THREE GORGES NEW ENERGY JIUQUAN CO., LTD GUAZHOU 100MW SOLAR POWER PROJECT

Document Prepared By Climate Bridge Ltd.

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Three Gorges New Energy Jiuquan Co., Ltd Guazhou 100MW Solar Power Project (hereafter simplified as "the project") is a newly built grid-connected solar photovoltaic power plant with installed capacity of 100.39[1] MWp, which is located in Solar Power Industry Zone, Guazhou County, Jingyuan City, Gansu Province of China. The project is developed and operated by Three Gorges New Energy Jiuquan Co., Ltd (hereafter simplified as "the project owner").

The existing scenario prior to the implementation of the project is the electricity being generated by Northwest Power Grid (NWPG), and the baseline scenario of the project is the same as the existing scenario.

Purpose of the project is to generate electricity by using the renewable solar energy, and the electricity generated by the project will be delivered into NWPG to replace the equivalent electricity generated by fossil-fuel dominated NWPG, therefore the GHG emission reductions will be achieved.

During the first crediting period, the annual average GHG emission reductions are estimated to be 126,206 tCO_2e, while the total GHG emission reductions during the first 10-year crediting period are estimated to be 1,262,062 tCO_2e.

<u>Contribution to sustainable development</u>

The project promotes local sustainable development through the following aspects:

- The project activity will displace the power generation of fossil fuel power plants, reducing CO_2, SO_x and NO_x emissions significantly, thus mitigating the air pollution and its adverse impacts on human health.
- Improvement of the fossil fuel dominated fuel mix of the electricity generation in the power grid by providing clean and renewable energy source, and help to energy supply security.
- Promote application and diffusion of the innovative/creative solar PV technology in China through the demonstrative practice of the project activity.

1.2 Sectoral Scope and Project Type

Sectoral Scope 1: Energy industries (renewable - / non-renewable sources)

Project Type: Grid-connected renewable power generation

The project is not a grouped project.

[1] The total installed capacity of the Solar Photovoltaic Modules is 100.39 MW (=250W*294,315 + 255W*105,144), while the capacity of inverters and box transformers is 100MW. Hence, the total installed capacity of the project is 100MW, this is in accordance with the FSR and EIA approval.

1.3 Project Proponent

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Title	General Manager Assistant
Address	No.12, lane 2, Baiguang Road, Xuanwu District, Beijing, China
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1.4 Other Entities Involved in the Project

Organization name	Climate Bridge Ltd.
Role in the project	Consultant and VCU Buyer
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1.5 Project Start Date

30/12/2013 (commissioning start date)

1.6 Project Crediting Period

This project adopts renewable crediting periods of 25 years (from 30/12/2013 to 29/12/2038), and the first 10-year crediting period is from 30/12/2013 to 29/12/2023 (both days included).

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission

	reductions or removals (tCO_2e)
30/12/2013-29/12/2014	131,977
30/12/2014-29/12/2015	130,908
30/12/2015-29/12/2016	129,572
30/12/2016-29/12/2017	128,237
30/12/2017-29/12/2018	126,901
30/12/2018-29/12/2019	125,565
30/12/2019-29/12/2020	124,229
30/12/2020-29/12/2021	122,893
30/12/2021-29/12/2022	121,558
30/12/2022-29/12/2023	120,222
Total estimated ERs	1,262,062
Total number of crediting years	10
Average annual ERs	126,206

1.8 Description of the Project Activity

The project will generate electricity by using renewable solar photovoltaic (PV) power and deliver to the NWPG, replacing equivalent electricity generated by fossil fuel fired power plants connected to the NWPG and therefore reducing GHG emissions.

The installation capacity of the Project is 100.39 MWp which consists of 100 sets of power generation units (sub-systems). Each of the power generation unit is equipped with 2 inverters and one box transformer. The technical parameters of the main equipment for the project are shown in **Table 1**. The expected grid-in electricity in the first operation year is about 158,798.4 MWh[2] and the accumulative decay rate during the whole lifetime in 25 years is ≤ 20%. Therefore the expected annual grid-in electricity in 25 years is 142,391.4 MWh, at 1,423.9 operational hours with a PLF of 16.25%; and the annual grid-in electricity in the first 10 years is 151,855 MWh, range from 158,798MWh to 144,654MWh, please refer to **Table 2** for details. For the first 10-year crediting period, the GHG emission reduction estimations are calculated based on values in Table 2.

Table 1: Parameters of the equipment used in the proposed project

Photovoltaic Modules	CS6P-250P	CS6P-255P
Manufacturer	Changshu Artes sunshine Power Technology Co., Ltd.	
Quantity	294,315	105,144
Rated maximum power	250	255

[2] Data source: FSR page 96

(Wp)		
Rated Power Voltage (V)	30.1	30.2
Rated Power Current (A)	8.30	8.43
Open circuit voltage (V)	37.2	37.4
Life time (years)	25	25
Decay rate in 25 years (%)	≤ 20	≤ 20
Conversion Efficiency (%)	15.54	15.54
Inverter	SG500MX	EP-0500-A
Manufacturer	Sungrow Power Supply Co., Ltd.	Wuxi Sineng New Energy Co. , Ltd
Quantity	98	102
Rated output Power (kW)	500	500
Rated output Voltage (V)	3 ~ 315	315
Rated output frequency (Hz)	50	50
Max. output current (A)	1,008	1,008

Box transformer	ZGS-Z.G-1000/38.5	YBF-1000/40.5	ZGSF11-Z.G-1000/35
Manufacturer	Ningbo Tian'an Transformer Co., Ltd.	Sunel Transformer Co., Ltd.	Jiangsu Huapeng Transformer Co., Ltd.
Quantity	40	30	30
Rated capacity (kVA)	1,000	1,000	1,000
Rated Voltage (V)	38,500±2×2.5/315/315	40,500	38,500±2×2.5/315/315

Table 2 The expected annual power generation in first 10 years[3]

Year	Expected annual power generation (MWh)
30/12/2013-29/12/2014	158,798
30/12/2014-29/12/2015	157,513
30/12/2015-29/12/2016	155,905
30/12/2016-29/12/2017	154,298
30/12/2017-29/12/2018	152,691
30/12/2018-29/12/2019	151,084
30/12/2019-29/12/2020	149,476
30/12/2020-29/12/2021	147,869
30/12/2021-29/12/2022	146,262

[3] Data source: FSR page 96

30/12/2022-29/12/2023	144,654
Annual average	151,855

The electricity generated from inverters will be transformed to 35kV by box transformers, connected to the onsite substation via 35kV lines, and then transformed to 110kV through the two main transformers before delivered to Bulongji 330kV Substation of the grid company and finally to NWPG.

The existing scenario prior to the implementation of the project is the electricity being generated by Northwest Power Grid (NWPG), and the baseline scenario of the project is the same as the existing scenario.

1.9 Project Location

The Project is located in Solar Power Industry Zone, Guazhou County, Jingyuan City, Gansu Province of China. The coordinates of the project are:

Latitude: 40°36′21.40" - 40°37′502.90" N

Longitude: 96°24′6.30" - 96°25′38.30" E

The location of the Project is shown in the map of **Figure 1**.

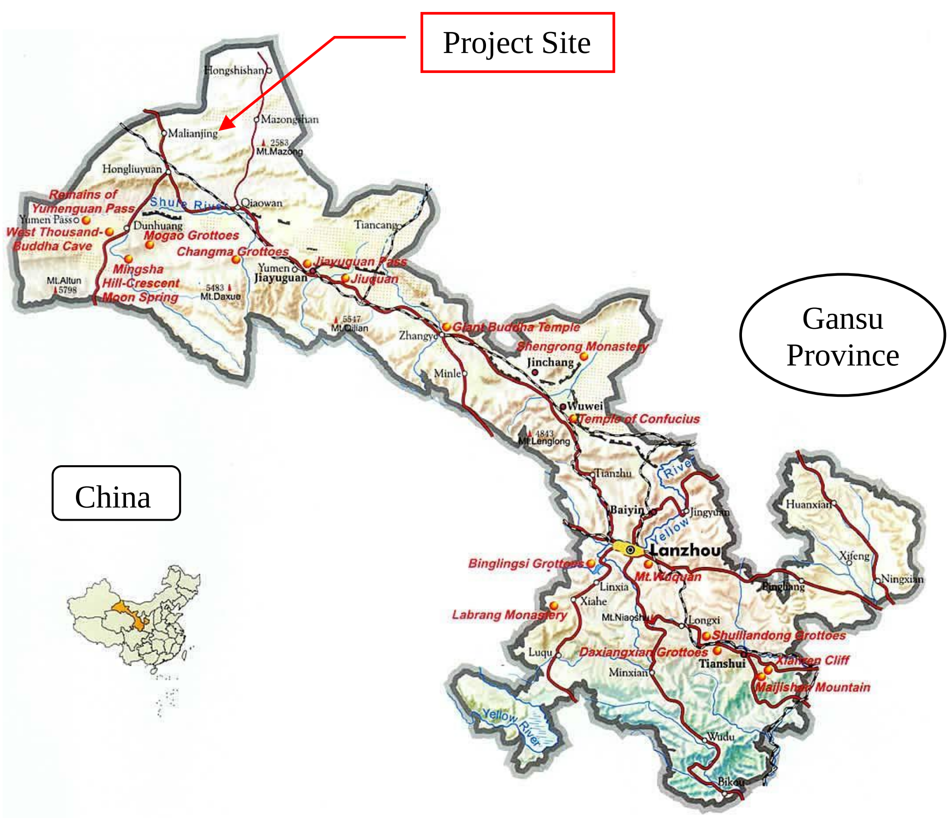

Figure 1: The location of the project

1.10 Conditions Prior to Project Initiation

Purpose of the project is to generate electricity by using solar PV technology, and to deliver the electricity to the NWPG. The condition prior to project initiation is that the equivalent electricity service would be provided by the power grid. And the baseline scenario is the same as the conditions prior to project initiation, please refer to **Section 2.4** for details.

The project is a power generation project by using renewable solar photovoltaic (PV) power without GHG emissions during operation period. Therefore, it was confirmed that the project has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project complies with all Chinese relevant laws and regulations. It has obtained the approval letters from governmental authorities: Development and Reform Commission (DRC), as well as Environment Protection Agency (EPA) of Gansu Province. The two approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, status and other regulatory frameworks.

1.12 Ownership and Other Programs

1.12.1 Right of Use

The business license of Three Gorges New Energy Jiuquan Co., Ltd is the evidence for right of use. The approval of Feasibility Study Report (FSR) and Environmental Impact Assessment (EIA) are evidences for legislative right. Besides, the power purchase agreement is the evidence for the ownership of the plant, equipment and process generating.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emission trading program or any other mechanism that includes GHG allowance trading.

1.12.3 Other Forms of Environmental Credit

The project hasn't sought or received another form of environmental credits.

1.12.4 Participation under Other GHG Programs

The project hasn't participated under CDM, GS or any other GHG Programs.

1.12.5 Projects Rejected by Other GHG Programs

The project hasn't been rejected by any other GHG Programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

N/A

Leakage Management

According to applied CDM methodology ACM0002, leakage is not considered.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

No further information is required.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

ACM0002: "Grid-connected electricity generation from renewable sources" (Version 16.0);

The methodology also refers to:

"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);

More information concerning the above methodology and tools can be referred to: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

2.2 Applicability of Methodology

The approved methodology ACM0002 is applicable to the project activity, because:

a) The Project is a newly-built grid-connected renewable energy (i.e. photovoltaic power) power plant at a site where no renewable power plant was operated prior to the implementation of the project activity.

b) The Project does not involve an on-site switch from fossil fuels to a renewable source.

Therefore, the baseline methodology ACM0002 (version 16.0) is applicable to the project activity. In addition, project activity will supply electricity to the NWPG, so "Tool to calculate the emission factor for an electricity system" can be used to estimate OM, BM and/or CM for baseline emission calculation.

2.3 Project Boundary

The electricity generated by the proposed project will be transferred to NWPG, according to 2014 Baseline emission factors for regional power grids in China[4] issued by the National Development and Reform Commission of the Government of China (China DNA), NWPG consists of independent province-level electricity systems including Shaanxi Province, Gansu Province, Qinghai Province, Ningxia Hui Autonomous Region and Xinjiang Uyghur Autonomous Region. For the proposed project, the spatial extent of the project boundary includes the proposed project and all power plants connected physically to the NWPG that the proposed project is connected to.

According to ACM0002, the Green House Gases ("GHG") and emission sources included in or excluded from the project boundary are shown in the following table:

Source		Gas	Included?	Justification/Explanation
Baseline	CO_2 emission from electricity generation of NWPG	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project	Photovoltaic power plant	CO_2	No	No project emissions for solar photovoltaic power plant, according to the methodology, PE_y= 0.
		CH_4	No	
		N_2O	No	

The project boundary is shown in the following flow diagram:

[4] http://cdm.ccchina.gov.cn/Detail.aspx?newsId=51651&TId=3

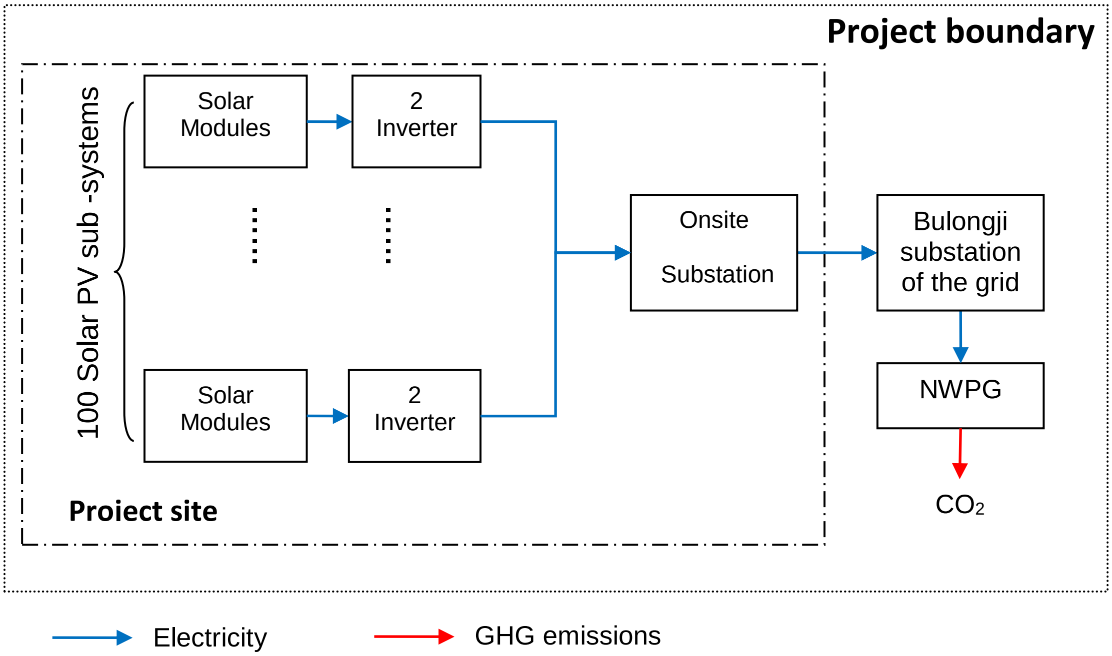

Figure 2: Project boundary

2.4 Baseline Scenario

According to the methodology ACM0002 (version 16.0), as the Project is the installation of a Greenfield solar photovoltaic power plant, the baseline scenario of the Project is the following:

Electricity delivered to NWPG 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".

2.5 Additionality

According to the methodology ACM0002 (version 16.0), the additionality of the project activity shall be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality".

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

According to the methodology ACM0002, the baseline scenario which is the most realistic and credible alternative scenario to the project activity is:

Electricity delivered to NWPG 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".

Therefore, proceed to Step 2 directly.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

According to ACM0002, if the project activity and the alternatives identified in Step 1 generate no financial or economic benefits other than carbon related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

For this project, the alternative to the project activity is the supply of electricity from a grid which is not considered as an investment by project participant, so the benchmark analysis (Option III) will be used.

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

The benchmark of Equity IRR (after tax) is 10% in the Chinese power generation industry[5]. This project will generate electricity using solar energy, so the benchmark IRR of this project is determined to be 10%.

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

The main financial parameters and IRR of this project are shown in **Table 3** and **Table 4** below.

Table 3: Key Financial Parameters

Index	Value
Total static investment	940.3715 million CNY
Debt ratio of the total investment	70%
Average annual total O&M cost	17.02 million CNY
Including:	
Annual salary and welfare	2.09 million CNY
Annual insurance	2.18 million CNY
Annual material cost	1.51 million CNY
Average annual maintenance expenses	8.73 million CNY
Annual miscellaneous expenses	2.51 million CNY
Period of depreciation	20 years
Residual value rate	5%
Staff number	25
Average annual salary	55,000 CNY
Welfare rate	52.2% (of the salary)
Insurance rate	0.25% (of the fixed assets)
Material cost	15 CNY/kW
Miscellaneous expenses	25 CNY/kW

[5] Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects, China Electric Power Press, 2003, Beijing.

Maintenance expenses rate	1% (of the fixed assets)
Annual electricity delivered to the grid	142,391 MWh
Electricity tariff for the first 20 operation years (including VAT)	0.9 CNY/kWh
Electricity tariff for the rest operation years (including VAT)	0.3343 CNY/kWh[6]
VAT rate	17%
City maintenance and construction tax rate	5% (of VAT)
The additional education tax rate	5% (of VAT)
Income tax rate	25% (0 for the first 3 years, half for the 2nd 3 years)
Period of assessment	25 years

Data source: FSR

Table 4: IRR results with and without CERs

	Without carbon credits	**Benchmark**
Project IRR	7.94%	10%

As shown in the table, without the revenue from the sale of carbon credits the Equity IRR of this project is 7.94%, which is lower than the benchmark IRR of 10%. Therefore the project is unlikely to be financially attractive without carbon revenue.

Sub-step 2d: Sensitivity analysis

The sensitivity analysis is to show whether the conclusion regarding the financial/economic attractiveness is robust to reasonable variations in the critical assumptions.

According to Guidelines on the Assessment of Investment Analysis (Version 05, EB 62 Annex 5), only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. For this project, the total static investment constitutes more than 20% of total project costs; the product of electricity tariff and Annual electricity delivered to the grid constitute more than 20% of the total revenue of the project; and the total O&M throughout the project lifetime also accounts for more than 20% of the project cost. Therefore, considering the reasonable variations in the critical assumptions, the sensitivity analysis is made regarding the 4 key factors of total static investment, electricity tariff, annual O&M cost and annual electricity delivered to the grid, as shown in **Table 4** and **Figure 3**.

Table 4: Sensitivity analysis of IRR

Range of Variation	**-10%**	**-5%**	**0**	**+5%**	**+10%**	**Critical variation**
Total static investment	10.87%	9.30%	7.94%	6.73%	5.66%	-7.31%
Electricity tariff	5.42%	6.67%	7.94%	9.23%	10.55%	7.92%
Annual O&M cost	8.36%	8.15%	7.94%	7.73%	7.51%	-48.96%
Annual electricity delivered to the grid	5.42%	6.67%	7.94%	9.23%	10.55%	7.92%

[6] http://www.gsdrc.gov.cn/content/2011-11/22632.html

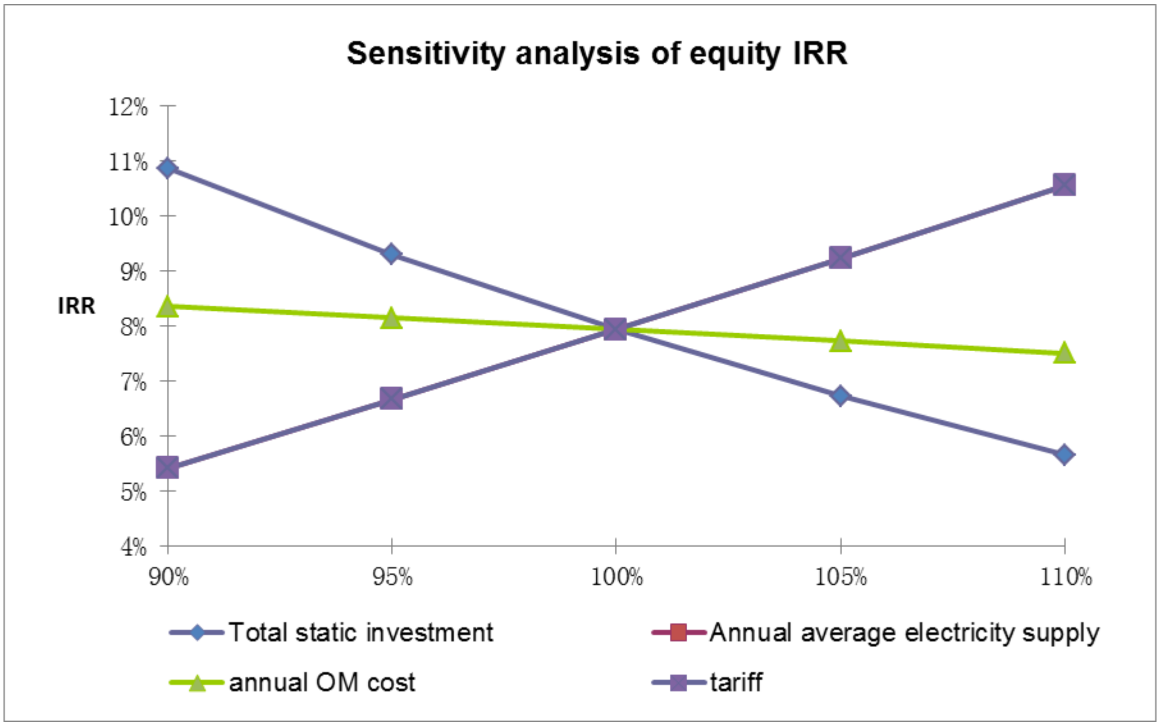

Figure 3: Sensitivity analysis

Total static investment

The IRR of this project will only reach the benchmark of 10% when total static investment decreases by 7.31%, to 871.615 million CNY. A fall of this significant decrease is impossible as the project has already finished construction, and the statistics of all project contracts[7] provided by the project owner shows that totally 914.722 million CNY have been spent.

Electricity Tariff

As the above sensitivity analysis shows, the tariff will have to increase 7.92% to 0.97 CNY/kWh for the IRR to go over the benchmark. An increase of this magnitude is highly impossible because the electricity tariff in China is strictly regulated by government and is established according to strict regulations rather than by a market mechanism. The tariff applied for the project, 0.9 CNY/kWh is taken from the FSR which was based on NDRC Notice for Development of Solar Sector by utilizing feed-in Tariff Policy (FaGaiJiaGe [2013] No.1638) issued by NDRC on 26/08/2013 which stated that for the projects located in the Jiuquan City which the project is located and was approved on and after 01/09/2013, the solar power feed-in tariff should be 0.9 CNY/kWh. In reality, the executed tariff of the project is 0.9 CNY/kWh[8], so it is unlikely for the fixed tariff to increase as significantly to 0.97 CNY//kWh to cross the benchmark.

Annual O&M cost

[7] Including equipment purchase contract, construction contract and all other relevant contracts signed for the project.
[8] Data source: Tariff approval of the project by Gansu Provincial DRC, valid till the end of project life.

Annual O&M cost has a relatively small impact on overall costs, it has to decrease 48.96% for the IRR to go over the benchmark.

According to the FSR, the annual O&M cost was comprised of Salary and welfare, Insurance, Material cost, Maintenance expenses and Miscellaneous expenses.

Average annual total O&M cost	17.02 million CNY
Including:	
Annual salary and welfare	2.09 million CNY
Annual insurance	2.18 million CNY
Annual material cost	1.51 million CNY
Average annual maintenance expenses	8.73 million CNY
Annual miscellaneous expenses	2.51 million CNY

According to the China Statistical Books, the Producer Price Index[9], Consumer Price Index [10] and Salary[11] has been rising in the recent years. Therefore, it is impossible that the annual O&M cost would decrease 48.96%.

Annual Electricity delivered to grid

For annual electricity delivered to grid, the IRR will reach benchmark only if the amount of average annual electricity for sale increases by 7.92% to 153,668.8 MWh. The theoretical electricity generation of this project was calculated using the past 30 years' historical data (from 1979 to 2008) of the solar resources in this region, and the annual net electricity supplied to the grid was estimated considering the influence of accumulative decay rate, so this value is reasonable and the fluctuation will not be great. Therefore, the electricity delivered to the grid is unlikely to increase by 7.92%. Moreover, as per the sales receipts of the project, the total electricity delivered to the grid by the project in 2014 is 128,162.1MWh and the corresponding PLF of 2014 is 14.63%, which is much lower than the expected annual electricity delivered to the grid and the expected PLF of 16.25%.

Outcome of Step 2: As analyzed above, the Equity IRR of this project is below the benchmark IRR in the reasonable variations of the key factors, thus this project is unlikely to be financially attractive. Then proceed to Step 4.

Step 4: Common practice analysis

As the project applies power generation based on renewable energy which is one of the measure(s) listed in the definitions section above, proceed to Sub-step 4a.

Sub-step 4a: The proposed project activity(ies) applies measure(s) that are listed in the definitions section above

According to the tool, apply the latest version of the "Guidelines on common practice" (hereafter simplified as "guideline") available on the UNFCCC website[12].

[9] http://www.stats.gov.cn/tjsj/ndsj/2012/html/I0915e.htm
[10] http://www.stats.gov.cn/tjsj/ndsj/2014/zk/html/Z0501e.htm
[11] http://www.stats.gov.cn/tjsj/ndsj/2014/zk/html/Z0606e.htm
[12] https://cdm.unfccc.int/Reference/Guidclarif/index.html

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

The install capacity of the project is 100MW, so the applicable capacity range as +/-50% of the total design capacity is 50-150MW.

Step (2): identify similar projects which fulfil all of the following conditions:

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

Considering the size of the P.R. of China and the geographical differences (e.g. access to natural resources, climate, terrain) as well as social-economic differences (e.g. regulatory framework, infrastructure, economic development levels, economic structure, access to technology, access to financing, tariff levels) between the provinces[13], the applicable geographic area is **Gansu province** where the project located.

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

The applicable measure is **power generation based on renewable energy**, same as the project.

(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 energy source is the renewable **solar energy**, same as the project.

(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 applicable project is to **produce electricity power**, same as the project.

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

As defined in **Step (1)**, the applicable capacity range is from **50 to 150 MW**.

(f) The projects started commercial operation before the project description (VCS-PD) 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 proposed project is 30/12/2013 which is earlier than the PD published, so the applicable commercial operation starting date is **before 30/12/2013**.

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

[13] China Electric Power Yearbook

According to the available statistics[14, 15] and relevant project information on CDM[16], VCS[17] and GS[18] website, $N_{all} = 0$.

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}.

Since $N_{all} = 0$, also $N_{diff} = 0$, $N_{all} = N_{diff}$.

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

As stated before, $N_{all} = N_{diff}$, $F = 1 - N_{diff}/N_{all} = 1 - 1 = 0<0.2$, therefore the project activity is NOT a "common practice" within a sector in the applicable geographical area, according to the guideline.

2.6 Methodology Deviations

No methodology deviations.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

According to ACM0002, 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 methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

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

And for Greenfield power plant,

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

Where

BE_y	=	Baseline emission in year *y* (tCO_2e)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year *y* (MWh)
$EG_{facility,y}$	=	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

[14] http://www.pvnews.cn/
[15] China Electric Power Yearbook
[16] http://cdm.unfccc.int/Projects/projsearch.html
[17] http://www.vcsprojectdatabase.org/
[18] http://www.goldstandard.org/about-us/project-registry

$EG_{export,y}$	=	Quantity of the electricity delivered to the grid by the project in year *y* (MWh/yr)
$EG_{import,y}$	=	Quantity of the electricity imported from the grid by the project 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 the latest version of the "*Tool to calculate the emission factor for an electricity system*" (tCO_2e/MWh)

According to the latest version of the "Tool to calculate the emission factor for an electricity system", $EF_{grid,CM,y}$ is calculated by following six steps:

- **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:** Calculate the build margin (BM) emission factor;
- **Step 6:** Calculate the combined margin (CM) emission factor.

As China DNA has published the calculation method for emission factor of grid, the published data and method have been applied for this project to calculate operating margin (OM) and build margin, as following steps:

Step 1: Identify the relevant electricity systems;

This project site is in Gansu Province of China, which belongs to Northwest China Power Grid (NWPG) according to the public delineation of DNA[19], so NWPG is identified as the relevant electric system.

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

For this project, Option I (only grid power plants are included in the calculation) is chosen.

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

Calculation of Operating Margin should be based on one of the four following methods according to the tool:

(a) Simple OM, or

(b) Simple adjusted OM, or

[19] http://cdm.ccchina.gov.cn/zyDetail.aspx?newsId=51492&TId=161

(c) Dispatch Data Analysis OM, or

(d) Average OM.

As the low-cost / must-run resources constituted less than 50% of total electricity generation of NWPG in recent five years, the Simple OM (a) method is selected and the following data vintage is chosen to calculate the emission factor:

Ex ante option: use a 3-year generation-weighted average, based on the most recent data available, without requirement to monitor and recalculate the emissions factor during the crediting period. And according to the tool, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

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

The Simple OM emission factor ($EF_{OM,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2e/MWh) of all generating sources serving in the system, excluding low-operating cost and must-run power plants. It may be calculated:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power plant / 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

Option B can only be used if:

(a) The necessary data for Option A is not available; and

(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and

(c) Off-grid power plants are not included in the calculation.

In this project, all of the above conditions can be met, so Option B was chosen.

Under this option, the simple OM emission factor 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:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y})}{EG_y} \qquad (3)$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
$FC_{i,y}$	=	Amount of 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 fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fuel type *i* in year *y* (t CO_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 fuel types combusted in power sources in the project electricity system in year *y*
y	=	The relevant year as per the data vintage chosen in **Step 3**.

Step 5: Calculate the build margin (BM) emission factor;

In term of the vintage data, according to the tool, there are two options can be chosen, and in this project, Option 1 is used to calculate the build margin emission factor, which is:

> 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 VCS-PD 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.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2e/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (4)$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* (t CO_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* (t CO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which electricity generation data is available

Since the relevant data required by the tool to determine the sample group of power unit m used to calculate the build margin is not available, the following deviations from this calculation method which have been approved by CDM EB[20] are applied:

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

1) Use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy, for each fuel type in estimating the fuel consumption to estimate the build margin (BM);
2) Use of capacity additions during last 1 - 3 years for estimating the build margin emission factor for grid electricity;
3) Use of weights estimated using installed capacity in place of annual electricity generation.

The alternative method is used with the following steps:

Sub-step 5a.: Calculate the proportion of the corresponding CO_2 emissions of solid, liquid and gas fuel in the total emissions of power generation, using the most recent one year fuel consumption information available at the time of PDD submission.

$$\lambda_{Coal,y} = \frac{\sum_{i \in Coal,j} FC_{i,j,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}}{\sum_{i,j} FC_{i,j,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}} \tag{5}$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in Oil,j} FC_{i,j,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}}{\sum_{i,j} FC_{i,j,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}} \tag{6}$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in Gas,j} FC_{i,j,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}}{\sum_{i,j} FC_{i,j,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}} \tag{7}$$

Where:

$FC_{i,j,y}$	=	amount of fuel *i* consumed by province *j* during the year *y* (mass or volume unit of the fuel)
$NCV_{i,y}$	=	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_2e/GJ)
Coal, Oil and Gas	=	foot marks for solid, liquid and gas fuels, and see **Annex 3** for details.

Sub-step 5b: Calculate the emission factor of fossil-fuel fired power plants, using the efficiency level of the best technology commercially available:

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

Where $EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are corresponding emission factors of the best commercially available coal, oil and gas fired technologies in year *y*.

Sub-step 5c: Calculate the BM:

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

Where:

$CAP_{Total,y}$	=	total newly added 20% installation capacity in year *y*
$CAP_{Thermal,y}$	=	fossil-fuel fired installed capacity in the newly added 20% capacity in year *y*

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

The combined margin emissions factor is calculated as follows:

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

Where:

$EF_{grid,OM,y}$	=	operating margin CO_2 emission factor in year *y* (tCO_2e/MWh)
$EF_{grid,BM,y}$	=	build margin CO_2 emission factor in year *y* (tCO_2e/MWh)
w_{OM}	=	the weight of operating margin emission factor (%)
w_{BM}	=	the weight of build margin emission factor (%)

According to the tool, as a solar power generation project, w_{OM} = 0.75 and w_{BM} = 0.25 for the first crediting period.

As calculated in Appendix I, $EF_{grid,CM,y}$ = 0.8311 tCO_2e/MWh.

3.2 Project Emissions

In accordance with the applied CDM methodology ACM0002, the project emission PE_y = 0.

3.3 Leakage

In accordance with the applied CDM methodology ACM0002, leakage of the project is not considered.

3.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad (11)$$

Where

ER_y	=	Emission reductions in year *y* (tCO_2e)
BE_y	=	Baseline emissions in year *y* (tCO_2e)
PE_y	=	Project emissions in year *y* (tCO_2e)

The ex-ante calculation is shown in the table below:

Year	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)
30/12/2013-29/12/2014	131,977	0	0	131,977
30/12/2014-29/12/2015	130,908	0	0	130,908
30/12/2015-29/12/2016	129,572	0	0	129,572
30/12/2016-29/12/2017	128,237	0	0	128,237
30/12/2017-29/12/2018	126,901	0	0	126,901
30/12/2018-29/12/2019	125,565	0	0	125,565
30/12/2019-29/12/2020	124,229	0	0	124,229
30/12/2020-29/12/2021	122,893	0	0	122,893
30/12/2021-29/12/2022	121,558	0	0	121,558
30/12/2022-29/12/2023	120,222	0	0	120,222
Total	1,262,062	0	0	1,262,062

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	$\mathbf{EF_{grid,CM,y}}$
Data unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y
Source of data	China DNA
Value applied:	0.8311
Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data

Purpose of Data	Calculation of baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant to the grid in year *y*
Source of data	Calculated
Description of measurement methods and procedures to be applied	Calculated based on the electricity delivered to the grid by the project ($EG_{export,y}$) and the electricity imported from the grid by the project ($EG_{import,y}$)
Frequency of monitoring/recording	Measured continuously and recorded monthly
Value applied:	151,855
Monitoring equipment	-
QA/QC procedures to be applied	The quantity of electricity delivered to the grid by the project ($EG_{export,y}$) and the electricity imported from the grid by the project ($EG_{import,y}$) will be crosschecked with electricity sales and purchase receipts.
Purpose of data	Calculation of baseline emissions
Calculation method	$EG_{facility,y}=EG_{export,y}-EG_{import,y}$
Comments	Value of 151,855 is the average of first 10 years power generation

Data / Parameter	$EG_{export,y}$
Data unit	MWh
Description	Quantity of the electricity delivered to the grid by the project in year *y*
Source of data	On-site measurement
Description of measurement methods and procedures to be applied	Use calibrated electric meters. The accuracy of the meter(s) is no lower than 0.5. The calibration will be conducted annually subject to national standards.
Frequency of monitoring/recording	Measured continuously and recorded monthly
Value applied:	151,855

Monitoring equipment	Electricity meters
QA/QC procedures to be applied	Cross check measurement results with electricity sales receipts
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	Value of 151,855 is the average of first 10 years power generation

Data / Parameter	$EG_{import,y}$
Data unit	MWh
Description	Quantity of the electricity imported from the grid by the project in year *y*
Source of data	On-site measurement
Description of measurement methods and procedures to be applied	Use calibrated electric meters. The accuracy of the meter(s) is no lower than 0.5. The calibration will be conducted annually subject to national standards.
Frequency of monitoring/recording	Measured continuously and recorded monthly
Value applied:	0
Monitoring equipment	Electric meters
QA/QC procedures to be applied	Cross check measurement results with electricity purchase receipts
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

4.3 Monitoring Plan

1) Operation and management structure

Overall responsibility for daily monitoring and reporting lies with the project owner. A monitoring group will be established within the project company to carry out the monitoring work. The structure of the monitoring group is as follows:

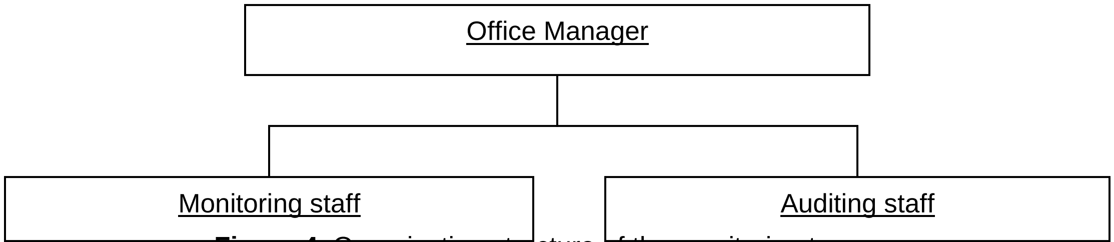

Figure 4: Organization structure of the monitoring team

The responsibilities of each role in the team structure are:

- Office manager has the overall management responsibility, especially supervising the implementation of the monitoring plan
- Monitoring staff measures the electricity imported to and exported from the project
- Auditing staff performs internal verification of the measurement, collects relevant receipts and calculates emission reductions
- Finally, the monitoring reports will be reviewed by the General Manager.

2) Monitoring equipment and installation

The electricity generated by the project was transformed to 110kV through the onsite 110kV substation before connected to the Bulongji Substation of NWPG through 110kV transmission line. And two bi-directional meters M1 and M2 are to be installed to monitor the electricity delivered to the grid by the project ($EG_{export,y}$) and the electricity imported from the grid by the project ($EG_{import,y}$). Meter M2 has been installed at the Bulongji substation, and meter M1 has been installed at the onsite 110kV substation. Meter M1 is owned, operated and maintained by the project owner and meter M2 is owned, operated and maintained by the grid company. Since meter M2 is out of project owner's reach, the readings from meter M1 will be used for ER calculation, and when M1 is out of order, the readings from meter M2, which will be provided by the grid company only under such circumstances, will be used instead. The total electricity delivered to the grid by the project is calculated as follows: $EG_{facility,y}=EG_{export,y}-EG_{import,y}$.

The meters were configured to meet the technology requirements of "Management Regulations for Power Metered Device Technology" (DL/T448-2000) and the subsequent industrial standards. These meters installed for power measurement should reach 0.5 or above in accuracy degree. And before the electric energy metering equipment was put into operation, the project owner and power grid company have checked and accepted the equipment according to the regulation.

The power line diagram of the project is shown as follows:

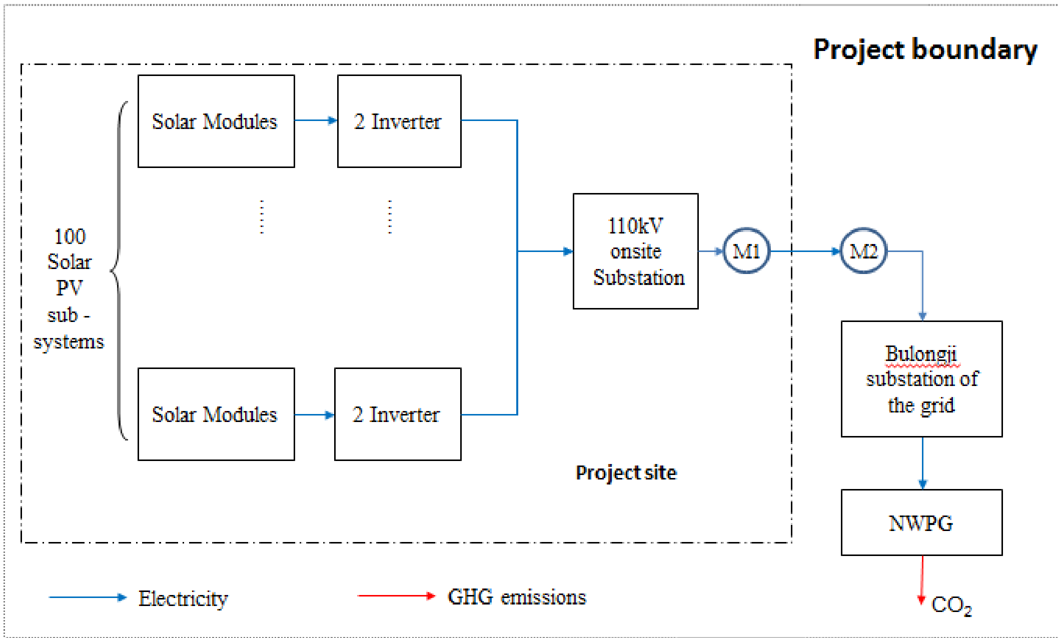

Figure 5: Power line diagram of the monitoring system

3) Data collection system

The procedures of data recording and collecting are listed below:

- The project owner reads meter M1 every month and then submits the reading results to the grid company for crosscheck with meter readings of meter M2. Upon agreement on the electricity reading from both parties, the project owner provides the grid company sale receipt for $EG_{export,y}$ and the power grid issue the project owner receipt for $EG_{import,y}$.
- The project owner files the meter readings of M1 in the monthly report. The monthly report will be archived and used to calculate emission reductions.
- The project owner collects and keeps on file maintenance records, meter calibration documents.

4) Quality assurance and quality control (QA/QC)

QA/QC practice involves:

- The metering equipment will be calibrated and checked annually for accuracy;
- Calibration will be carried out by qualified parties with the records being supplied to the project owner, and the calibration shall ensure sufficient accuracy so that any error resulting from such equipment shall not exceed the allowable error of full-scale rating.

- When M1 is out of work, M2 will be used for measurement, and no emission reduction will be claimed when both M1 and M2 are out of work.

All data collected as part of monitoring is archived electronically. All information should be stored by the technology department of the project owner and all the material has a physical copy for backup. And all data including calibration records is kept until 2 years after the end of the crediting period, or the last issuance of VCUs, whichever is later.

5 ENVIRONMENTAL IMPACT

The Environmental Impact Assessment (EIA) of this project has been examined and approved by Gansu Environmental Protection Bureau (Ganhuanshenbiaofa [2013] No.80) on 24/12/2013.

This project will not cause significant impact on the environment as to the conclusion of the EIA. The conclusions of EIA are documented below:

1) Ecological environment

The area influenced by the project construction is about 272.59 hm^2. The construction activity will destroy the nature vegetation. Working area should be strictly defined and water-and-soil conservation measures should be implemented to minimize the water loss and soil erosion.

2) Acoustic environment

The noise during construction period is mainly from the operation of the construction equipment such as excavator and concrete mixer, the sound source is from 86 to 105 dB. Therefore, the mechanical equipment should be well maintained during the construction period to keep the lubrication and decrease noise. The temporary acoustical insulation measures should be applied for the equipment which would cause high noise and also reduce their working hours to minimize the influence to acoustic environment around the project. There're no residents within 1km of the project site, hence the influence of noise is low.

The noise during operation period is mainly from main transformer (around 60dB(A)). After acoustical insulation and range attenuation, the noise inside the project boundary can meet the standard II of GB12348-2008.

3) Air environment

During the construction period, the activities of construction for buildings and roads will cause some ground excavation and massive earthwork transport, which will generate raise dust in the windy days and bring negative impact to local air environment in short time; the transport vehicle will aggravate the raise dust and the TSP concentration will exceed the limit. But due to the range attenuation of TSP, as long as there are effective prevention and treatment, the impact will be minimized to least.

4) Water environment

The highest amount of domestic sewage generated during construction period is about 2.4m^3/d which is mainly inside the living area. The temporary toilet built for compost treatment will prevent the pollution of water environment. The waste water from construction will be collected in sedimentation tank without discharge and then used for reducing road dust after treatment.

The domestic sewage generated during operation period will be treated and should reach the Water Quality Standard for Farmland Irrigation (GB5084-2005) and can be used for greenbelt around the plant area. In addition, a tank of 150m^3 will be built for temporary storage of waste water during winter season when no irrigation needed.

5) Solid waste environment

No waste earth and stone during construction period will be stockpiled, and the domestic garbage generated during construction and operation period will be gathered into the garbage bags and then transported to collection site in Guazhou County for disposal.

During year15-25 of operation period, the polysilicon batteries will be replaced step by step. Totally 7,437 tonnes of used batteries will be recycled by manufacture.

All dangerous waste will be gathered and transported to Gansu Hazardous Waste Disposal Centre.

6 STAKEHOLDER COMMENTS

The following people are considered as the stakeholders of this project:

- Residents of the nearby village;
- Staff of the project station;
- Relevant administrative staff of the local government.

The project owner designed a questionnaire to collect the comments of relevant stakeholders. The one page questionnaire was designed with the following sections:

1) Brief introduction of the project

2) Basic information of respondent

3) Major question issues

- Whether the project will cause water pollution?
- Whether the project will cause air pollution?
- Whether the project will cause noise pollution?
- Whether the project will impact on soil environment?
- Whether the project will impact on the surrounding animals and plants?
- Impact on the local residents' employment opportunities and income.

- Impact on the local economic development.
- Impact on the local power grid and NWPG.
- Attitude on developing the project.

30 questionnaires have been handed in total and all of them have been received successfully from the stakeholder representatives, respectively from the local government, and surrounding villages. The representatives covered different ages, different occupations and different education levels. Comments of the respondents are shown in **Table 5** as below:

Table 5: The result of stakeholders' comments

Item	Options	Results	Percentage
Whether the project will cause water pollution?	Yes	0	0.00%
	No	28	93.33%
	Don't know	2	6.67%
Whether the project will cause air pollution?	Yes	0	0.00%
	No	28	93.33%
	Don't know	2	6.67%
Whether the project will cause noise pollution?	Yes	0	0.00%
	No	28	93.33%
	Don't know	2	6.67%
Whether the project will impact on soil environment?	Yes	0	0.00%
	No	25	83.33%
	Don't know	5	16.67%
Whether the project will impact on the surrounding animals and plants?	Yes	0	0.00%
	No	21	70.00%
	Don't know	9	30.00%
Impact on the local residents' employment opportunities and income.	Advantageous	26	86.67%
	No impact	4	13.33%
	Disadvantageous	0	0.00%
Impact on the local economic development.	Advantageous	26	86.67%
	No impact	4	13.33%
	Disadvantageous	0	0.00%
Impact on the local power grid and NWPG.	Advantageous	22	73.33%
	No impact	8	26.67%
	Disadvantageous	0	0.00%
Attitude on developing the project.	Support	30	100.00%
	Oppose	0	0.00%
	Don't know	0	0.00%

As described above, most of the stakeholders interviewed expressed the project will benefit the local environment, economy and social development, some of them thought there is no significant impact on those, and no negative impact were raised by stakeholders..

APPENDIX 1: BASELINE INFORMATION

The baseline information for calculation of OM, BM and CM emission factors of North China Power Grid is shown in *2014 Baseline Emission Factors for Regional Power Grids in Chin*a by China DNA at http://cdm.ccchina.gov.cn released on 04/02/2015. The concrete processes are shown in the following tables.

I. Calculation of the Operating Margin emission factor ($EF_{OM,y}$)

The low calorific value, CO_2 emission factor and oxidation factor of fuels are listed in Table A3-1 below.

Table A-1 Low calorific values, CO_2 emission factor and oxidation factor of fuels

Fuel type	Default Carbon Content (tc/TJ)	OXID (%)	IPCC CO_2 Emission Factor (the Lower Limits of the 95% Confidence Intervals) ($kgCO_2$/TJ)	Low Calorific Value (MJ/t,km^3)
Raw Coal	25.8	100	87,300	20908
Cleaned Coal	25.8	100	87,300	26344
Other Washed Coal	25.8	100	87,300	8363
Briquette	26.6	100	87,300	20908
Coke	29.2	100	95,700	28435
Coal Gangue	25.8	100	87,300	8363*
Coke Oven Gas	12.1	100	37,300	16726*
Blast Furnace Gas	70.8	100	219,000	3763*
Converter Gas	46.9	100	145,000	7945*
Other Gas	12.2	100	37,300	5227
Crude Oil	20	100	71,100	41816
Gasoline	18.9	100	67,500	43070
Diesel Oil	20.2	100	72,600	42652
Fuel Oil	21.1	100	75,500	41816
Petroleum Coke	26.6	100	82,900	31947*
LPG	17.2	100	61,600	50179
LNG	15.3	100	54,300	51434*
Refinery Gas	15.7	100	48,200	46055
Natural Gas	15.3	100	54,300	38931
Other Petroleum Products	20	100	72,200	41816
Other Coke Oven Products	25.8	100	95,700	28435
Other Energies	0	0	0	0

Data Source：The emission factors and oxidation factors are form *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1.3,1.4, page 1.21-1.24, chapter 1Volume 2 Energy*.
The net calorific values are quoted from *China Energy Statistical Yearbook 2009*
*: Quoted from *Statistic Rules for Energy Consumption of Public Institute, July 2011*

Table A-2 CO_2 Emission Data of NWPG in Year 2010

Fuel type	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Subtotal	Carbon Content	OXID	CO_2 Emission Factor	Low Calorific Value	CO_2 Emission (tCO_2e)
								(tc/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km³)	L=F×I×J/100000 (mass unit)
		A	B	C	D	E	F=A+B+C +D+E	G	H	I	J	L= F×I×J /10000 (volume unit)
Raw Coal	10^4t	4850.49	2771.89	483.72	2916.46	2494.9	13517.46	25.8	100	87,300	20,908	246,729,926
Cleaned Coal	10^4t				1.05		1.05	25.8	100	87,300	26,344	24,148
Other Washed Coal	10^4t	11.01			42.96	6.82	60.79	25.8	100	87,300	8,363	443,822
Briquette	10^4t						0	26.6	100	87,300	20,908	0
Coke	10^4t						0	29.2	100	95,700	28,435	0
Coal Gangue	10^4t	355.13	37.86		163.58	2.85	559.42	25.8	100	87,300	8363	4,084,269
CokeOven Gas	10^8m^3	1.97	0.89			0.7	3.56	12.1	100	37,300	16726	222,101
Blast Furnace Gas	10^8m^3	18.24	4.06			5.28	27.58	70.8	100	219,000	3763	2,272,860
Converter Gas	10^8m^3		0.31				0.31	46.9	100	145,000	7945	35,713
Other Gas	10^8m^3						0	12.1	100	37,300	5,227	0
Crude Oil	10^4t						0	20	100	71,100	41,816	0
Gasoline	10^4t	0.01		0.03		0.01	0.05	18.9	100	67,500	43,070	1,454
Diesel Oil	10^4t	0.67	0.42	0.21	0.23	0.39	1.92	20.2	100	72,600	42,652	59,453
Fuel Oil	10^4t		0.17	0.09	0.1	0.7	1.06	21.1	100	75,500	41,816	33,465
LPG	10^4t						0	17.2	100	61,600	0,179	0
Refinery Gas	10^4t					12.2	12.2	15.7	100	48,200	46,055	270,822
Natural Gas	10^8m^3	0.87		2.48	0.3	8.54	12.19	15.3	100	54,300	38,931	2,576,909
OtherPetroleum Products	10^4t					0.01	0.01	20	100	72,200	41,816	302
Other Coke Oven Products	10^4t						0	25.8	100	95,700	28,435	0

Other Energies	10^4tce	1.76	2.68				4.44	0	0	0	0	0
											Total	**256,755,243**

Data source: *China Energy Statistical Yearbook 2011*

Table A-3 NWPG Fuel-fired Electricity Generation in Year 2010

	Electricity Generation (10^8kWh)	Electricity Generation (MWh)	Auxiliary Power Ratio (%)	Supplied Electricity (MWh)
Shanxi	958	95,800,000	7.23	88,873,660
Gansu	591	59,100,000	6.73	55,122,570
Qinghai	109	10,900,000	6.58	10,182,780
Ningxia	572	57,200,000		57,200,000
Xinjiang	539	53,900,000	8.7	49,210,700
Total		**276,900,000**		**260,589,710**

Data source: *China Electric Power Yearbook 2011*

Table A-4 CO_2 Emission Data of NWPG in Year 2011

Fuel type	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Subtotal	Carbon Content	OXID	CO_2 Emission Factor	Low Calorific Value	CO_2 Emission (tCO_2e)
								(tc/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	L=F×I×J/100000 (mass unit)
		A	B	C	D	E	F=A+B+C +D+E	G	H	I	J	L= F×I×J /10000 (volume unit)
Raw Coal	10^4t	4107.56	3427.4	556.68	5051.73	3358.94	16502.31	25.8	100	87,300	20,908	301,211,450
Cleaned Coal	10^4t						0	25.8	100	87,300	26,344	0
Other Washed Coal	10^4t	1473.38			42.36	9.62	1525.36	25.8	100	87,300	8,363	11,136,499
Briquette	10^4t						0	26.6	100	87,300	20,908	0
Coke	10^4t						0	29.2	100	95,700	28,435	0
Coal Gangue	10^4t	251.88	41.53		170.51	69.53	533.45	25.8	100	87,300	8,363	3,894,665
Coke Oven Gas	10^8m^3	6.35	0.66		0.05	1.38	8.44	12.1	100	37,300	16,726	526,555

Blast Furnace Gas	10^8m^3		4.68		0.14	4.47	9.29	70.8	100	219,000	3,763	765,586
Converter Gas	10^8m^3		1.08			1.05	2.13	46.9	100	145,000	7,945	245,381
Other Gas	10^8m^3						0	12.1	100	37,300	5,227	0
Crude Oil	10^4t						0	20	100	71,100	41,816	0
Gasoline	10^4t						0	18.9	100	67,500	43,070	0
Diesel Oil	10^4t	0.66	0.47	0.47	0.29	0.74	2.63	20.2	100	72,600	42,652	81,439
Fuel Oil	10^4t		0.15	0.08	0.47	0.06	0.76	21.1	100	75,500	41,816	23,994
LPG	10^4t						0	17.2	100	61,600	50,179	0
Refinery Gas	10^4t					7.99	7.99	15.7	100	48,200	46,055	177,366
Natural Gas	10^8m^3	0.83		4.62	0.77	9.26	15.48	15.3	100	54,300	38,931	3,272,400
Other Petroleum Products	10^4t						0	20	100	72,200	41,816	0
Other Coke Oven Products	10^4t						0	25.8	100	95,700	28,435	0
Other Energies	10^4tce	0.56	2.78			6.8	10.14	0	0	0	0	0
											Total	**321,335,334**

Data source: *China Energy Statistical Yearbook 2012*

Table A-5 NWPG Fuel-fired Electricity Generation in Year 2011

	Electricity Generation (10^8kWh)	Electricity Generation (MWh)	Auxiliary Power Ratio (%)	Supplied Electricity (MWh)
Shanxi	1084	108,400,000	7.2	100,595,200
Gansu	714	71,400,000	6.8	66,544,800
Qinghai	122	12,200,000	7.2	11,321,600
Ningxia	967	96,700,000		96,700,000
Xinjiang	725	72,500,000	8.2	66,555,000
Total		**361,200,000**		**341,716,600**

Data source: *China Electric Power Yearbook 2012*

Table A-6 CO_2 Emission Data of NWPG in Year 2012

Fuel type	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Subtotal	Carbon Content	OXID	CO_2 Emission Factor	Low Calorific Value	CO_2 Emission (tCO_2e)
								(tc/TJ)	(%)	($kgCO_2$/TJ)	(MJ/t,km^3)	L=F×I×J/100000 (mass unit)
		A	B	C	D	E	F=A+B+C+D+E	G	H	I	J	L= F×I×J /10000 (volume unit)
Raw Coal	10^4t	4160.44	3445.38	603.47	4626.48	4966.87	17,802.64	25.8	100	87,300	20,908	324,945,962
Cleaned Coal	10^4t						-	25.8	100	87,300	26,344	-
Other Washed Coal	10^4t	1522.62			351.83	8.45	1,882.90	25.8	100	87,300	8,363	13,746,863
Briquette	10^4t						-	26.6	100	87,300	20,908	-
Coke	10^4t						-	29.2	100	95,700	28,435	-
Coal gangue	10^4t	286.59	41.16		100.76	114.88	543.39	25.8	100	87,300	8,363	3,967,236
Coke Oven Gas	10^8m^3	16.57	0.5		1.23	2.64	20.94	12.1	100	37,300	16,726	1,306,404
blast-furnace gas	10^8m^3	23.45	3.76		0.65	4.22	32.08	70.8	100	219,000	3,763	2,643,703
Converter gas	10^8m^3		1.01			1.77	2.78	46.9	100	145,000	7,945	320,263
Other Gas	10^8m^3						-	12.1	100	37,300	5,227	-
Crude Oil	10^4t						-	20	100	71,100	41,816	-
Gasoline	10^4t						-	18.9	100	67,500	43,070	-
Diesel Oil	10^4t	0.45	0.34	0.27	0.19	0.68	1.93	20.2	100	72,600	42,652	59,763
Fuel Oil	10^4t		0.07	0.07	0.4	0.05	0.59	21.1	100	75,500	41,816	18,627
LPG	10^4t						-	17.2	100	61,600	50,179	-
Refinery Gas	10^4t		1.58			5.31	6.89	15.7	100	48,200	46,055	152,948

Natural Gas	10^8m^3	0.94		4.39	0.56	9.02	14.91	15.3	100	54,300	38,931	3,151,904
Other Petroleum Products	10^4t						-	20	100	72,200	41,816	-
Other Coke Oven Products	10^4t						-	25.8	100	95,700	28,435	-
Other Energies	10^4tce	2.03					2.03	0	0	0	0	-
											小计	**350,313,673**

Data source: *China Energy Statistical Yearbook 2013*

Table A-7 NWPG Fuel-fired Electricity Generation in Year 2012

	Electricity Generation (10^8kWh)	**Electricity Generation (MWh)**	**Auxiliary Power Ratio (%)**	**Supplied Electricity (MWh)**
Shanxi	1149	114,900,000	7.1	106,742,100
Gansu	666	66,600,000	6.5	62,271,000
Qinghai	120	12,000,000	7.9	11,052,000
Ningxia	952	95,200,000		95,200,000
Xinjiang	998	99,800,000	8.1	91,716,200
Total		**388,500,000**		**366,981,300**

Data source: *China Electric Power Yearbook 2013*

Table A-8 Calculation of Simple OM Emission Factor of NWPG

	Total Power Supply (MWh)	**CO_2 emission (tCO_2)**	***OM* Emission Factor (tCO_2/MWh)**
2010	260,589,710	256,755,243	0.9853
2011	341,716,600	321,335,334	0.9404
2012	366,981,300	350,313,673	0.9546
The weighted average *OM* Emission Factor			**0.9720**

The Operating Margin (*OM*) emission factor is the weighted average emission factors of year 2010-2012, as follows: EF_{OM} **= 0.9578** tCO_2/MWh.

II. Calculation of the Build Margin emission factor ($EF_{BM,y}$)

1. **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 A-9 Percentages of CO2 emissions from the coal-, gas- and oil-fired power plants in total fuel-fired CO2 emissions in 2012

Fuel type	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Subtotal	Carbon Content	OXID	CO_2 Emission Factor	Low Calorific Value	CO_2 Emission (tCO_2e)
		A	B	C	D	E	F=A+B+C +D+E	G	H	I	J	L= F×I×J /100000
Raw Coal	10^4t	4160.44	3445.38	603.47	4626.48	4966.87	17,802.64	25.8	100	87,300	20,908	324,945,962
Cleaned Coal	10^4t						-	25.8	100	87,300	26,344	-
Other Washed Coal	10^4t	1522.62			351.83	8.45	1,882.90	25.8	100	87,300	8,363	13,746,863
Briquette	10^4t						-	26.6	100	87,300	20,908	-
Coke	10^4t						-	29.2	100	95,700	28,435	-
Coal Gangue	10^4t	286.59	41.16		100.76	114.88	543.39	25.8	100	87,300	8,363	3,967,236
Other Coke Oven Products	10^4t						-	25.8	100	95,700	28,435	-
Subtotal												**342,660,061**
Crude Oil	10^4t						-	20	100	71,100	41,816	-
Gasoline	10^4t						-	18.9	100	67,500	43,070	-
Diesel Oil	10^4t	0.45	0.34	0.27	0.19	0.68	1.93	20.2	100	72,600	42,652	59,763
Fuel Oil	10^4t		0.07	0.07	0.4	0.05	0.59	21.1	100	75,500	41,816	18,627
Other Petroleum Products	10^4t						-	20	100	72,200	41,816	-
Subtotal							-					**78,390**
LPG	10^4t						-	17.2	100	61,600	50,179	-
Refinery Gas	10^4t		1.58			5.31	6.89	15.7	100	48,200	46,055	152,948
Natural Gas	10^8m^3	0.94		4.39	0.56	9.02	14.91	15.3	100	54,300	38,931	3,151,904
Coke Oven Gas	10^8m^3	16.57	0.5		1.23	2.64	20.94	12.1	100	37,300	16,726	1,306,404
Blast Furnace Gas	10^8m^3	23.45	3.76		0.65	4.22	32.08	70.8	100	219,000	3,763	2,643,703
Converter Gas	10^8m^3		1.01			1.77	2.78	46.9	100	145,000	7,945	320,263

Other Gas	10^8m^3						-	12.1	100	37,300	5,227	-
Subtotal							-					**7,575,223**
Other Energies	10^4tce	2.03	0	0	0	0	2.03	0	0	0	0	0
											小计	**350,313,673**

Data source: *China Energy Statistical Yearbook 2013*

According to the above table and formulas described 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:

$\lambda_{Coal,y}$ =97.82%, $\lambda_{Oil,y}$ =0.02%, $\lambda_{Gas,y}$ =2.16%.

2. Calculating the fuel-fired emission factor ($EF_{Thermal}$)

Table A-10 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/10,000*B*C**
Coal-fired Power Plant	$EF_{Coal,Adv,y}$	40.03	87,300	1	0.7851
Oil-fired Power Plant	$EF_{Oil,Adv,y}$	52.9	75,500	1	0.5138
Gas-fired Power Plant	$EF_{Gas,Adv,y}$	52.9	54,300	1	0.3695

$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y}$ = 0.77606 tCO_2e/MWh.

3. Calculating the Build Margin (*BM*) emission factor ($EF_{BM,y}$)

Table A-11 Installed Capacity data of NWPG in Year 2010

	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Total
Thermal power	MW	21,370	13,240	1,930	12,710	11,720	60,970
Hydro power	MW	2,210	6,110	10,680	430	2,990	22,420
Nuclear power	MW	0	0	0	0	0	0
Wind power and other	MW	0	1,390	0	600	1,360	3,352
Total	MW	23,580	20,740	12,610	13,740	16,070	86,742

Data source: *China Energy Statistical Yearbook 2011*

Table A-12 Installed Capacity data of NWPG in Year 2011

	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Total
Thermal power	MW	22,160	15,240	2,300	16,400	16,230	72,330
Hydro power	MW	2,320	6,550	10,960	430	3,270	23,530
Nuclear power	MW	0	0	0	0	0	0
Wind power and other	MW	120	5,661	958	1661	1,880	10,280
Total	MW	24,600	27,451	14,218	18,491	21,380	106,140

Data source: *China Energy Statistical Yearbook 2012*

Table A-13 Installed Capacity data of NWPG in Year 2012

	Unit	Shanxi	Gansu	Qinghai	Ningxia	Xinjiang	Total
Thermal power	MW	22,270	15,510	2,300	16,400	22,570	79,050
Hydro power	MW	2,500	7,300	11,010	430	3,850	25,090
Nuclear power	MW	0	0	0	0	0	0
Wind power and other	MW	171	6350	1380	2890	3100	13,891
Total	MW	24,941	29,160	14,690	19,720	29,520	118,031

Data source: *China Energy Statistical Yearbook 2013*

Table A-15 Calculation of BM Emission Factor of NWPG

	Installed capacity in 2010	Installed capacity in 2011	Installed capacity in 2012	Newly added capacity from 2010 to 2012	Newly added capacity from 2011 to 2012	Share in total capacity additions
	(MW)	(MW)	(MW)	(MW)	(MW)	
	A	B	C	D=C-A	E=C-B	
Thermal power	60,970	72,330	79,050	18,347	6,820	58.14%
Hydro power	22,420	23,530	25,090	2,670	1,560	8.46%
Nuclear power	0	0	0	0	0	0.00%
Wind power and Other	3,352	10,280	13,891	10,539	3,611	33.40%
Total	**86,742**	**106,140**	**118,031**	**31,556**	**11,991**	**100.00%**
Share in total installed capacity of 2012				26.74%	10.16%	

The Build Margin (*BM*) emission factor is calculated as: $EF_{BM,y}$ = 0. 77606×58.14%=0.4512 tCO_2/MWh

III. Calculation of the baseline emission factor ($EF_{CM,y}$)

According to the formula (10) described in **Section 3.1**, the baseline emission factor during the first crediting period of this project is calculated as: $EF_{CM,y}$= $EF_{OM,y}$ ×0.75+$EF_{BM,y}$ ×0.25 = 0.9578×0.75+0.4512×0.25=**0.8311** tCO_2/MWh

The baseline emission factor applied in this PD is fixed for the first crediting period and may be revised at the renewal of the crediting period.