LUOFAN 24MW HYDROPOWER PROJECT IN GUIZHOU PROVINCE CHINA

Document Prepared By (Guizhou Honor Carbon Asset Management Co., Ltd.)

Project Title	Luofan 24MW Hydropower Project in Guizhou Province China
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Luofan 24MW Hydropower Project (hereafter referred to as “the project”) is located in Yanjia Town, Ceheng County, Guizhou Province, China. The total installed capacity of the project is 24MW（2×10MW+1×4MW）, and the annual utilization hours are 3,601h, the annual electricity generation is 86,420 MWh with the net electricity of 85,988 MWh supplied to the China Southern Power Grid (CSPG) annually. The project will achieve CO_2 emission reduction by replacing electricity supplied by fossil fuel fired power plant connected into CSPG.

The project won’t produce any greenhouse gas (GHG) during the operation. The electricity generated by the project can displace part of the power from the fossil fuel-fired power plants of CSPG, and the expected annual GHG emission reductions are 55,857tCO_2e.

The project activity will promote the local and national sustainable development powerfully in the following aspects:

- Reduce the GHG emission to mitigate the global warming trend by providing clean electric power.
- Mitigate the shortage of power in Guizhou Province, and promote the local economic development.
- The project activity can create some job opportunities during the construction period and operation period. The project will also promote the local development in industry, agriculture and service trade.

1.2 Sectoral Scope and Project Type

The project falls into: Sectoral Scope 1: energy industries (renewable sources)
Subclass: hydro power

The Project is not a Grouped project.

1.3 Project Proponent

Organization name	Guizhou Zhongshui Energy Co., Ltd
Contact person	Wang Fei
Title	
Address	ShunCheng NO.1 Xixiu district, Anshun city, Guizhou Province.
Telephone	+86 13984359397
Email	41816524@qq.com

1.4 Other Entities Involved in the Project

No.

1.5 Project Start Date

The project start date is 05/12/2011.

1.6 Project Crediting Period

The crediting period is 10 years and can be renewable at 2 times. The first crediting period is from 05/12/2011 (the date of putting into operation) to 04/12/2021.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

The total installed capacity of the project is 24MW. It is expected that the project activities will generate annual emission reductions for about 55,857tCO_2e.

Project Scale	
Project	
Large project	Yes

Years	Estimated GHG emission reductions or removals (tCO_2e)
2011	4,131 (05/12/2011-31/12/2011)
2012	55,857
2013	55,857
2014	55,857
2015	55,857
2016	55,857
2017	55,857
2018	55,857
2019	55,857
2020	55,857
2021	51,726 (01/01/2021-04/12/2021)
Total estimated ERs	558,570
Total number of crediting years	10
Average annual ERs	55,857

1.8 Description of the Project Activity

The project is a dam type hydropower plant with total installed capacity of 24MW (2×10MW+1×4MW). The main buildings consist of diversion tunnel, a powerhouse and a switch station, etc. There are 3 water turbine-generator units in the powerhouse.The water pressure drives the turbine to rotate through diverting water from the intake to the powerhouse, the turbine drives the generator to rotate, thus the water energy is changed into electric energy. The electric power is delivered to the grid through the booster transformers and one 110kV power transmission line.

The detailed features of the project are shown in Table 1 as below:

The detailed features of the project are shown in Table 1 as below:

Parameter	**Unit**	**Value**	
Hydro Turbines			
Model	----	HLA550-LJ-131	HLA708B-LJ-98
Quantity	unit	2	1
Rated power	MW	10	4
Rated water head	m	144.0	144.0
Rated flow rate	m^3/s	7.85	3.99
Lifetime	Years	30	
Data source	Technical Agreement of Water Turbine & Generator Units		
Generators			
Model	----	SF10-10/2860	SF4000-8/2500
Quantity	unit	2	1
Rated Power	MW	10	4
Power factor	----	0.8	0.8
Rated Voltage	kV	10.5	10.5
Lifetime	Years	30	30
Data source	Technical Agreement of Water Turbine & Generator Units		

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

The project won't produce any greenhouse gas (GHG) during the operation. The electricity generated by the project can displace part of the power from the fossil fuel-fired power plants of CSPG, and the expected annual GHG emission reductions are 55,857tCO_2e.

1.9 Project Location

The project is located in Yanjia Town, Ceheng County, Guizhou Province, People's Republic of China.

Longitude: 105°51′E
Latitude: 25°07′N
The location of the proposed project activity is shown in Fig. 1.

1.10 Conditions Prior to Project Initiation

Prior to the project initiation, the equivalent electricity produced by the proposed project will be provided by China Southern Power grid, which is dominated by fossil fuel-fired power plants. As a hydro power project, the project will produce clean electricity using hydro power resources and will generate GHG emission reductions by avoiding CO_2 emission from electricity generation of fossil fuel fired power plants. Operation of the project does not lead to GHG emission. It is confirmed that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

Luofan Hydropower Preliminary Design Report has been approved on May 27, 2009 by Qianxinan Miao and Buyi Autonomous Prefecture Development and Reform Commission. The financial and economic analyses are drafted in accordance with following lows and regulations：
Water conservancy construction engineering budget quota;
Budgetary estimate quota for middle and small scale water conservancy and hydropower equipment installation;
Budgetary estimate procedures of resettlement compensation for water conservancy and hydropower environment protection;
Budgetary estimate procedures and quota for conservation of water and soil;

The Environmental Impact Assessment (EIA) of the project has been approved on April 23, 2009 by Qianxinan Miao and Buyi Autonomous Prefecture Environmental Protection Bureau. The EIA report is drafted in accordance with the following laws and regulations：
Environmental Protection Law of the People's Republic of China;
Environmental Impact Assessment Law of the People's Republic of China;
Law of the People's Republic of China on Water and Soil Conservation;
Law of the People's Republic of China on the Prevention and Control of Water Pollution;
Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution;
Law of the People's Republic of China on the Prevention and Control of Ari Pollution;
Law of the People's Republic of China on the Prevention and Control of Urban;
Law of the People's Republic of China on the Wildlife Protection;
Law of the People's Republic of China on the Wild Plant Protection;

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1.12 Ownership and Other Programs

1.12.1 Right of Use

The business license of Guizhou Zhongshui Energy Co., Ltd.

The approval letter of the Project

The EIA approval letter of the Project

The construction contract and purchase contract of main equipment.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable.

1.12.3 Participation under Other GHG Programs

Not applicable.

1.12.4 Other Forms of Environmental Credit

The project proponent has not created another form of environmental credit.

1.12.5 Projects Rejected by Other GHG Programs

Not applicable.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

This project is not a grouped project.

Leakage Management

According to the consolidated methodology ACM0002 (Version 14.0.0), the leakage of the Project is not considered.

Commercially Sensitive Information

The commercially sensitive information has been excluded from the public version of the project description.

Further Information

There is no further information that may have a bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net emission reduction or removals.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The choice methodology is CDM methodology ACM0002 (Version 14.0.0): "Grid-connected electricity generation from renewable sources".

ACM0002 refers to the following tools:
"Tool for the demonstration and assessment of additionality" (Version 07.0.0);
"Tool to calculate the emission factor for an electricity system" (Version 04.0.0);

2.2 Applicability of Methodology

The project activity is a new grid-connected renewable power generation project, and there is no renewable power plant operated prior to the implementation of the project activity at the site.

The methodology ACM0002 (Version 14.0.0) is applicable to the proposed project due to the following conditions:

No.	Applicability criteria in ACM0002 (Version 14.0.0)	The project activity
1	This methodology is applicable to grid-connected renewable power generation project activities that: (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition;	The project belongs to (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant).The

	(c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	proposed project doesn't involve situation (b)-(d) in the methodology.
2	The methodology is applicable under the following conditions: The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project is the newly-installed hydropower plant (with an accumulation reservoir), so the project is applicable for this category.
3	In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 10 to calculate the parameter $EG_{PJ,y}$): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	The project is a green-field hydropower plant, which is not applicable for the case of capacity additions, retrofits or replacements.
4	In case of hydro power plants: ● One of the following conditions must apply: ✓ The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of reservoirs; or ✓ The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2; or ✓ The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2. In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 all the following conditions must apply: ✓ The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2; ✓ Multiple reservoirs and hydro power	The project activity results in a new single reservoir, and the power density is 80 W/m^2[1] which is greater than 4 W/m^2.

[1] According to PDR, the surface area of reservoir is 300,000m^2, so the power density is 80 W/m^2 (24,000,000 W/300,000 m^2= 80W/ m^2)

	plants located at the same river and where are designed together to function as an integrated project that collectively constitute the generation capacity of the combined power plant; ✓ Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity; ✓ Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4W/m^2, is lower than 15 MW; ✓ Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.	
5	The methodology is not applicable to the following: ● Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; ● Biomass fired power plants; ● A hydro power plant that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the power plant is less than 4 W/m^2.	The project activity is to establish one new hydropower plant, therefore: ● The project doesn't involve switching from fossil fuels to renewable energy sources at the site. ● The project is not a biomass fired power plant. ● The project is a hydro power plant that results in the creation of a new single reservoir, and the power density is 80 W/m^2 which is greater than 4 W/m^2.
6	In the case of retrofits, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, i.e. to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The project doesn't involve retrofits, replacements, or capacity additions.

Therefore, the methodology ACM0002 (Version 14.0.0) is applicable to the project activity.

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2.3 Project Boundary

According to ACM0002 (Version 14.0.0), the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the CSPG that the power plant of the project activity is connected to. The project boundary is schematically illustrated in Figure 2.

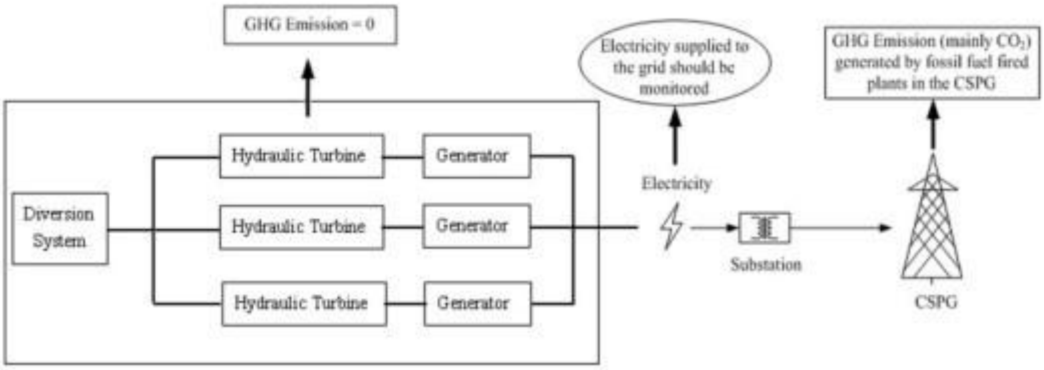

Fig. 2 Flow diagram of the proposed project activity

The GHG emissions sources in the project boundary are listed in Table 3 below:

Source		Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	NO	Minor emission source
		N_2O	NO	Minor emission source
		Other	NO	Minor emission source
Project	For hydro power plants, Emissions of CH4 from the reservoir	CO_2	NO	Minor emission source
		CH_4	NO	The power density of the project is 80 W/m^2 greater than $10W/m^2$, the emission from the reservoir is not considered.
		N_2O	NO	Minor emission source
		Other	NO	Minor emission source

2.4 Baseline Scenario

According to ACM0002 (Version 14.0.0), if the project activity is the installation of a new grid-connected renewable power plant, the baseline scenario is as follow:

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) calculations described in the “Tool to calculate the emission factor for an electricity system”.

The electricity generated by the project will be delivered to the CSPG. Therefore, the project’s baseline scenario is that equivalent amount of electricity is generated by CSPG-connected power plants and the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system” (Version 04.0.0).

2.5 Additionality

According to the "Tool for the demonstration and assessment of additionality" (Version 07.0.0) approved by EB, the additionality of the project is demonstrated and assessed through the following steps:

Step1. Investment analysis

Sub-step 1a. Determine appropriate analysis method

According to "Tool for the demonstration and assessment of additionality" (Version 07.0.0), there are three analysis methods for investment analysis, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

Because the project activity will generate economic benefits from the sale of electricity generation other than VCS related income, simple cost analysis method is not applicable; the electricity supply by CSPG isn't a concrete investment project, so investment comparison analysis method isn't applicable, too. Therefore, benchmark analysis method is chosen for the investment analysis.

Sub-step 1b. Option III. Apply benchmark analysis

The benchmark Internal Rate of Return (IRR) after tax for total investment for a hydropower project with the installed capacity of under 50MW is 10% which is quoted from Economic Evaluation Code for Small Hydropower Projects (SL16-2010) approved by Ministry of Water Resources of P. R. China. This benchmark IRR is used extensively in China for investment analysis of hydropower projects.

Sub-step 1c. Calculation and comparison of financial indicators

Based on Preliminary Design Report（PDR）, the main assumptions for the investment analysis are shown in Table 4.

Table 4 Main parameters for investment analysis and evaluation

No.	Main Parameter	Unit	Value	Reference
1	Installed capacity	MW	24	PDR
2	Total investment	10^4 Yuan	159,69	PDR
3	Net electricity generation	MWh	85,988	PDR
4	Residual rate of fixed assets value	%	5	PDR
5	Electricity tariff (with VAT)	Yuan/KWh	0.2574	PDR
6	VAT	%	6	PDR
7	Loan interest rate	%	5.94	PDR
8	Depreciation rate	%	4.75	PDR
9	Repair rate	%	1	PDR
10	Staffs	person	20	PDR
11	Annual salary per person	10^3 Yuan	20	PDR
12	Welfare, insurance and housing fund rate	%	41	PDR

13	Water resources fee	Yuan /kwh	0.007	PDR
14	Reservoir region maintenance	Yuan /kwh	0.001	PDR
15	Other costs	Yuan /kw	12	PDR
16	City maintenance & construction tax	%	5	PDR
17	Education surtax	%	3	PDR
18	Surplus accumulative fund	%	10	PDR
19	Income tax	%	25	PDR
20	Operation period	year	20	PDR
21	O & M costs	10^6 Yuan /Year	3.13	PDR
22	Expected VERs Sale Price	EUR/tCO_2e	4	

The IRR of the project is shown as Table 5.

Table 5 The project financial indicator without VERs revenue

Item	Without VERs revenue	Benchmark	With VERs revenue
IRR	7.82%	10%	9.22%

Without VERs revenue, the project IRR of the proposed project is only 7.82%, which is lower than benchmark IRR. With VERs revenue, the project IRR is 9.22%.which is obviously higher than benchmark IRR. Thus, the project is not financially attractive.

Sub-step1d. Sensitivity analysis

Four parameters including Static total investment, electricity tariff, net electricity generation and annual operation & maintenance costs are selected as sensitive factors to check the financial attractiveness, the result of the sensitivity analysis is shown as follows:

Table 6 Sensitivity Analysis (IRR)

Variation rate / IRR (%) / Factor	-10%	0	+10%
Static Total Investment	9.00%	7.82%	6.82%
Electricity Tariff	6.62%	7.82%	8.97%
Net Electricity Generation	6.66%	7.82%	8.93%
O & M Costs	8.00%	7.82%	7.64%

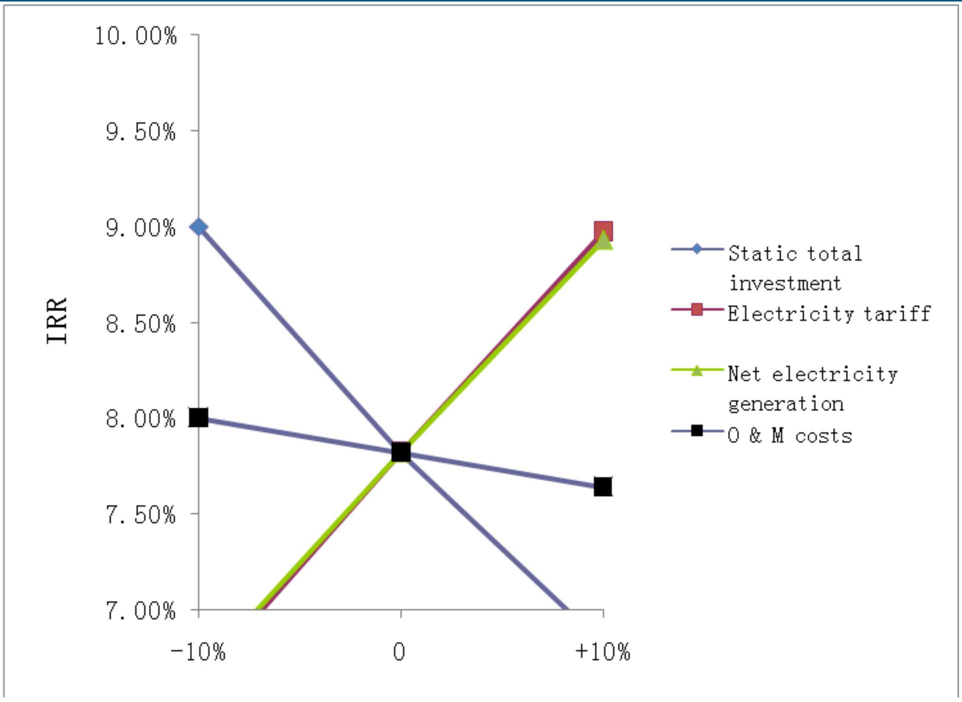

Fig. 3 Sensitivity Analysis (IRR)

Table 6 shows that IRRs of the project are always lower than the benchmark (10%) within the reasonable variation scope of the static total investment, electricity tariff, net electricity generation and operation & maintenance costs, thus the project activity is unlikely to be financially attractive.

The critical point of the sensitive factors variation when IRR reaching the benchmark are analyzed and assessed in Table 7.

Table 7 Sensitivity Analysis

Variation range& Assessment / Factor	Variation range to reach benchmark	Practical assessment of the critical factors
Static total investment	-17.20%	When total investment of project decreases, the IRR of project goes up. The static total investment of project is mainly subject to the price indices of investment in fixed assets, according to the data in "13-6 Price Indices of Investment in Fixed Assets" in *Guizhou Statistical Yearbook 2009* published by the Guizhou Statistical Bureau, the price iindices of investment in fixed assets are respectively 101.1, 103.5, 108.9 from 2006 to 2008. Thus the price indices of investment in fixed assets has an increasing trend and will not decrease. Thus, as the recent published statistics, it is unlikely that the static total investment of the project decreases17.2%.
Electricity Tariff	+19.20%	When the tariff increases, the IRR of project goes up.

		This means that the IRR of the project would reach the benchmark of 10% only when the electricity tariff increases 19.20%. According to Qianjiage [2011]217 document, the same scale hydropower electricity tariff is about 0.2574Yuan/kWh. The electricity tariff is strictly controlled by the government and relatively stable in China. Thus, the increase of 19.20% of the electricity tariff shall not occur.
Net electricity generation	+19.9%	When the net electricity generation increases, the IRR of project goes up. The variation of net electricity generation is mainly subject to the water resources of project site, and also is the outcome of the year's rainfall. It is impossible for the net electricity generation of the project to increase 19.90%, because the expected net electricity generation is calculated by accredited third party design institute according to the hydrological data for 49 years, it will not change much. And thus, the increase of 19.90% of the net electricity generation shall not occur.
O & M costs	-100%	There is an inherent cost involved in operating a hydropower station. Therefore it is impossible for the Annual O&M cost to decrease 100.00% of the estimated value in the published PDR.

Within the reasonable variation scope of electricity tariff, net electricity generation, static total investment and O & M costs, the IRRs of the project are always lower than the benchmark, thus the project isn't attractive economically.

Step2 Barrier analysis

It is not analyzed in the project.

Step 3 Common practice analysis

In line with the "Tool for the demonstration and assessment of additionality" (Version 07.0.0) paragraph 13, four types of measures are currently covered in the framework:

(i) Fuel and feedstock switch (example: switch from naphtha to natural gas for energy generation, or switch from limestone to gypsum in cement clinker production);

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

(iii) Methane destruction (example: landfill gas flaring);

(iv) Methane formation avoidance (example: use of biomass that would have been left to decay in a solid waste disposal site resulting in the formation and emission of methane, for energy generation).

As a newly-built hydropower project, the project is not a first-of-its kind project and belongs to the type (b) of measures above.

Therefore, according to the “Tool for the demonstration and assessment of additionality” (Version 07.0.0), the existing common practice is identified and discussed through the following 5 steps:

Step 1: calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.

The total installed capacity of the Proposed Project Activity is 24MW, therefore the applicable output range is 12MW to 36MW.

Step 2: identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

(a) The projects are located in the applicable geographical area;

China is a very large country in which the economic development level, the industrial structure, the fundamental infrastructure, development strategy and the policy framework is different. As such a number of key economic factors vary from province to province. These include tariff rates of products, the cost of materials, the cost of electricity and other utilities such as water, the cost of labor and services and the types of loan that can be obtained. These factors all vary among provinces. Therefore, Guizhou Province is selected as the region for common practice.

(b) The projects apply the same measure as the proposed project activity;

As per defined by *Guidelines on Common Practice*, the same measures is “*Fuel and feedstock switch (example: switch from naphtha to natural gas for energy generation, or switch from limestone to gypsum in cement clinker production)*”;

(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;

The proposed project activity use hydro energy;

(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;

The proposed project is implemented for power generation mainly, therefore hydropower projects are applied

(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;

The installed capacity between 12 and 36 MW are considered as similar as per step 1.

(f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

The start date of the project is 13/10/2009.

With the above mentioned criteria, hydropower projects located in Guizhou province with installed capacity of 12 to 36 MW, have started commercial operation before the start date of the project, were selected for further analysis.

A number of hydropower projects under construction or seeking CDM assistance are therefore not included in the table.

The table below shows hydropower projects with a similar scale that have already been commissioned.

table 8 Similar hydropower project in Guizhou Province

No.	Name of the project	Capacity （MW）	Start Operation year
1	Tianbianzhai Hydropower Plant[2]	25	2000
2	Baishuihe 2nd Cascade Hydropower Plant[3]	34	2000
3	Zhongshanbao Hydropower Plant[4]	30	2001

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

From the above table, the parameter N_{all} is 3.

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

The intensive and extensive power sector reforms happened in China since 10th February 2002[5], which led to diversification in the ownership of power generation and therefore a totally new investment climate. As a result, new power generation plant, including hydropower plant, was expected to compete under more commercial conditions. Therefore, projects which started construction before 10th February 2002 can be considered as apply different technologies from the proposed project and should be excluded. So, No.1 to No.3, All 3 projects should be excluded.

According to the above analysis, all the projects listed in table 8 are different from the Project, $N_{diff,hydropower}$ =3.

Step 5: calculate factor F=1-Ndiff/Nall representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

[2] http://www.shp.com.cn/shp/zhwy/hygk/webinfo/2002/07/1288247365863007.htm
[3] http://baike.baidu.com/view/4562720.htm
[4] http://baike.baidu.com/view/4562727.htm
[5] http://www.ccoalnews.com/zt/103148/130756.html

The proposed project activity is a common practice within a sector in the applicable geographical area if both the following conditions are fulfilled:

(a) The factor F is greater than 0.2, and

(b) N_{all}-N_{diff} is greater than 3.

According to the analysis of Step3 and Step 4, it is concluded that:

$F=1-N_{diff}/N_{all}=1-3/3=0<0.2$;

and $N_{all} - N_{diff} = 3-3=0<3$

Therefore, the proposed project activity is not a common practice within a sector in the applicable geographical area.

In conclusion, all the steps above are satisfied, the proposed VCS project is not a common practice and the project activity is additional.

The implementation timeline of the proposed VCS project activity is as follows:

Events	Time
The Preliminary Design Report (PDR) was finished.	01/2009
The Environmental Impact Assessment Report was finished.	01/2009
The EIA was approved.	23/04/2009
The Approval of the project activity was issued	27/05/2009
The Contract of the Civil Works construction was signed(starting date of the project).	25/09/2009
The Construction of the Civil Works was started.	13/10/2009
The purchase contract of Water Turbine & Generator Units was signed.	20/11/2009
The project was operated	05/12/2011

2.6 Methodology Deviations

Not applicable.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

According to baseline methodology ACM0002 (Version 14.0.0), the baseline emissions are the CO_2 emissions from the equivalent electricity supply by CSPG that is displaced by the project activity. So the baseline emissions by the project activity during a given year *y* is obtained as follow:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (1)$$

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 calculated using "Tool to calculate the emission factor for an electricity system (Version 04.0.0)" (tCO_2/MWh).

.According to baseline methodology ACM0002, for greenfield renewable energy power plants:

$$EG_{PJ,y} = EG_{facility,y} \quad (2)$$

Where:

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

The emission coefficient (measured in kg CO_2e/kWh) should be calculated in a transparent and conservative manner as: a combined margin (CM), consisting of the combination of operating margin(OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system (Version 04.0.0)".

The data used for calculation are from an official source (where available) and publicly available. The calculation processes are as follows:

STEP 1: Identify the relevant electricity system.
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: Calculate the build margin (BM) emission factor.
STEP 6: Calculate the combined margin (CM) emissions factor.

STEP 1: Identify the relevant electricity system

According to 'Tool to calculate the emission factor for an electricity system' (Version 04.0.0), as the generated electricity of the proposed project will be delivered to CSPG, relevant electricity system is defined as all power plants connected to CSPG[6], which includes Guangdong Province, Guangxi Zhuang Autonomous Region, Guizhou Province, Yunnan Province and Hainan Province.

As there are electricity transfers from Central China Power Grid (CCPG), the CO_2 emission factor for net electricity imports from Central China Power Grid must be calculated on calculation of Operation Margin emission factor of CSPG. According to “Tool to calculate the emission factor for an electricity system” (Version 04.0.0), the project activity selects option (b) to calculate CO_2 emission factor for net electricity imports from CCPG, that is “The simple operating margin emission rage of the exporting grid”.

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

According to ‘Tool to calculate the emission factor for an electricity system’ (Version 04.0.0), there are two options to calculate the operation margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.
For the proposed project, Option I is chosen.

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

According to “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”, there are four methods for calculating the $EF_{grid,OM,y}$:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM

Method (a) can be used if low-cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages data for hydroelectricity production. It can be found from Table 11 that the low-cost/must run resources including hydro, geothermal, wind, low-cost biomass constitute less than 50% of CSPG during year 2006 to 2010. Thus, method (a) is applicable to calculate $EF_{grid,OM,y}$.

Table 10 Percentage of low-cost/must run resources in CSPG during year 2006～2010[7]

Year	2008	2009	2010	2011	2012
Percentage (%)	27.01	29.28	36.07	32.36	32.81

For the project, $EF_{grid,OMsimple,y}$ is calculated using ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to VVB for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

[6] Department of Climate Change of National Department and Reform Commission, 2013 Baseline Emission Factors for Regional Power Grids in China, 17/09/2013.
[7] China Electric Power Yearbook 2008～2012

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

According to "Tool to calculate the emission factor for an electricity system (Version 04.0.0)", there are two options based on different data for calculating $EF_{grid,OMsimple,y}$:

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.

For the project, the necessary data for Option A is not available, so Option A can't be used, Option B can be used if only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known and off-grid power plants are not included in the calculation. Nuclear and renewable power generation are considered as low-cost / must-run power sources in CSPG, and the quantity of electricity supplied to CSPG by these sources is known and off-grid power plants are not included in the calculation, so Option B is used for calculating $EF_{grid,OMsimple,y}$, the formula is as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO_{2,i,y}})}{EG_y} \quad (3)$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	=	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	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 plant/unit m in year *y*
y	=	The relevant year as per the data vintage chosen in step 3

The calculation method of $EF_{grid,OMsimple,y}$ issued by National Development and Reform Commission is referred to for the project[8], to see A1～A7 in Annex for details.

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

'Tool to calculate the emission factor for an electricity system' (Version 04.0.0) provides two options (Option 1 and Option 2) to calculate the build margin emission factor in terms of vintage of data.

Option 1 is chosen to calculate the build margin emission factor. For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available

[8]Department of Climate Change of National Department and Reform Commission, 2013 Baseline Emission Factors for Regional Power Grids in China, 17/09/2013.

on units already built for sample group m at the time of VCS-PD submission to the VVB 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 VVB. 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.

According to 'Tool to calculate the emission factor for an electricity system' (Version 04.0.0),build Margin emission factor ($EF_{grid, BM, y}$) is calculated by utilizing an *ex-ante* 3 years data vintage for CSPG, the formulae as follow:

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \tag{4}$$

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

According to "2013 Baseline Emission Factors for Regional Power Grids in China" issued by National Development and Reform Commission on 17 September 2013, because of the unavailability of the data at the power plant level in China, the 22nd CDM EB meeting agreed the following deviation[9] approaches for $EF_{grid,BM,y}$ calculation:

1) Use the efficiency level of the most advanced commercialized technologies of provincial/regional or national grid of China, as a conservative proxy, for fuel *i* consumption estimation to estimate the $EF_{grid,BM,y}$;

2) Use of capacity additions during last several years for estimating the $EF_{grid,BM,y}$ i.e. the capacity addition over last several years, whichever results in a capacity addition that is closest to 20% of total installed capacity;

3) Use of installed capacity to replace annual power generation to estimate weights.

Due to the difficulty of separating the coal-fired, gas-fired or oil-fired installed capacity from the total thermal installed capacity, the $EF_{grid,BM,y}$ will be calculated as:

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

1) Based on the most recent years energy balance of the CSPG, calculating the proportions of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total CO_2 emissions of thermal power plants and taking them as weights of each type of plants in the following calculations;

2) Based on the most advanced commercialized technologies which applied by the coal-fired, oil-fired and gas-fired power plants, calculating the emission factor of thermal power plants in CSPG. This approach is more conservative as it assumes all recently built plants have the fuel efficiency as that of the most advanced commercialized technologies;

3) Calculating the $EF_{grid,BM,y}$ through multiplying the emission factor of thermal power plants by the percentage share of thermal power plants installed capacity addition within all recently built installed capacity. The proper year is selected so that it is the closest time when the last 20% of installed capacity was built.

The BM in this PD is calculated as the following sub-steps.

SUB-STEP 5a: Calculating the percentages of CO_2 emissions from the coal-fired, gas-fired and oil-fired power plants in CO_2 emissions from total thermal power plants

$$\lambda_{Coal,y} = \frac{\sum_{i \in Coal,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (5)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in Oil,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (6)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in Gas,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (7)$$

Where:

$\lambda_{Gas,y}$ =Percentage of CO_2 emissions from the gas-fired power plants in CO_2 emissions from total thermal power plants in year y;

$\lambda_{Oil,y}$ = Percentage of CO_2 emissions from the oil-fired power plants in CO_2 emissions from total thermal power plants in year y;

$\lambda_{Coal,y}$ = Percentage of CO_2 emissions from the coal-fired power plants in CO_2 emissions from total thermal power plants in year y;

$F_{i,j,y}$ = Amount of fuel i (mass or volume unit, t for solid and liquid fuel, m^3 for gas fuel) consumed by the power sources of province j in year y;

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/t for solid and liquid fuel, GJ/ m^3 for gas fuel);

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

SUB-STEP 5b: Calculating the fuel-fired emission factor ($EF_{Thermal}$)

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \qquad (8)$$

Where:

$EF_{Thermal,y}$ = Emission factor of thermal power plants;

$EF_{Coal,Adv,y}$ = Emission factor of coal-fired power plants applying the most advanced commercialized technologies;

$EF_{Oil,Adv,y}$ = Emission factor of oil-fired power plants applying the most advanced commercialized technologies;

$EF_{Gas,Adv,y}$ = Emission factor of gas-fired power plants applying the most advanced commercialized technologies.

SUB-STEP 5c: Calculating the Build Margin (BM) emission factor ($EF_{grid,BM,y}$)

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \qquad (9)$$

Where:

$EF_{grid,BM,y}$ = Build Margin (BM) emission factor with advanced commercialized technologies for year y of CSPG;

$CAP_{Total,y}$ = Incremental installed capacity of recently built power plants, which constitutes near and greater than 20% of the total installed capacity;

$CAP_{Thermal,y}$ = Newly installed capacity of recently built thermal power plants;

$EF_{Thermal,y}$ = Emission factor of thermal power plants.

$EF_{grid,BM,y}$ is calculated according to the latest available data at the submission time of this PD, the detailed data for the calculations is shown in Table A8-Table A13 of Annex.

STEP 6: Calculate the combined margin (CM) emissions factor

According to ‘Tool to calculate the emission factor for an electricity system’ (Version 04.0.0), baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$):

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y} \qquad (10)$$

Where:

w_{OM} = Weighting of operating margin emission factor (%);

w_{BM} = Weighting of build margin emission factor (%).

The weighs w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM}= w_{BM}= 0.5$) in the first crediting period .

3.2 Project Emissions

According to ACM0002 (Version 14.0.0), Emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{EF,\,y} + PE_{GP,\,y} + PE_{HP,\,y} \qquad (11)$$

Where:

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

$PE_{EF,\,y}$ = 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 (tCO_2e/yr)

$PE_{HP,\,y}$ = Project emissions from water reservoirs of hydro power plants in year y (tCO_2e/yr)

There is no use of fossil fuel for the hydropower project, so $PE_y = PE_{HP,\,y}$

According to ACM0002 (Version 14.0.0), the power density of the project is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

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 capacity of the hydro power plant before the implementation of 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 reservoirs, this value is zero

As the project will build a new reservoir, Cap_{BL} and A_{BL} are zero.
PD = (24,000,000 W-0) / (300,000 m^2-0) = 80 W/m^2
The power density of the project is more than 10 W/m^2, so PE_y =0.

3.3 Leakage

According to baseline methodology ACM0002 (Version 14.0.0), no leakage emissions are considered. L_y=0.

3.4 Summary of GHG Emission Reductions and Removals

Project emission

According to section 3.2, $PE_y = 0$

Baseline emission

According to the formula (2)-(10) in section 3.1, the results of $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ and $EF_{grid,CM,y}$ are listed in following Table 12 , the detailed calculation is shown in Annex.

Table 12 Calculating result of baseline emission factor of CSPG

$EF_{grid,OM,y}$ **(tCO_2e/MWh)**	$EF_{grid,BM,y}$ **(tCO_2e/MWh)**	$EF_{grid,CM,y}$ **(tCO_2e/MWh)**
0.9223	0.3769	0.64960

According to the formula (1) in Section 3.1, the baseline emissions (BE_y) of the project in a typical year are calculated as follows:

$$BE_y = EG_y \cdot EF_{grid,CM,y} = 85{,}988 MWh \times 0.64960\ tCO_2e/MWh = 55{,}857 tCO_2e/yr$$

Emission Reductions

The emission reductions (ER_y) of the project in a typical year are calculated as follows:

$$ER_y = BE_y - PE_y = 55{,}857\ tCO2e/yr - 0\ tCO2e/yr = 55{,}857\ tCO_2e/yr$$

The estimated project emission reductions in the first crediting period are listed in Table 13:

Years	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2011 (05/11/2011-31/12/2011)	4,131	0	0	4,131
2012	55,857	0	0	55,857
2013	55,857	0	0	55,857
2014	55,857	0	0	55,857
2015	55,857	0	0	55,857
2016	55,857	0	0	55,857

2017	55,857	0	0	55,857
2018	55,857	0	0	55,857
2019	55,857	0	0	55,857
2020	55,857	0	0	55,857
2021 (01/01/2021-04/11/2021)	51,726	0	0	51,726
Total	558,570	0	0	558,570

4 MONITORING

4.1 Data and Parameters Available at Validation

Data Unit / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	The grid CO2 emission factor of the CSPG where the Project connected to.
Source of data:	2013 Baseline Emission Factors for Regional Power Grids in China
Value applied:	0.64960
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$NCV_{i,y}$
Data unit:	kJ/kg or kJ/m3
Description:	The net calorific value (energy content) per mass or volume unit of fuel i in year y
Source of data:	China Energy Statistical Yearbook 2010.
Value applied:	See Appendix 4 for details.
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$EG_{Thermal,j,y}$
Data unit:	MWh

Description:	The electricity generated by fuel-fired power plants in province j in CSPG in year y
Source of data:	China Electric Power Yearbook 2010-2012
Value applied:	See Appendix 4 for details.
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$IPCR_{j,y}$
Data unit:	%
Description:	The internal power consumption rate of power plants in province j in CSPG in year y.
Source of data:	China Electric Power Yearbook 2010-2012
Value applied:	See Appendix 4 for details.
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$EF_{CO2,\ i,y}$
Data unit:	tCO2/TJ
Description:	The CO2 emission factor per unit of fuel i in year y
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	See Appendix 4 for details.
Justification of choice of data or description of measurement methods and procedures applied:	No specific Chinese value available, to adopt the IPCC default value.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$FC_{i,\ y}$
Data unit:	10^4 t, 10^8 m^3
Description:	The quantity of fuel i (in a mass or volume unit) consumed by CSPG in year y
Source of data:	China Energy Statistical Yearbook 2010-2012
Value applied:	See Appendix 4 for details.

Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$CAP_{j,\,y}$
Data unit:	MW
Description:	Installed capacities of province j in CSPG in years y.
Source of data:	China Electric Power Yearbook 2010-2012
Value applied:	See Appendix 4 for details.
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$GENE_{Coal,Adv}$
Data unit:	/
Description:	The power supply efficiency of coal-fired power plants with best technology commercially available
Source of data:	2013 Baseline Emission Factors for Regional Power Grids in China
Value applied:	39.84%
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.
Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	$GENE_{Oil/gas,Adv,y}$
Data unit:	/
Description:	The power supply efficiency of oil/gas-fired power plants with best technologies commercially available
Source of data:	2013 Baseline Emission Factors for Regional Power Grids in China
Value applied:	52.50%
Justification of choice of data or description of measurement methods and procedures applied:	Data used are from Chinese authorities.

Purpose of Data	Calculation of baseline emission
Any comment:	/

Data Unit / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero
Source of data:	Project site
Value applied:	0（The project is a new hydro power plant.）
Justification of choice of data or description of measurement methods and procedures applied:	Determine the installed capacity based on recognized standards
Purpose of Data	Calculation of baseline emission
Any comment:	

Data Unit / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m2). For new reservoirs, this value is zero.
Source of data:	Project site
Value applied:	0（The project is a new hydro power plant with a new reservoir.）
Justification of choice of data or description of measurement methods and procedures applied:	Measured from topographical surveys, maps, satellite pictures, etc.
Purpose of Data	Calculation of project emission
Any comment:	/

4.2 Data and Parameters Monitored

Data Unit / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project to the grid in year *y*
Source of data:	Electricity meter(s)
Description of measurement methods and procedures to be applied:	The following parameters shall be measured: (i) $EG_{out,y}$, The quantity of electricity supplied by the project to the grid; and (ii) $EG_{in,y}$,The quantity of electricity delivered to

	the project from the grid
Frequency of monitoring/recording:	Continuous measurement and at least monthly recording
Value applied:	The net annual electricity supplied to the grid is estimated to be 85,988MWh/year
Monitoring equipment:	Meters
QA/QC procedures to be applied:	Cross check measurement results with records for sold electricity
Purpose of Data	Calculation of baseline emission
Calculation method:	$EG_{facility,y}=EG_{out,y}-EG_{in,y}$
Any comment:	/

Data Unit / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data:	Project site
Description of measurement methods and procedures to be applied:	Determine the installed capacity based on recognized standards
Frequency of monitoring/recording:	Yearly
Value applied:	24,000,000
Monitoring equipment:	/
QA/QC procedures to be applied:	/
Purpose of Data	/
Calculation method:	/
Any comment:	/

Data Unit / Parameter:	A_{PJ}
Data unit:	m^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data:	Project site
Description of measurement methods and procedures to be applied:	The data will be measured by professional survey method.
Frequency of monitoring/recording:	Yearly
Value applied:	300,000
Monitoring equipment:	

QA/QC procedures to be applied:	The data was measured every year by professional design institute is reliable and creditable.
Purpose of Data	Calculation of project emission
Calculation method:	/
Any comment:	/

4.3 Description of the Monitoring Plan

1. Monitoring subject

The main data monitored are the electricity delivered to CSPG by the project and electricity consumed by the project activity from the CSPG. The net electricity delivered to CSPG is the difference of the electricity delivered to CSPG by the project and electricity consumed by the project activity from the CSPG according to the readings of the main meter.

2. Operational and management structure

In order to obtain reliable monitoring data, the project owner will establish a monitoring management structure prior to the starting of the crediting period. Clear responsibilities will be assigned to all staffs involved in the VCS project. A monitoring director will be appointed who has the overall responsibilities for the monitoring of the project, other staffs will be responsible for the data recording, data collecting, data archiving and emission reductions calculation. The detailed structure is as follows:

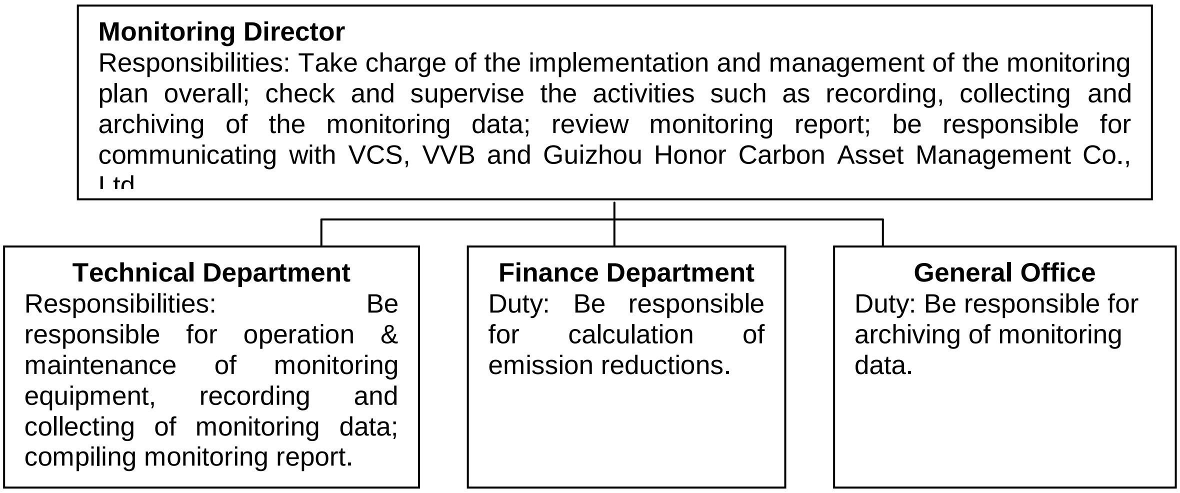

Fig. 4 Operational and Management Structure

3. Monitoring apparatus and installation:

The electricity metering equipment is selected according to the general industrial technical standards and inspected by the project owner and the grid company together in accordance with the requirement of "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, and the meters of the project are expected to be calibrated annually to ensure its precision.

There is one electricity metering spot for monitoring the net power exported to the grid:

The monitoring system （including a main meter and a back-up meter ）owned by the power grid company is installed at the connection point from the booster station of Luofan Plant to 110KV Transformer Substation, which monitors the power exported to the grid and the power imported from the grid.

The electrical connection and monitoring locations of the Bundled Project are shown below:

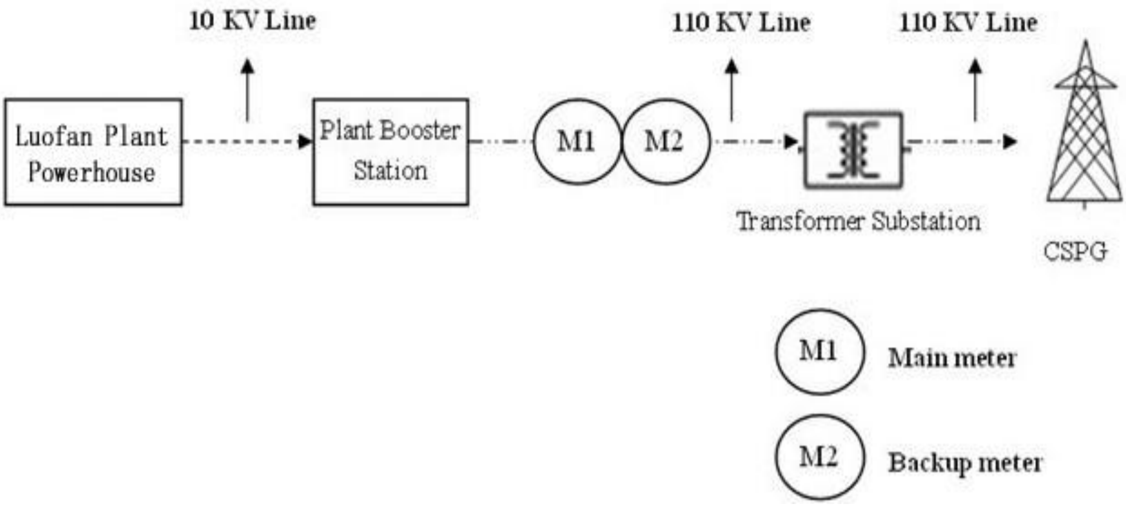

Fig. 5 Line Diagram of Monitoring Equipment

4. Data monitoring

The readings of the main meter are used for calculating the emission reductions when the main meter is in normal operation state. The monitoring processes are as follows:

(1) In each month, the designated persons from the grid company and the project company record the readings of the meter for the electricity delivered to CSPG and consumed by the project activity from CSPG for last month;

(2) The project owner provides the power grid company with the copy of the sale record, and preserves the copy of the sale record.

5. Quality control

1) Calibration of meters

The calibration of meters conducted by a qualified organization must comply with “Verification Regulation of Electrical Energy Meters with Electronics” (JJG596-1999) to ensure the accuracy. The main meter and back-up meter at the connection point to the grid will be calibrated once per year.

When the main meter or back-up meter have a breakdown, the party finding the breakdown should tell another party and inform the qualified calibration organization to check, calibrate, test and treat the meter so as to recover the normal monitoring state.

2) Emergency treatment

When the main meter or back-up meter have a breakdown, the electricity generation difference will be treated as follows:

(1) When one of the two meters has a breakdown, the readings of another meter will be adopted;

(2) If both of the main meter and back-up meter have breakdowns, the net electricity supplied to the grid will be determined conservatively after the discussion between the owner and the grid company.

6. Data management

All monitoring data and records will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

7. Training program

The proposed project developer and Guizhou Honor Carbon Asset Management Co., Ltd. will train all the related staffs before on duty and during project operation. The training contains VCS knowledge, operational regulations, quality control (QC), data monitoring requirements and data management regulations,

5 ENVIRONMENTAL IMPACT

1. Analysis of environmental impacts

In 2009, the project owner entrusted a third party to conduct the Environmental Impact Assessment (EIA) on the project, Qianxinan Miao and Buyi National Minority Autonomous Prefecture Environmental Protection Bureau approved the EIA report on 23 April 2009, the approval is as follows: “On the condition that the owner takes the measures of pollution prevention and ecological protection presented in the EIA report, the Department approves the construction of the project at the angle of environmental protection.”

The forecasting and assessment of the main impacts on environment and relevant protection measures to be taken are as follows:

Table 12 Environmental impact and protection measures

Impact item	Assessment of impacts on environment	Measures for environmental Protection
Water quality	The waste water from the sand processing system, machinery repairing and living sewage will have impact on the water quality downstream.	(1)To clean the sediment detention pool in time; (2) Set up the special ditch to collect and treat the waste oil; (3) Living sewage will be used as fertilizer.

Air quality	The waste powder from sands screening, concrete mixing and drilling will have some impacts on the air quality, but only the workers in the construction area will be influenced, local people who reside far away from the construction area won't been influenced.	(1) Adopt advanced construction technique ; (2) Sprinkle water to prevent the fly ash from drilling, earth & stone excavation, transportation; (3) Provide workers with dust-proof appliances.
Noise	The noise is from sand processing system, concrete mixing and vehicles, but only the workers in the construction area will be influenced, local people who reside far away from the construction area won't been influenced.	(1) Control noise source through improving the construction technology and using the equipment with low noise; (2) Control noise spreading channel through reasonable arrangement of workshop and office & living area; (3) Provide workers with noise-proof appliances.
Solid waste	The solid garbage mainly includes the earth and stone caused by the construction and living rubbish.	(1) waste earth and stone should be put in the fixed deposit place, corresponding water & soil conservation measures should be taken in time; (2) Put up sanitary equipment in the office and living area.
Ecological environment	There will be few impacts on the ecological environment except a little water & soil erosion due to the construction.	(1) The main engineering area should be made green by planting trees and grass according to the EIA approval after the completion of the project; (2) Temporary earth pile should be covered with plastic film; (3) The minimum water flow 55 m^3/s for ecological environment impact should be assured.
Human health	There are fewer impacts on workers' health.	(1) Conduct sanitation quarantine before workers entering the construction area; (2) Conduct health examination for workers during construction period ; (3) Conduct planned immunization for workers, strengthen the diet sanitation supervision and sanitation propaganda so as to improve workers' sanitation knowledge level and health protection consciousness.

2. Environmental impact assessment

The host Party and the project owner both regard that the proposed project will not bring significant impacts on the environment.

6 STAKEHOLDER COMMENTS

1. Analysis of environmental impacts

In order to let the stakeholders realize the project situation and hear their opinions and recommendations on the project, the project owner had posted a notice which invited stakeholders to take part in a symposium on 10 May 2009. On 20 May 2009, the owner presided over the symposium introducing the basic situation of the project and hearing stakeholders' opinions and recommendations. There were 30 representatives of stakeholders attending the symposium, including local inhabitants, social organization and related governmental departments.

2. Summary of comments received

The positive assessment on the project was made by the stakeholders taking part in the symposium:

1. The project will generate electricity with the water resources of Datianhe, it will mitigate the power lack of the area.
2. The project activity can provide some job opportunities for the local residents during the construction and after the project is put into operation, and promote the local development of the 3rd industry and relevant industries, thus the living standard of the local people will be improved.
3. After the project is put into operation, the tax revenue will be improved for the local district, this will promote the local development in society and in economy powerfully.
4. They all support the project powerfully because it is helpful to the country and the masses. They hope that the project can be put into operation as soon as possible so as to produce benefits.

The stakeholders also put forward the following issues and suggestions:

1.The local residents should have a priority to get job opportunities during the construction and operation.

2.Although the impacts on water, air and noise environment during the construction are in a small scope and slight degree, the owner should take the measures of the environmental protection stated in the EIA report seriously to ensure that the production and living of the local people isn't affected obviously.

3. The water and soil conservation should be conducted well, especially the vegetation should be recovered after the completion of the construction.

3. Report on consideration of comments received

The owner had taken the stakeholders' comments into full account and will implement the following activities well:

1. The project owner promises that the local residents have a priority to get job opportunities during the construction and operation.
2. The environmental protection measures presented in the EIA report will be taken strictly to minimize the adverse impacts from the project and bring the positive impacts on the environment into full play;
3. The vegetation will be recovered at once in the construction area after the completion of the construction of the project activity.

Annex: BASELINE INFORMATION

The installed capacity and the fuel consumption data used for OM and BM calculations 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 ($kgCO_2/TJ$)	Oxidation Factor
Raw Coal	20,908 kJ/kg	87,300	1
Cleaned Coal	26,344 kJ/kg	87,300	1
Other Washed Coal	8,363 kJ/kg	87,300	1
Moulded Coal	20,908 kJ/kg	87,300	1
Coal Gangue*	8,363 kJ/kg	87,300	1
Coke	28,435 kJ/kg	95,700	1
Other Coking Products	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
Petroleum Coke*	31,947 kJ/kg	82,900	1
Other Oil Production	41,816 kJ/kg	72,200	1
Natural Gas	38,931 kJ/m3	54,300	1
LNG*	51,434 kJ/kg	54,300	1
Coke Oven Gas	16,726 kJ/m3	37,300	1
Blast Furnace Gas*	219,000 kJ/m3	3,763	1
Converter Gas*	145,000 kJ/m3	7,945	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: (1)The net calorific values are quoted from <China Energy Statistical Yearbook 2010> page 285. (2)The emission factors are quoted from <2006 IPCC Guidelines for National Greenhouse Gas Inventories >, Table 1.3 and Table 1.4, Page 1.21-1.24, Chapter 1, Volume 2 Energy. 95% of lower limit value of emission factors confidence interval is adopted. (3)The Low Calorific Values of the fuel with *are from <The Statistical System of Public Institutions Energy consumption >. which is formulated by Bureau of Government Offices Administration under the State Council and approved by State Statistics Bureau in July 2011.

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

Table A2 Simple OM Emission Factors Calculation of CSPG for Year 2009

Fuel	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total	EF	Oxidation	Emission Factor	Average Low Calorific Value	CO_2 Emission (tCO_2e)
								(tC/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	K=G×I×J/ 100000 (for mass unit)
		A	B	C	D	E	F=A+B+C+D+E	G	H	I	J	K= G×I×J / 10000 (for volume unit)
Raw Coal	10^4 t	8,011.98	1,815.41	4,925.23	3,311.44	376.59	18,440.65	25.8	100	87,300	20,908	336,591,357
Cleaned Coal	10^4 t	1.8					1.8	25.8	100	87,300	26,344	41,397
Other Washed Coal	10^4 t			11.67	44.92		56.59	25.8	100	87,300	8,363	413,158
Briquettes	10^4 t	195.86					195.86	26.6	100	87,300	20,908	3,574,971
Coke	10^4 t	4.9	1.6		1.63		8.13	29.2	100	95,700	28,435	221,236
Coke Oven Gas	10^8 m^3		2.89	2.02	2.48		7.39	12.1	100	37,300	16,726	461,047
Other Gas	10^8 m^3	1.11	20.88		48.61		70.6	12.1	100	37,300	5,227	1,376,468
Crude Oil	10^4 t						0	20	100	71,100	41,816	0
Gasoline	10^4 t						0	18.9	100	67,500	43,070	0
Diesel Oil	10^4 t	6.46	0.52		0.49	0.12	7.59	20.2	100	72,600	42,652	235,027
Fuel Oil	10^4 t	157.37	0.09				157.46	21.1	100	75,500	41,816	4,971,182
LPG	10^4 t						0	17.2	100	61,600	50,179	0
Refinery Dry Gas	10^4 t	0.51					0.51	15.7	100	48,200	46,055	11,321
Natural Gas	10^8 m^3	47.21				6.19	53.4	15.3	100	54,300	38,931	11,288,511
Other Petroleum Products	10^4 t	45.31				0.83	46.14	20	100	72,200	41,816	1,393,020
Other Coking Products	10^4 t						0	25.8	100	95,700	28,435	0
Other Energy	10^4tce	152.99	98.56	23.01	49.01	20	343.57	0	0	0	0	0
Total												**360,578,694**

Data Source: <China Energy Statistical Yearbook 2009>

Table A3 Fuel-fired Electricity Generation of CSPG for Year 2009

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	(MWh)	(%)	(MWh)
Guangdong	2,143	214,300,000	6.16	201,099,120
Guangxi	428	42,800,000	6.69	39,936,680
Guizhou	978	97,800,000	6.68	91,266,960
Yunnan	548	54,800,000	6.52	51,227,040
Hainan	114	11,400,000	8.17	10,468,620
Total				**393,998,420**

Data Source: <China Electric Power Yearbook 2010>.

Table A4 Simple OM Emission Factors Calculation of CSPG for Year 2010

Fuel	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total	EF	Oxidation	Emission Factor	Average Low Calorific Value	CO_2 Emission (tCO_2e)
								(tC/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	K=G×I×J/ 100000 (for mass unit)
		A	B	C	D	E	F=A+B+C+D+E	G	H	I	J	K= G×I×J / 10000 (for volume unit)
Raw Coal	10^4 t	9758.45	2330.59	4876.8	3345.11	471.84	20782.79	25.8	100	87,300	20,908	379,341,699
Cleaned Coal	10^4 t	1.03	0.39				1.42	25.8	100	87,300	26,344	32,658
Other Washed Coal	10^4 t			11.24	39.08		50.32	25.8	100	87,300	8,363	367,381
Briquettes	10^4 t	179.27					179.27	26.6	100	87,300	20,908	3,272,159
Coke	10^4 t						0	29.2	100	95,700	28,435	0
Coal Gangue	10^4 t	301.69		26.13	62.95		390.77	25.8	100	87,300	8,363	2,852,972
Coke Oven	10^8		2.82	2.02	3.25		8.09	12.1	100	37,300	16,726	504,719

Gas	m^3											
Blast Furnace Gas	10^8 m^3	0.79	42.32	9.32	48.03		100.46	70.8	100	219,000	3,763	8,278,878
Converter Gas	10^8 m^3	0.33	4.25		1.8		6.38	46.9	100	145,000	7,945	734,992
Other Gas	10^8 m^3						0	12.1	100	37,300	5,227	0
Crude Oil	10^4 t						0	20	100	71,100	41,816	0
Gasoline	10^4 t						0	18.9	100	67,500	43,070	0
Diesel Oil	10^4 t	4.65	0.41	2.29	0.76	0.08	8.19	20.2	100	72,600	42,652	253,606
Fuel Oil	10^4 t	83.39	0.1				83.49	21.1	100	75,500	41,816	2,635,869
Petroleum Coke	10^4 t	20.4					20.4	26.6	100	82,900	31,947	540,275
LPG	10^4 t						0	17.2	100	61,600	50,179	0
Refinery Dry Gas	10^4 t	0.56					0.56	15.7	100	48,200	46,055	12,431
LNG	10^4 t	164.94					164.94	15.3	100	54,300	51,434	4,606,554
Natural Gas	10^8 m^3	34.04				7.62	41.66	15.3	100	54,300	38,931	8,806,729
Other Petroleum Products	10^4 t	0.63				0.47	1.1	20	100	72,200	41,816	33,210
Other Coking Products	10^4 t						0	25.8	100	95,700	28,435	0
Other Energy	10^4tce	163.95	77.36		26.02	23.47	290.8	0	0	0	0	0
Total												**412,274,132**

Data Source: <China Energy Statistical Yearbook 2011>

Table A5 Fuel-fired Electricity Generation of CSPG for Year 2010

Province	Electricity Generation (10^8 kWh)	Electricity Generation (MWh)	Auxiliary Power Ratio (%)	Supplied Electricity (MWh)
Guangdong	2535	253,500,000	5.97	238,366,050
Guangxi	557	55,700,000	6.55	52,051,650
Guizhou	956	95,600,000	6.85	89,051,400
Yunnan	546	54,600,000	6.93	50,816,220
Hainan	139	13,900,000	7.57	12,847,770
Total				**443,133,090**

Data Source: <China Electric Power Yearbook 2011>.

Table A6 Simple OM Emission Factors Calculation of CSPG for Year 2011

Fuel	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total	EF	Oxidation	Emission Factor	Average Low Calorific Value	CO_2 Emission (tCO_2e)
								(tC/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	K=G×I×J/ 100000 (for mass unit)
		A	B	C	D	E	F=A+B+C+D+E	G	H	I	J	K= G×I×J / 10000 (for volume unit)
Raw Coal	10^4 t	11799.44	2807.29	4266	3520.42	607.41	23000.56	25.8	100	87,300	20,908	419,821,954
Cleaned Coal	10^4 t						0	25.8	100	87,300	26,344	0
Other Washed Coal	10^4 t			1291.29	22.96		1314.25	25.8	100	87,300	8,363	9,595,207
Briquettes	10^4 t	182.83					182.83	26.6	100	87,300	20,908	3,337,138
Coke	10^4 t						0	29.2	100	95,700	28,435	0
Coal Gangue	10^4 t	320.15		71.26	36.78		428.19	25.8	100	87,300	8,363	3,126,172
Coke Oven Gas	10^8 m^3		3.05	1.88	2.26		7.59	12.1	100	37,300	16,726	16,726
Blast Furnace Gas	10^8 m^3	1.58	44.78	9.16	50.65		106.17	70.8	100	219,000	3,763	8,749,438
Converter Gas	10^8 m^3	0.33	2.71		2.38		5.42	46.9	100	145,000	7,945	624,398
Other Gas	10^8 m^3						0	12.1	100	37,300	5,227	0
Crude Oil	10^4 t						0	20	100	71,100	41,816	0
Gasoline	10^4 t						0	18.9	100	67,500	43,070	0
Diesel Oil	10^4 t	2.8	0.58	3.58	1.05	0.03	8.04	20.2	100	72,600	42,652	248,961
Fuel Oil	10^4 t	24.44	0.07				24.51	21.1	100	75,500	41,816	773,807
Petroleum Coke	10^4 t	16.51			1.38		17.89	26.6	100	82,900	31,947	473,800
LPG	10^4 t						0	17.2	100	61,600	50,179	0
Refinery Dry Gas	10^4 t	0.91					0.91	15.7	100	48,200	46,055	20,201
LNG	10^4 t	195.1					195.1	15.3	100	54,300	51,434	5,448,882

Natural Gas	10^8 m^3	38.19		0.76		6.83	45.78	15.3	100	54,300	38,931	9,677,678
Other Petroleum Products	10^4 t	0.53				0.53	1.1	20	100	72,200	41,816	16,001
Other Coking Products	10^4 t						0	25.8	100	95,700	28,435	0
Other Energy	10^4tce	34.53	159.22		25.2		218.95	0	0	0	0	0
Total												**462,387,161**

Data Source: <China Energy Statistical Yearbook 2011>

Table A7 Fuel-fired Electricity Generation of CSPG for Year 2011

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	(MWh)	(%)	(MWh)
Guangdong	3046	304,600,000	5.6	287,542,400
Guangxi	637	63,700,000	6.6	59,495,800
Guizhou	1022	102, 200,000	7.3	94,739,400
Yunnan	536	53,600,000	7.7	49,472,800
Hainan	158	15,800,000	7.8	14,567,600
Total				**505,818,000**

Data Source: <China Electric Power Yearbook 2012>.

The Operating Margin (OM) emission factor is the weighted average emission factors of year 2008-2010, and is expressed as follows:

$$EF_{grid,OM,y} = 0.9223\ tCO_2e/MWh.$$

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

		Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total	Average Low Calorific Value	Emission Factor (tC/TJ)	Oxidation	CO_2 Emission (tCO_2e)
Fuel	**Unit**	**A**	**B**	**C**	**D**	**E**	**F=A+…+E**	**G**	**H**	**I**	**J=F×G×H×I/100,000**
Raw Coal	10^4 t	11,799.44	2,807.29	4,266.00	3,520.42	607.41	23,000.56	20,908	87,300	1	419,821,954
Cleaned Coal	10^4 t	0	0	0	0	0	0	26,344	87,300	1	0
Other Washed Coal	10^4 t	0	0	1,291.29	22.96	0	1,314.25	8,363	87,300	1	9,595,207
Briquette	10^4 t	182.83	0	0	0	0	182.83	20,908	87,300	1	3,337,138
Coal Gangue	10^4 t	320.15	0	71.26	36.78	0	428.19	8,363	87,300	1	3,126,172
Coke	10^4 t	0	0	0	0	0	0	28,435	95,700	1	0
Other Coking Products	10^4 t	0	0	0	0	0	0	28,435	95,700	1	0
Subtotal											435,880,470
Crude Oil	10^4 t	0	0	0	0	0	0	41,816	71,100	1	0
Gasoline	10^4 t	0	0	0	0	0	0	43,070	67,500	1	0
Diesel Oil	10^4 t	2.80	0.58	3.58	1.05	0.03	8.04	42,652	72,600	1	248,961
Fuel Oil	10^4 t	24.44	0.07	0	0	0	24.51	41,816	75,500	1	773,807
Petroleum Coke	10^4 t	16.51	0	0	1.38	0	17.89	31,947	82,900	1	473,800
Other Petroleum Products	10^4 t	0.53	0	0	0	0	0.53	41,816	72,200	1	16,001
Subtotal											1,512,570
Natural Gas	$10^7 m^3$	381.90	0	7.60	0	68.30	457.8	38,931	54,300	1	9,677,678
LNG		195.10	0	0	0	0	195.1	51,434	54,300	1	5,448,882
Coke Oven Gas	$10^7 m^3$	0	30.50	18.80	26.60	0	75.9	16,726	37,300	1	473,525
Blast Furnace Gas	$10^7 m^3$	15.80	447.80	91.60	506.50	0	1061.7	3,763	219,000	1	8,749,438

Converter Gas	$10^7 m^3$	3.30	271.00	0	23.80	0	298.1	7,945	145,000	1	3,434,187
Other Gas	$10^7 m^3$	0	0	0	0	0	0	5,227	37,300	1	0
LPG	10^4 t	0	0	0	0	0	0	50,179	61,600	1	0
Refinery Dry Gas	10^4 t	0.91	0	0	0	0	0.91	46,055	48,200	1	20,201
Subtotal											27,803,910
Other Energy	10^4tce	34.53	159.22	0	25.20	0	218.95	0	0	0	0
Total											465,196,950

Data Source: <China Energy Statistical Yearbook 2011>

According to Table A8 and formula (4), (5), (6) in section 3.1, 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:

$$\lambda_{Coal,y} = 93.70\%, \quad \lambda_{Oil,y} = 0.33\%, \quad \lambda_{Gas,y} = 5.98\%$$

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

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

Table A9 Emission factors of coal/gas/oil-fired power plants applying the most advanced commercialized technologies

	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	$EF_{Coal,Adv,y}$	39.84	87,300	1	0.7889
Gas-fired Power Plant	$EF_{Oil,Adv,y}$	52.50	75,500	1	0.5177
Oil-fired Power Plant	$EF_{Gas,Adv,y}$	52.50	54,300	1	0.3723

According to Table A9 and formula (7) in section 3.1, the $EF_{Thermal,y}$ is calculated as follows.

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

= 0.76317CO_2/MWh

= 0.76723 tCO_2/MWh

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

Table A10 Installed Capacity of CSPG in 2011

Installed capacity	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total
Fuel-fired	MW	56,350	11,770	11,360	20,300	3,150	102,930
Hydro	MW	13,020	15,260	28,420	18,660	810	76,170
Nuclear	MW	6,120	0	0	0	0	6,120
Wind and other	MW	748	50	690	40	275	1,803
Total	MW	76,238	27,080	40,470	39,000	4,235	187,023

Data Source: <China Electric Power Yearbook 2012>

Table A11 Installed Capacity of CSPG in 2010

Installed capacity	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total
Fuel-fired	MW	52,870	10,390	11,330	17,530	2,970	95,090
Hydro	MW	12,600	14,940	24,350	16,550	750	69,190
Nuclear	MW	5,030	0	0	0	0	5,030
Wind and other	MW	620	0	360	0	210	1,190
Total	MW	71,120	25,330	36,040	34,080	3,930	170,500

Data Source: <China Electric Power Yearbook 2011>

Table A12 Installed Capacity of CSPG in 2009

Installed capacity	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total
Fuel-fired	MW	48,300	10,770	10,710	17,310	3,090	90,180
Hydro	MW	11,260	14,750	20,900	13,610	700	61,220
Nuclear	MW	3,950	0	0	0	0	3,950
Wind and other	MW	560	0	80	0	60	700
Total	MW	64,070	25,520	31,690	30,920	3,850	156,050

Data Source: <China Electric Power Yearbook 2010>

able A13 Installed Capacity of CSPG in 2008

Installed capacity	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Hainan	Total
Fuel-fired	MW	45,730	10,270	10,030	17,170	2,370	85,570
Hydro	MW	10,280	13,970	15,740	9,470	410	49,870
Nuclear	MW	3,780	0	0	0	0	3,780
Wind and other	MW	290	0	80	0	10	380
Total	MW	60,080	24,240	25,850	26,640	2,790	139,600

Data Source: <China Electric Power Yearbook 2010>

Table A14 The Calculation of BM Emission Factor for the South China Power Grid

Installed capacity	2008	2009	2010	2011	Increase from 2008 to 2011[1]	Increase from 2008to 2011[2]	Increase from 2008 to 2011[3]	Percentage
	A	B	C	D	E	F	G	H
Fuel-fired (MW)	85,570	90,180	95,090	102,930	26,984	11,030	8,154	49.38%
Hydro (MW)	49,870	61,220	69,190	76,170	23,900	5,870	6,680	43.74%
Nuclear (MW)	3,780	3,950	5,030	6,120	2,340	1,080	1,090	4.28%
Wind (MW)	380	700	1,190	1,803	1,423	490	613	2.60%

Total(MW)	**139,600**	**156,050**	**170,500**	**187,023**	**54,647**	**35,007**	**16,537**	**100.00%**
Percentage of year 2010					29.22%	18.72%	8.84%	

1 and 2 : The newly added installed capacity is calculated with consideration of installed capacity, capacity of closed units and bumped storage installed capacity.
Data Source: <China Electric Power Yearbook 2010-2012>

According to Table A13 and formula (8) in section 3.1, the $EF_{grid,BM,y}$ is calculated as:

$$EF_{grid,BM,y} = 0.76723 \times 49.38\% = 0.3769 \ tCO_2/MWh$$

Step 3: Calculating the baseline emission factor ($EF_{grid,CM,y}$)
According to formula (9) in section 3.1, the baseline emission factor of CSPG is calculated as:

$$EF_{grid,CM,y} = 0.5 \times EF_{grid,OM,y} + 0.5 \times EF_{grid,BM,y} = 0.6496tCO_2e/M$$