquad (13)$$

$EF_{grid,BM,y}$ = the Build Margin (BM) emission factor of CCPG in year *y*;
$CAP_{Total,y}$ =the total newly-installed capacity beyond 20% of the current installed capacity;
$CAP_{Thermal,y}$ =the newly-installed capacity of thermal power plants;
$EF_{Thermal,y}$ =the emission factor of thermal power plants.

According to the calculation of DNA of China, adopting *ex ante* calculation, the **$EF_{grid,BM,y}$ is 0.5802 tCO_2e/MWh.** Please see Annex 3 for details.

Substep 7. Calculate the combined margin (CM) emission factor

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \qquad (14)$$

Where:

$EF_{grid,BM,y}$ =Build margin CO_2 emission factor in year y (tCO_2/MWh)

$EF_{grid,OM,y}$ =Operating margin CO_2 emission factor in year y (tCO_2/MWh)

W_{OM} = Weighting of operating margin emissions factor (%)

W_{BM} =Weighting of build margin emissions factor (%).

The weighting W_{OM} and the weighting W_{BM} are both taken 0.5 as default for the first crediting period.

For the second and third crediting period, W_{OM} = 0.25 and W_{BM} = 0.75.

For the first crediting period, the weights w_{OM} and w_{BM} are 50% (i.e., $w_{OM} = w_{BM} = 0.5$).

According to the formula, the baseline emission factor of CCPG in 2009 is:

$\mathbf{EF_{grid,CM,y}}$ **=** 0.5×(1.1255+0.5802)=**0.85285tCO₂e/MWh**.

STEP 3: estimate the Leakage (*LE_y*)

According to ACM0002 (version 11), no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activites such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected. **LE_y=0**

STEP 4: estimate the emissions reductions (ER_y)

$$ER_y = BE_y - PE_y \qquad (15)$$

Where,

ER_y = Emission reductions in year y (tCO_2e/yr)

BE_y = Baseline emissions in year y (tCO_2e/yr)

PE_y = Project emissions in year y (tCO_2e/yr)

The estimation for the emission reductions is demonstrated in B.6.3.

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

Data / Parameter:	EG_y
Data unit:	MWh
Description:	The net electricity generated and delivered to the grid by all power sources serving the system
Source of data used:	*China Electric Power Yearbook（2006~2008）*
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures	Official statistical data

actually applied :	
Any comment:	

Data / Parameter:	$F_{i,j,y}$
Data unit:	10^4 t, 10^8 m^3
Description:	The amount of fuel *i* consumed by province *j* in year(s) *y*
Source of data used:	*China Energy Statistical Yearbook (2006 ~2008)*
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official Statistical data
Any comment:	

Data / Parameter:	$PR_{m,y}$
Data unit:	%
Description:	The internal power consumption rate of power plants in province *j* in CCPG in year *y*.
Source of data used:	*China Electric Power Yearbook 2006-2008*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$EF_{CO2,i,j,y}$
Data unit:	tCO_2/TJ
Description:	The CO_2 emission factor of fuel *i* in *j* province in year(s) *y*;
Source of data used:	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied:	See Annex3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	

Data / Parameter:	$FC_{i,y}$
Data unit:	T,km^3
Description:	The amount of fossil fuel type *i* consumed in the project electricity system in year *y*

Source of data used:	*China Energy Statistics Yearbook (2006-2008)*
Value applied:	See Annex3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistical data
Any comment:	

Data / Parameter:	$NCV_{i,y}$
Data unit:	kJ/kg or kJ/m^3
Description:	The net calorific value (energy content) per mass or volume unit of fuel i in year y.
Source of data used:	*China Energy Statistical Yearbook 2008*
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official data
Any comment:	

Data / Parameter:	CAP_{BL}
Data unit:	MW
Description:	Installed capacities of the hydro power plant before the implementation of the project activity.
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	For new hydro power plant, this value is zero.
Any comment:	

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full.
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or	For new projects the value is zero.

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$EF_{Coal,Adv,y}$
Data unit:	%
Description:	The power supply efficiency of coal-fired power plants with best technology commercially available
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids
Value applied:	38.10%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$EF_{Oil/Gas,Adv,y}$
Data unit:	%
Description:	The power supply efficiency of oil/gas-fired power plants with best technologies commercially available
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids
Value applied:	49.99%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	the operating margin CO_2 emission factor in year *y*
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids
Value applied:	1.1255
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese NDRC.
Any comment:	

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	The build margin CO_2 emission factor in year *y*
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids
Value applied:	0.5802
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese NDRC.
Any comment:	

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	The combined margin CO_2 emission factor in year *y*
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids
Value applied:	0.85285
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese NDRC.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

1. **Project Emissions**

According to B6.1, $PE_y = 0$

2. **Baseline Emissions**

According to the formula (7)-(14) in section B.6.1, the results of $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ and $EF_{grid,CM,y}$ are listed in following Table B-7 , the detailed calculation is shown in Annex 3.

Table B-7 Calculating result of baseline emission factor of CCPG

$EF_{grid,OM,y}$ (tCO_2e/MWh)	$EF_{grid,BM,y}$ (tCO_2e/MWh)	$EF_{grid,CM,y}$ (tCO_2e/MWh)
1.1255	0.5802	0.85285

According to the formula (4) in Section B.6.1, the baseline emissions (BE_y) of the project in a typical year are calculated as follow:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} = 91{,}013\text{MWh} \times 0.85285\ tCO_2e\ /MWh = 77{,}621\ tCO_2e\ /yr$$

3. Leakage

According to Section B.6.1., no leakage emissions (LE_y) are considered.

4. Emission Reductions

According to the formula (15) in Section B.6.1, the emission reductions (ER_y) of the project in a typical year are calculated as follows:

$$ER_y = BE_y - PE_y = 77{,}621 - 0 = 77{,}621 \text{ tCO}_2\text{e/yr}$$

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

Year	**Estimation of project activity emissions (tonnes of CO_2e)**	**Estimation of baseline emissions (tonnes of CO_2e)**	**Estimation of leakage (tonnes of CO_2e)**	**Estimation of emission reductions (tonnes of CO_2e)**
Year 1	0	77,621	0	77,621
Year 2	0	77,621	0	77,621
Year 3	0	77,621	0	77,621
Year 4	0	77,621	0	77,621
Year 5	0	77,621	0	77,621
Year 6	0	77,621	0	77,621
Year 7	0	77,621	0	77,621
Total (tonnes of CO_2e)	0	543,344	0	543,344

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{facility\ to\ grid,y}$
Data unit:	MWh
Description:	Quantity of electricity supplied by the project plant/unit to the grid in year y.
Source of data to be used:	Project activity site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	In this PDD, the net electricity delivered to the grid is 91,013MWh
Measurement procedures (if any)	Electricity meters
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures to be applied:	Cross check measurement results with records for sold electricity
Any comment:	The metering instruments will be checked/calibrated annually.

Data / Parameter:	$EG_{grid\ to\ facility,\ y}$
Data unit:	MWh
Description:	Electricity consumed by the Project activity during its operation supplied by CCPG in year y.
Source of data to be used:	Project site, it was assumed as 0 in the PDD and the actual data will be based on meter reading
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Measurement procedures (if any)	Electricity meters
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures to be applied:	Cross check with the main and auxiliary ammeters
Any comment:	The metering instruments will be checked/ calibrated annually.

Data / Parameter:	$\boldsymbol{Cap_{PJ}}$
Data unit:	MW
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data:	Project site
Measurement procedures (if any):	Determine the installed capacity based on recognized standards and labels of the generator and turbines.

Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$\boldsymbol{A_{PJ}}$
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data:	Project site
Measurement procedures (if any):	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

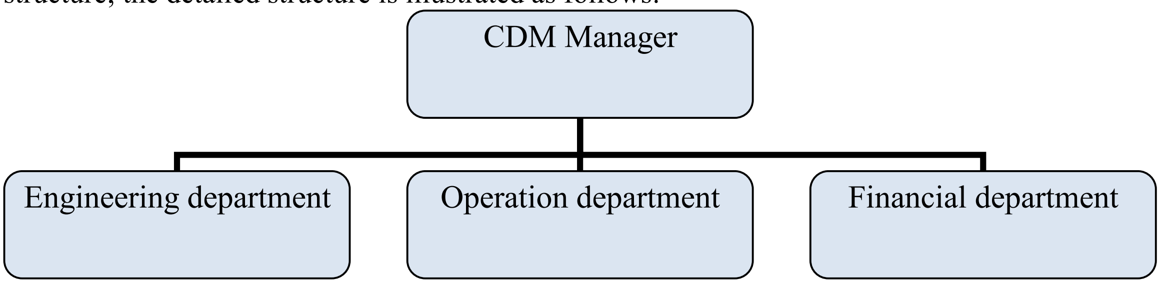
B.7.2 Description of the monitoring plan:

1. Monitoring subject

The aim of this Monitoring Plan is to make sure that data monitored and required for verification and issuance are to be properly measured and archived during the project operation period. The main data to be monitored are the electricity delivered to CCPG by the project and electricity consumed by the project activity from the CCPG.

2. Management structure and responsibilities

In order to obtain rational monitored data, the project owner established a monitoring management structure; the detailed structure is illustrated as follows:



FigB-3 Operational and Management Structure

The main responsibility of each apartment:

1. CDM Manager: Take charge of the implementation and management of the monitoring plan overall. Be responsible for communicating with EB, DOE and CDM project consulting agent and CER buyer.
2. Engineering Department: responsible for keeping maintenance of the facilities and tools of the hydropower plant, ensuring all of the equipments (e.g. hardware and software of the computer monitoring system, turbines and generators) are working properly.
3. Operation department: Working in the control room of the hydropower plant, be responsible for daily operation which includes record the operation period, meter reading and recording of the electricity data in paper work as well as electronically.
4. Financial Department: be responsible for the collection of electricity sale invoices (include net electricity supplied to the grid, and consumed from the grid), calculation of emission reductions, monitoring the financial inflow and outflow.

3. Monitoring apparatus and installation

The metering equipment (include M1 and M2. Please see Table B-5 for meter description) will be properly installed at the inlet of the Project Activity Site and checked annually according to the requirement from *Technology & Management Regulations for Power Metering Devices* (DL/T448－2000). The accuracy of the meters will be 0.5S or higher than 0.5S meeting the national standard. The metering equipment will be checked by the Project Entity and Grid Company before operation. The project is planned to connect with Sichuan Xichang Power Grid, the power meter diagram (FigB-4) indicates the principles for positioning of metering instruments that will be used in the monitoring of emission reductions. The generated electricity is stepped up from the power generator of 10.5 kV to 110kV through the power station transformer to the Songtuo transmission line, then further stepped up to 220kV delivered to the Central China Power Grid.

FigB-4 Power Meter diagram of the Project Activity

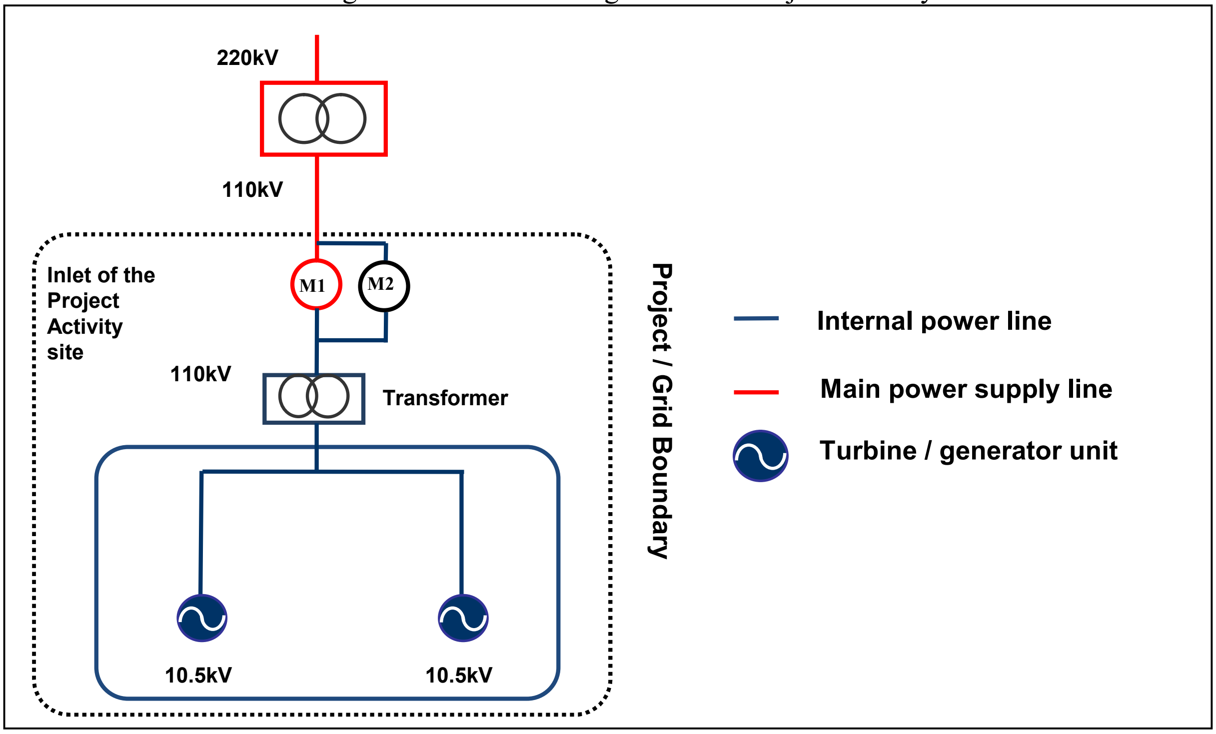


Table B-5 description of the meters appeared in the Power Meter Diagram

Meter	Type	Accuracy	Function
M1	main electricity meter (bi-directional)	0.5s or above, meet national standard (*Technology & Management Regulations for Power Metering Devices* (DL/T448－2000)	monitoring the electricity delivered to the grid and electricity imported from the grid
M2	Back-up meter (bi-directional)		Operating the same time as M1, in case M1 inaccurate or break down.

4. Data collection procedure

The specific steps for data collection and reporting are listed below:

- The data is measured continuously and at least recorded monthly; The Project Entity reads the main/backup meter and records data on a regular day of every month.
- The Project Entity records the data of net electricity delivered to the grid, and consumed from the grid.
- Grid Company, together with the Project Entity reads the main meter and records data at a regular time of day of each month.
- Electricity sale invoices will be provided by the grid company once the net electricity supplied to the grid is confirmed.
- The Project Entity provides two meters' readings and photocopies of invoices to DOE for verification.

5. Quality control

1) Calibration of meters

The calibration of meters conducted by qualified organization must comply with national standards and industrial regulations to ensure the accuracy. The meters will be sealed for safety after calibration. The calibration records will be archived together with other monitoring records.

2) Error Handling and Emergency Control

Once the project start operation, in the event of the electricity measuring device inaccurate or breakdown, the electricity sale company (PO) and the grid company will notice each other immediately, and the project entity will try to restore the normal monitoring system as soon as possible. During this period, the electricity sold to grid shall be confirmed according to the requirement of *Power Supply Operation Regulation* and *Management Regulation for Power Metering Devices* (DL/T448-2000); if it is difficult to confirm, the amount of electricity sold to the grid will be finally agreed by PO and the grid company by check the recorded data of each related meters.

All the records of showing net electricity supplied to the grid (e.g. sale invoices, etc) will be double check by the CDM consultant and DOE. Where errors in the calculations are discovered by either of these Parties, the monitoring report shall be modified and the corrected version shall be resubmitted to the verifier.

In the event of emergencies, the project entity will not claim emission reductions due to the project activity for the duration of the emergency. The project entity will declare the emergency period over the following procedure:

1. The project entity will ensure that all requirement for monitoring of emission reductions have been re-established;

2. The monitoring officer and the head of operations of the hydropower station will both sign a statement declaring the emergency situation to have ended and normal operation to have resumed.

6.Training Plan

Training for operation and maintenance for the project will be provided by the Project Entity's internal training programmes and by the equipment supplier. Members of staff who are involved in the CDM project will be given training by the CDM consulting agent.

7. Data management

All monitoring data and records will be archived electronically in the computer as well as paper documents. The electronic documents will be backed up in Compact Discs. The project owner will also keep the copies of sales invoices and prepare a monitoring report which includes the monitoring data summary, the calibration records, the emission reduction calculations and emergency report (if applicable).

All the electronic and paper documents will be archived and be kept at least for 2 years after the end of the last crediting period.

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

This version PDD was completed on 26/11/2010 by:

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Emai: li.huang@eeafm.com

The persons/entities listed above are not the project participants listed in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

20/08/2009 (The Construction Contract signing date is the earliest date of the project activity.)

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

>>

30 years 0 month

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

C.2.1. Renewable crediting period

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

>>

01/12/2011 or the date of registration, whichever is later

C.2.1.2. Length of the first crediting period:

>>

7 years 0 month

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Not applicable

C.2.2.2. Length:

>>

Not applicable

SECTION D. Environmental impacts

>>

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

>>

According to the Clauses 13 and 19 of Environmental Protection Law of the People's Republic of China, the project entity must assess the environmental impacts of project activity before exploiting natural resources and developing project construction. The Environmental Impact Assessment (EIA) for the project had been carried out by Sichuan Research Academy of Environmental Sciences, and subsequently approved by Liangshan State Environmental Protection Bureau of Sichuan Province. Therefore the proposed project complied with national, regional and local environmental regulations.

The impacts on the environment and the measures to be taken to mitigate the impacts during the construction and operation periods are summarised in the following:

<table>
<tr><th>Impact</th><th colspan="2">Main Emission Source</th><th>Pollutants</th><th>Prevention/ mitigation measures</th></tr>
<tr><td rowspan="3">Air Quality</td><td rowspan="2">Construction period</td><td>Construction site</td><td>Dust, aerosol</td><td>Dust and soot will be strictly controlled by watering the blasting surface; some dustproof mask will be prepared for operating staff.</td></tr>
<tr><td>Transport (e.g. Tractor/ Lorry)</td><td>Exhaust emissions</td><td>Exhausting system in the transport will have to meet the national standard. During construction period, transportation routes will be controlled to mitigate the pollutants.</td></tr>
<tr><td>Operation period</td><td>Transport</td><td>Exhaust emissions</td><td>During operation period, transportation routes will be controlled to mitigate the pollutants.</td></tr>
<tr><td rowspan="3">Water Quality</td><td rowspan="2">Construction period</td><td>Construction site</td><td>COD, BOD</td><td>Wastewater from tunnel construction, sand and rock processing, materials and machines flushing will be retained in the sedimentation pond before discharged into the river or put into pool for irrigating plants.</td></tr>
<tr><td>Construction machinery</td><td>Oily pollutants</td><td>Waste oily water will not be fed into river directly, but collected in the effluent disposal system; the oil slick will be disposed specifically, and the water after treatment will be reused.</td></tr>
<tr><td>Operation period</td><td>Residential site-domestic sewage</td><td>COD, BOD</td><td>Daily living sewage will be retained in the sedimentation pond before discharged into the river or put into pool for irrigating plants.</td></tr>
<tr><td rowspan="2">Solid waste</td><td rowspan="2">Construction period</td><td>Construction site</td><td>Waste soil and rock</td><td>Will be compost or placed under certain regulation</td></tr>
<tr><td>Residential site</td><td>Domestic waste</td><td>Transported to landfill site periodically.</td></tr>
</table>

	Operation period	Residential site	Domestic waste	Some of biodegradable organic waste can be compost; other inorganic waste will be transported to landfill site periodically.
Noise	Construction period	Construction site	Noise pollution during construction comes from the machines and vehicles.	Construction daily time will be strictly controlled. The noise level from construction machines and vehicles will be kept in a certain range under the national regulation. Some anti-noise earplug and safety helmet will be prepared for the operating staff.
	Operation period	Powerhouse	Noise from electricity generator	Vibration reduction, sound insulation and other measures will be carried out to meet the regulation standard.
Ecosystem	Construction period	Construction site	Biodiversity	Educate construction worker; strengthen their environmental protection awareness for vegetation and wild animal. Set up a fire prevention and fire alarm system; ensure the safety of the regional natural resource.
	Operation period	Construction site	Affected vegetation plant	After the completion of construction, the land in the power plant management site and temporary construction site will be restored; trees and vegetation will be recovered.
	Operation period	River	Aquatic organism	A 0.8m diameter discharge pipe will be installed in the left of the dam to ensure the minimum ecological water flow meet the requirement even during dry season, to retain the capability/ balance of the aquatic ecosystem in the downstream river.

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

>>

According to the EIA and the EIA approval from Liangshan State Environmental Protection Agency of Sichuan Province, the proposed project will not bring significant impacts on the environment after taking the necessary measures.

SECTION E. Stakeholders' comments

>>

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

>>

The project owner carried out a survey about the construction of the proposed project in 10 May 2009. The questionnaire has been filed by 30 representatives of stakeholder with different age group, gender, and the education background, the actual figure has shown in the table below:

Table E-1 Background of the surveyed stakeholder representatives

	Gender		Age group			Education level			
	Female	Male	<35	35-50	<50	Primary School	Middle School	High School	Bachelor Degree
No. of people	15	15	9	12	9	6	12	9	3
%	50	50	30	40	30	20	40	30	10

E.2. Summary of the comments received:

>>

The project owner has carried out a survey to find out the public's opinion by sending out the questionnaires. 30 questionnaires were distributed and all the questionnaire feedbacks were returned.

The questions and answer in questionnaire are shown in the table below.

Table E-2 Stakeholder Questionnaire Survey

QUESTION	OPINION	NO. of people
1. Have you heard about Hekou 23MW Hydropower Project?	Yes	30
	No	0
2. What is your opinion about the construction of the Project?	Support	28
	Not Support	2
	Do not mind	0
3. If your house or farmland is affected, would you agree for the relocation and compensation?	Yes	30
	No	0
	Do not mind	0
4. Do you think the project will boost the development of local economy?	Yes	30
	Not sure	0
	No	0
5. What do you think the project construction may affect you?	Noise	0
	Dust	2
	Transportation inconvenience	8
	Nothing	20
6. Will the project have negative impacts upon the local	Yes	0

residents?	Not sure	0
	No	30
7. Will the project have impacts upon water usage for local residents?	Yes	0
	Not sure	3
	No	27
8. Will the project have impacts on natural landscape/ resource/ wild animals?	Yes	0
	Not sure	0
	No	30

The investigation indicates that all the people investigated are supporting the construction of the project. However, some of the local residents still made their suggestions, as shown below:

1. The measures that are stated in the EIA report should be fully implemented by the project participant, to ensure air, water, noise pollution is strictly controlled and construction waste is properly disposed. The project developer should speed up the construction pace, start operation as soon as possible to improve the economy of Puge County.
2. Local residents should have the priority employment during the construction and operation of this project.
3. After completing construction, all vegetation/ plants should be recovered as a balance ecosystem.

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

>>

After review the above suggestions/ comments received from local residents, the project participants took the following measures as the corresponding solutions:

1. The environmental protection measures presented in the EIA report will be taken strictly to minimize pollutions/ negative impacts from the project. The project construction will be speed up, to make a contribution to the local economy.
2. The local residents will have the priority employment of this project, will help them to increase their incomes.
3. The vegetation will be recovered as required after the completion of the project construction.

Following feedback from the project entity all stakeholders shared the sentiment that the advantages of the Project Activity, outweigh any potential disadvantages and any potential negative impacts were being effectively managed. After these measures mentioned above were taken, the issues that some stakeholders had raised were appropriately dealt with, and all the stakeholders agreed to support the construction of the proposed project. The potential impacts has seriously considered by the Project Entity and design institute of the Project Activity. Necessary measures and monitoring plan will be taken during construction and operation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

CER Seller Information

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from the Annex I countries for the project.

Annex 3

BASELINE INFORMATION[51]

The installed capacity, power generation, internal power use rate of power plant and fuel consumption data used for OM and BM calculation are derived from '*China Energy Statistical Yearbook*', '*China Electric Power Yearbook*'.

The low calorific value, CO_2 emission factor and oxidation factor of fuels are listed in Table A1 below.

Table A1 Low calorific values, CO_2 emission factors and oxidation factors of fuels

Fuel	Low Calorific Value	Emission Factor (tC/TJ)	Oxidation Factor
Raw Coal	20,908 kJ/kg	87,300	1
Cleaned Coal	26,344 kJ/kg	87,300	1
Moulded Coal	20,908 kJ/kg	87,300	
Other Washed Coal	8,363 kJ/kg	87,300	1
Coke	28,435 kJ/kg	95,700	1
Crude Oil	41,816 kJ/kg	71,100	1
Gasoline	43,070 kJ/kg	67,500	1
Diesel Oil	42,652 kJ/kg	72,600	1
Fuel Oil	41,816 kJ/kg	75,500	1
Other Oil	41,816 kJ/kg	75,500	1
Natural Gas	38,931 kJ/m^3	54,300	1
Coke Oven Gas	16,726 kJ/m^3	37,300	1
Other Gas	5,227 kJ/m^3	37,300	1
LPG	50,179 kJ/kg	61,600	1
Refinery Dry Gas	46,055 kJ/kg	48,200	1

Data Source:

The net calorific values are quoted from '*China Energy Statistical Yearbook 2008*', Page 283.

[51] DNA, Bullet of Baseline Emission Factor of China Grid, 2nd July 2009. http://qhs.ndrc.gov.cn/qjfzjz/t20090703_289357.htm

The emission factors and oxidation factors are quoted from "*Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories*", Table 1.3 and Table 1.4, Page 1.21-1.24, Chapter 1, Volume 2.

Step 1: Calculating the Operating Margin emission factor ($EF_{grid,OM,y}$)

Table A2 Simple OM Emission Factors Calculation of CCPG for Year 2005

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Carbon content	Oxidation	Emission Factor	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	L=G×J×K/ 100000 (for mass unit)
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	J	K	L=G×J×K/ 10000 (for volume unit)
Raw Coal	10^4 t	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	**17827.75**	25.8	100	87,300	20908	325,404,287
Cleaned Coal	10^4 t	0.02						**0.02**	25.8	100	87,300	26344	460
Other Washed Coal	10^4 t		138.12			89.99		**228.11**	25.8	100	87,300	8363	1,665,408
Coke	10^4 t		25.95		105			**130.95**	29.2	100	95,700	28435	3,563,450
Coke Oven Gas	10^8 m^3			1.15		0.36		**1.51**	12.1	100	37,300	16726	94,206
Other Gas	10^8 m^3		10.2			3.12		**13.32**	12.1	100	37,300	5227	259,696
Crude Oil	10^4 t		0.82	0.36				**1.18**	20	100	71,100	41816	35,083
Gasoline	10^4 t		0.02			0.02		**0.04**	18.9	100	67,500	43070	1,163
Diesel Oil	10^4 t	1.3	3.03	2.39	1.39	1.38		**9.49**	20.2	100	72,600	42652	293,861
Fuel Oil	10^4 t	0.64	0.29	3.15	1.68	0.89	2.22	**8.87**	21.1	100	75,500	41816	280,035
LPG	10^4 t							**0**	17.2	100	61,600	50179	0
Refinery Dry Gas	10^4 t	0.71	3.41	1.76	0.78			**6.66**	15.7	100	48,200	46055	147,842
Natural Gas	10^8 m^3						3	**3**	15.3	100	54,300	38931	634,186
Other Petroleum Products	10^4 t							**0**	20	100	75,500	38369	0
Other Coking Products	10^4 t				1.5			**1.5**	25.8	100	95,700	28435	40,818
Other Energy	10^4tce		2.88		1.74	32.8		**37.42**	0	100	0	0	0
Total													**332,420,496**

Data Source: *'China Energy Statistical Yearbook 2006'*

Table A3 Fuel-fired Electricity Generation of CCPG for Year 2005

Province	Electricity Generation (10^8 kWh)	Electricity Generation (MWh)	Internal Power Consumption Rate (%)	Supplied Electricity (MWh)
Jiangxi	300	30,000,000	6.48	28,056,000
Henan	1,315.9	131,590,000	7.32	121,957,612
Hubei	477	47,700,000	2.51	46,502,730
Hunan	399	39,900,000	5.00	37,905,000
Chongqing	175.84	17,584,000	8.05	16,168,488
Sichuan	372.02	37,202,000	4.27	35,613,475
Total				**286,203,305**

Data Source: *'China Electric Power Yearbook 2006'*

According to Table A2, the total CO_2 emission of CCPG is 332,420,496 t CO_2e in year 2005. According to Table A3, the total supplied electricity of CCPG is 286,203,305 MWh. According to formula (4) in section B.6.1, the $EF_{grid,OM,2005}$ is 1.16148 tCO_2e/MWh.

Table A4 Simple OM Emission Factors Calculation of CCPG for Year 2006

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Carbon content	Oxidation	Emission Factor	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	L=G×J×K/100000 (for mass unit)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K	L=G×J×K/10000 (for volume unit)
Raw Coal	10^4 t	1926.02	8098.01	3179.79	2454.48	1184.3	3285.22	**20127.82**	25.8	100	87,300	20908	367,386,738
Cleaned Coal	10^4 t					5.79		**5.79**	25.8	100	87,300	26344	133,160
Other Washed Coal	10^4 t	4.51	104.12		8.59	79.21		**196.43**	25.8	100	87,300	8363	1,434,116
Briquette	10^4 t						0.01	**0.01**	26.6	100	87,300	20908	183
Coke	10^4 t		17.23		0.32			**17.55**	29.2	100	95,700	28435	477,576
Coke Oven Gas	10^8 m^3		0.52	1.07	4.24	0.38	0.01	**6.22**	12.1	100	37,300	16726	388,053
Other Gas	10^8 m^3	12.69	3.95		1.7	4.36	0.01	**22.71**	12.1	100	37,300	5227	442,770
Crude Oil	10^4 t		0.49					**0.49**	20	100	71,100	41816	14,568
Gasoline	10^4 t		0.01					**0.01**	18.9		67,500	43070	291
Diesel Oil	10^4 t	0.91	2.23	1.41	1.78	0.96		**7.29**	20.2	100	72,600	42652	225,737
Fuel Oil	10^4 t	0.51	1.26	1.31	0.8	0.57	3.49	**7.94**	21.1	100	75,500	41816	250,674
LPG	10^4 t							**0**	17.2	100	61,600	50179	0
Refinery Dry Gas	10^4 t	0.86	8.1	1	0.97			**10.93**	15.7	100	48,200	46055	242,630
Natural Gas	10^8 m^3			0.28		0.16	18.63	**19.07**	15.3	100	54,300	38931	4,031,309
Other Petroleum Products	10^4 t							**0**	20	100	75,500	38369	0
Other Coking Products	10^4 t						0.01	**0.01**	25.8	100	95,700	28435	272
Other Energy	10^4tce	17.45	37.36	31.55	18.29	29.35		**134**	0	100	0	0	0
Total													**375,028,077**

Data Source: *'China Energy Statistical Yearbook 2007'*

Table A5 Fuel-fired Electricity Generation of CCPG for Year 2006

Province	Electricity Generation (10^8 kWh)	Electricity Generation (MWh)	Internal Power Consumption Rate (%)	Supplied Electricity (MWh)
Jiangxi	344.49	34,449,000	6.17	32,323,497
Henan	1,512.35	151,235,000	7.06	140,557,809
Hubei	548.41	54,841,000	2.75	53,332,873
Hunan	464.08	46,408,000	4.95	44,110,804
Chongqing	234.87	23,487,000	8.45	21,502,349
Sichuan	441.93	44,193,000	4.51	42,199,896
Total				**334,027,226**

Data Source: *'China Energy Statistical Yearbook 2007'*, *'China Electric Power Yearbook 2007'*

The electricity import to the CCPG from NWPG was 3,028,950MWh in year 2006. The Operating Margin emission factor of NWPG was 0.99148 According to Table A4, the total CO_2 emission of CCPG is 378,031,235 t CO_2e in year 2006. According to Table A5, the total supplied electricity of CCPG was 337,056,176 MWh. According to formula (4) in section B.6.1, the $EF_{grid,OM,2006}$ is 1.12157 tCO_2e/MWh.

Table A6 Simple OM Emission Factors Calculation of CCPG for Year 2007

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Carbon content	Oxidation	Emission Factor	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	L=G×J×K/ 100000 (for mass unit)
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	J	K	L=G×J×K/ 10000 (for volume unit)
Raw Coal	10^4 t	2200.57	9357	3479.81	2683.81	1547.7	3239	**22507.89**	25.8	100	87,300	20,908	410,829,404
Cleaned Coal	10^4 t		3.07			3.8		**6.87**	25.8	100	87,300	26,344	157,998
Other Washed Coal	10^4 t	0.04	87.16		2.06	96.42		**185.68**	25.8	100	87,300	8,363	1,355,631
Briquette	10^4 t						0.01	**0.01**	26.6	100	87,300	20,908	183
Coke	10^4 t							**0**	29.2	100	95,700	28,435	0
Coke Oven Gas	10^8 m^3	0.08	2.61	0.25	0.31	0.91		**4.16**	12.1	100	37,300	16,726	259,534
Other Gas	10^8 m^3	29.17	25.79		24.69		23.98	**103.63**	12.1	100	37,300	5,227	2,020,444
Crude Oil	10^4 t		0.43					**0.43**	20	100	71,100	41,816	12,784
Gasoline	10^4 t				0.04	0.01		**0.05**	18.9	100	67,500	43,070	1,454
Diesel Oil	10^4 t	0.98	3.21	2.51	2.83	1.93		**11.46**	20.2	100	72,600	42,652	354,863
Fuel Oil	10^4 t	0.42	1.25	1.33	0.63	0.64	1.74	**6.01**	21.1	100	75,500	41,816	189,742
LPG	10^4 t							**0**	17.2	100	61,600	50,179	0
Refinery Dry Gas	10^4 t	1.43	10.01	0.97	0.7			**13.11**	15.7	100	48,200	46,055	291,022
Natural Gas	10^8 m^3		0.12	0.18		0.2	1.87	**2.37**	15.3	100	54,300	38,931	501,007
Other Petroleum Products	10^4 t							**0**	20	100	75,500	41,816	0
Other Coking Products	10^4 t							**0**	25.8	100	95,700	28,435	0
Other Energy	10^4tce	23.43	63.65	35.95	29.46	23.21		**175.7**	0	0	0	0	0
Total													**415,974,066**

Data Source: *'China Energy Statistical Yearbook 2008'*

Table A7 Fuel-fired Electricity Generation of CCPG for Year 2007

Province	Electricity Generation (10^8 kWh)	Electricity Generation (MWh)	Internal Power Consumption Rate (%)	Supplied Electricity (MWh)
Jiangxi	421	42,100,000	7.72	38,849,880
Henan	1773	177,300,000	7.55	163,913,850
Hubei	609	60,900,000	6.69	56,825,790
Hunan	542	54,200,000	7.18	50,308,440
Chongqing	288	28,800,000	9.2	26,150,400
Sichuan	451	45,100,000	8.68	41,185,320
Total				**377,233,680**

Data Source: 'China Energy Statistical Yearbook 2008', 'China Electric Power Yearbook 2008'

The electricity import to the CCPG from NWPG was 3,005,400 MWh in year 2007. The Operating Margin emission factor of NWPG was 1.01129 According to Table A6, the total CO_2 emission of CCPG was 419,013,395 t CO_2e in year 2007. According to Table A7, the total supplied electricity of CCPG was 380,239,080 MWh. According to formula (4) in section B.6.1, the $EF_{grid,\ OM,\ 2007}$ is 1.10197 tCO_2e/MWh.

The Operating Margin (OM) emission factor is the weighted average emission factors of year 2005-2007, and is expressed as follows:

$$EF_{grid,OM,y} = \mathbf{1.1255\ tCO_2e/MWh}.$$

Step 2: Calculating the Build Margin emission factor ($EF_{grid,BM,y}$)

Sub-Step 2a: Calculation of percentages of CO_2 emissions from the coal-fired, gas-fired and oil-fired power plants in total fuel-fired CO_2 emissions

Table A8 Percentages of CO_2 emissions from the coal-fired, gas-fired and oil-fired power plants in total fuel-fired CO_2 emissions

		Jiangxi	Henan	Hubei	Hunan	Chong qing	Sichuan	Total	Average Low Calorific Value	Emission Factor (tC/TJ)	Oxidation rate	CO_2 Emission (tCO_2e)
Fuel	**Unit**	**A**	**B**	**C**	**D**	**E**	**F**	**G=A+…+F**	**H**	**I**	**J**	**K=G×H×I×J/100,000**
Raw Coal	10^4 t	2,200.57	9,357	3,479.81	2,683.81	1,547.7	3,239	22,507.89	20,908	87,300	100	410,829,404
Cleaned Coal	10^4 t	0	3.07	0	0	3.8	0	6.87	26,344	87,300	100	157,998
Other Washed Coal	10^4 t	0.04	87.16	0	2.06	96.42	0	185.68	8,363	87,300	100	1,355,631
Briquette	10^4 t	0	0	0	0	0	0.01	0.01	20,908	87,300	100	183
Coke	10^4 t	0	0	0	0	0	0	0	28,435	95,700	100	0
Subtotal												**412,343,216**
Crude Oil	10^4 t	0	0.43	0	0	0	0	0.43	41,816	71,100	100	12,784
Gasoline	10^4 t	0	0	0	0.04	0.01	0	0.05	43,070	67,500	100	1,454
Diesel Oil	10^4 t	0.98	3.21	2.51	2.83	1.93	0	11.46	42,652	72,600	100	354,863
Fuel Oil	10^4 t	0.42	1.25	1.33	0.63	0.64	1.74	6.01	41,816	75,500	100	189,742
Other Petroleum Products	10^4 t	0	0	0	0	0	0	0	41,816	75,500	100	0
Subtotal												**558,843**
Natural Gas	10^8m^3	0	1.2	1.8	0	2	18.7	23.7	38,931	54,300	100	501,007
Coke Oven Gas	10^8m^3	0.8	26.1	2.5	3.1	9.1	0	41.6	16,726	37,300	100	259,534
Other Gas	10^8m^3	291.7	257.9	0	246.9	0	239.8	1,036.3	5,227	37,300	100	2,020,444
LPG	10^4 t	0	0	0	0	0	0	0	50,179	61,600	100	0
Refinery Dry Gas	10^4 t	1.43	10.01	0.97	0.7	0	0	13.11	46,055	48,200	100	291,022
Subtotal												**3,072,007**
Total												**415,974,066**

Data Source: *'China Energy Statistical Yearbook 2008'*

According to Table A8 and formula (6) – (8) in section B.6.1, the percentages of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total fuel-fired CO_2 emissions are calculated as:

$$\lambda_{Coal,y} = 99.13\%,\ \lambda_{Oil,y} = 0.13\%,\ \lambda_{Gas,y} = 0.74\%$$

Sub-Step 2b: Calculation of the fuel-fired emission factor ($EF_{Thermal,\ y}$)

The most advanced technologies commercially available for coal-fired power plants in China are domestic 600 MW sub-critical generators, with the standard coal consumption of power supply of 322.5 gce/kWh. For gas-fired and oil-fired power plants in China, the most advanced technologies commercially available are 200 MW combined cycle generators. The standard coal consumption (equivalent) for power supply of oil-fired and gas-fired power plants is 246 gce/kWh.

Parameters used for calculating fuel-fired emission factor are shown in Table A9 below:

Table A9 Parameters used for calculating fuel-fired emission factor

	Parameter	Efficiency of Power Supply	Emission Factor of Fuel $kgCO_2/TJ$)	Oxidation Factor	Emission Factor (tCO_2/MWh)
		A	B	C	D=3.6/A/1,000,000×B×C
Coal-fired Power Plant	$EF_{Coal,Adv,y}$	38.10%	87,300	100%	0.8249
Gas-fired Power Plant	$EF_{Gas,Adv,y}$	49.99%	75,500	100%	0.5437
Oil-fired Power Plant	$EF_{Oil,Adv,y}$	49.99%	54,300	100%	0.3910

According to Table A9 and formula (9) in section B.6.1, the $EF_{Thermal}$ is calculated as follows.

$$EF_{Thermal,\ y} = EF_{Coal,Adv,y} \cdot \lambda_{Coal,\ y} + EF_{oil,Adv\ y} \cdot \lambda_{Oil,\ y} + EF_{gas\ Adv\ y} \cdot \lambda_{Gas,\ y}$$

$$= 0.8213\ tCO_2/MWh$$

Sub-Step 2c: Calculation of the Build Margin (BM) emission factor ($EF_{grid,BM,y}$)

Table A10 Installed Capacity of CCPG in 2007

Installed capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Fuel-fired	MW	9,270	38,540	13,040	13,360	6,370	12,000	92,580
Hydro	MW	3,570	2,740	24,020	9,220	2,240	19,860	61,650
Nuclear	MW	0	0	0	0	0	0	0
Wind	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 A11 Installed Capacity of CCPG in 2006

Installed capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Fuel-fired	MW	6,568	32,603	11,623	10,715	5,594	9,555	76,658
Hydro	MW	3,288	2,553	18,320	8,648	1,979	17,730	52,518
Nuclear	MW	0	0	0	0	0	0	0
Wind	MW	0	0	0	17	24	0	41
Total	MW	9,856	35,156	29,943	19,380	7,597	27,285	129,217

Data Source: *'China Electric Power Yearbook 2007'*

Table A12 Installed Capacity of CCPG in 2005

Installed capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Fuel-fired	MW	5,906	26,267.8	9,526.3	7,211.6	3,759.5	7,496	60,167.2
Hydro	MW	3,019	2,539.9	17,888.9	7,905.1	1,892.7	14,959.6	48,205.2
Nuclear	MW	0	0	0	0	0	0	0
Wind	MW	0	0	0	0	24	0	24
Total	MW	8,925	28,807.7	27,415.2	15,116.7	5,676.2	22,455.6	108,396.4

Data Source: *'China Electric Power Yearbook 2006'*

Table A13 Newly Added Installed Capacity from Year 2005-2007

type	Installed capacity in 2005	Installed capacity in 2006	Installed capacity in 2007	Increased capacity from 2005 to 2007	% of newly installed capacity
	A	B	C	D=C-A	
Fuel-fired (MW)	60,167.2	76,658	92,580	32,412.8	70.64%
Hydro (MW)	48,205.2	52,518	61,650	13,444.8	29.30%
Nuclear (MW)	0	0	0	0	0.00%
Wind (MW)	24	41	51	27	0.06%
Total(MW)	**108,396.4**	**129,217**	**154,281**	**458,84.6**	**100.00%**
Percentage of newly installed capacity to 2007	70.26%	83.75%	100%		

Data Source: *'China Electric Power Yearbook 2006-2008'*

According to Table A10 and formula (10) in section B.6.1, the $EF_{grid,BM,y}$ is calculated as:

$$EF_{grid,BM,y} = 0.8213 \times 70.64\% = 0.5802 \text{ tCO}_2\text{/MWh}$$

Step 3: Calculating the baseline emission factor (*$EF_{grid,CM,y}$*)

According to formula (11) in section B.6.1, the baseline emission factor of CCPG is calculated as:

$$EF_{grid,CM,y} = 0.5 \times EF_{grid,OM,y} + 0.5 \times EF_{grid,BM,y} = 0.85285 \text{ tCO}_2\text{e/MWh}$$

Annex 4

MONITORING INFORMATION

Please refer to the section B.7 of the PDD.