65MW DAGUSHAN HYDROPOWER PROJECT IN CHINA

Document Prepared by Climate Bridge (Shanghai) Ltd.

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Project Title	**65MW Dagushan Hydropower Project in China**
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The 65MW Dagushan Hydropower Project in China (hereinafter referred as to "the project") is located in Su'nan Yugu Autonomous County and about 102 km far from Zhangye City in Gansu Province, China. The project activity is constructed and operated by Gansu Zhangye Dagushan Hydropower Co. Ltd. It is a run-of-river hydropower project with a total installed capacity of 65MW (2×26 MW+1×13 MW). The designed operation life of the project is 30 years with an annual electricity generation of 195,150MWh to the Northwest Power Grid of China (NWPG).

The estimated average annual emission reductions of the project is 108,030 tCO_2e during the second crediting period from 22/07/2019 to 21/07/2029, and the total emission reductions during this second crediting period are 1,080,300 tCO_2e.

The project started the construction on 16/11/2007, and 3 units 26 MW, 26 MW and 13 MW are commissioned on 22/07/2009, 24/07/2009, and 26/07/2009 respectively. The project consists of diversion weir, a tunnel, a penstock, high pressure pipelines, a power station and a transfer station. Three units are three phases' vertical axis hanging turbines. As a renewable energy project, Dagushan Hydropower Plant (abbreviation "DHP") produces positive environmental and economic benefits and contributes to the local sustainable development.

The scenario existing prior to the start of the implementation of the project activity is Northwest Power Grid of China (NWPG) providing the same electricity service as the Project.

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

1.2 Sectoral Scope and Project Type

Sectoral scope: 1. Energy industries (renewable/non-renewable sources);

Project type: Hydropower generation project; The project is not a grouped project.

1.3 Project Eligibility

The project is not a grouped project.

1.4 Project Design

The project has been designed to include a single installation of an activity, not multiple project activity instances, nor as a grouped project.

1.5 Project Proponent

Organization name	Gansu Zhangye Dagushan Hydropower Co., Ltd.
Contact person	Mengde Liu
Title	Project Manager
Address	Cross at Qingnian East Street of Zhangye City, Su'nan Yugu Autonomous County, Zhangye City, Gansu Province, China
Telephone	+86 021-23019950
Email	1169735462@qq.com

1.6 Other Entities Involved in the Project

Organization name	Climate Bridge (Shanghai) Ltd.
Role in the project	Consultancy
Contact person	Gao Zhiwen
Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai
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1.7 Ownership

The project proponent is Gansu Zhangye Dagushan Hydropower Co., Ltd., who has the full ownership of the project. The approval of Environmental Impact Assessment (EIA), Feasibility Study Report (FSR), and Letter of Approval for the Project as a CDM Project issued by China National Development and Reform Commission, and the business license of the project owner are evidences for legislative right. Besides, the equipment purchasing contract and the purchasing power agreement are the evidences for the ownership of the plant, equipment and power generating.

1.8 Project Start Date

The project started on 22/07/2009 (The commissioning date of the 1st generator).

1.9 Project Crediting Period

There is a deviation for the crediting period. The project is registered under VCS Version 2007.1 and completed validation before 19/03/2020. Thus, it remains eligible to apply the crediting period requirements under VCS 2007.1 which shall be a maximum of ten years and may be renewed at most twice, so the first renewable crediting period of the project should be updated from 22/07/2009 ~ 08/05/2010 to 22/07/2009~21/07/2019.

Therefore, the project crediting period is ten years, twice renewable for a total of 30 years. However, as the project is also registered as a CDM project with a seven year twice renewable project crediting period, it is not eligible for VCU issuance beyond the end of those 21 years (08/05/2031). The project first crediting period is from 22/07/2009 to 21/07/2019. This is the second crediting period from 22/07/2019 to 21/07/2029.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
22/07/2019~21/07/2020	108,030
22/07/2020~21/07/2021	108,030
22/07/2021~21/07/2022	108,030
22/07/2022~21/07/2023	108,030
22/07/2023~21/07/2024	108,030
22/07/2024~21/07/2025	108,030
22/07/2025~21/07/2026	108,030
22/07/2026~21/07/2027	108,030
22/07/2027~21/07/2028	108,030
22/07/2028~21/07/2029	108,030

Total estimated ERs	1,080,300
Total number of crediting years	10
Average annual ERs	108,030

1.11 Description of the Project Activity

The purpose of the Project is to use well established hydro power generation technology for electricity generation and transmission to generate low emissions electricity for the Grid thereby displacing CO_2 emissions from electricity generation from the Grid. The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity: electricity delivered to the Grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The Grid includes the Shaanxi Provincial Grid, Gansu Provincial Grid, Qinghai Provincial Grid, Ningxia Autonomous Region Grid and Xinjiang Autonomous Region Grid.

The project is a run-of-river hydropower project, the total installed capacity is 65MW served by two 26MW generators and one 13MW generator. The expected annual feed-in electricity of the project is 195,150MWh. The expected annual operation hours of the project are 3,094 hours, thus the plant load factor of the project is 35.3%[1]. The expected operational lifetime of the project activity is 30 years.

The electricity generated by the project is transmitted to Heihe Substation (330kV) together with the electricity of Erlongshan Hydropower Plant (hereinafter “EHP”, a CDM project, located in the upper reaches of the project), and then to Gansu Power Grid and finally to NWPG. The net electricity supplied to the Grid by the project is monitored by two bidirectional electricity meters, M1 and M2 located at the 330kV Heihe Substation.

Details on the monitoring equipment and its location are given in section 5.3 of the PD.

The key technical parameters of turbine and generator are listed in Table 1.

Table 1 Main Technical Parameters of hydro turbines

Equipment	Parameter	Unit	Amount
Turbine	Units(large/small)	-	3 (2*large/1*small)
	Model(large/small)	-	HL(257)-LJ-225 HL(257)-LJ-160
	Rated Head	m	73
	Rated Flow (large/small)	m^3/s	40/21

[1] 3094hours/(24hours*365 days)=35.3%

	Rated Rotation Speed (large/small)	r/min	300/428.6
	Rated Power (large/small)	MW	27.3/13.6
	Annual operation time	h	3,094
Generator	Model (large/small)	-	SF-J26-20/4800 SF-J13-14/3400
	Rated Power	MW	26/13
	Rated Voltage	kV	10.5
	Rated Rotation Speed	r/min	300/428.6
	Load factor	-	35.3%
	lifetime	year	30
Manufacturer	Hangzhou Resource Power Equipment Co., Ltd.		

1.12 Project Location

This project activity is located in the middle of the upper steam of the Heihe River, within the territory of Su'nan Yugu Autonomous County of Gansu Province, approximately 102 km far from Zhangye City. The geographical coordinates of the project are east longitude of 100°01'29″ and north latitude of 38°37'21″, as shown in figure 1.

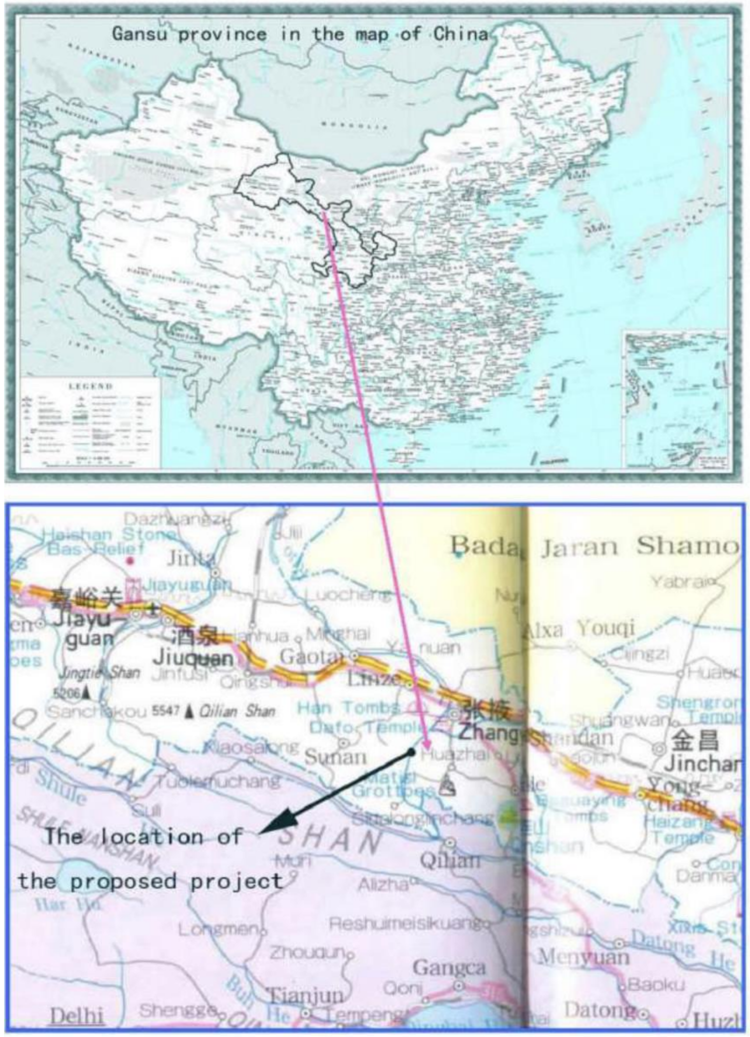

Figure 1 Project Location

1.13 Conditions Prior to Project Initiation

The scenario existing prior to the start of the implementation of the project activity is NWPG providing the same electricity service as the Project;

The project scenario is the implementation of the Project, the installation and operation of turbines with a total capacity of 65MW which supply an average annual generation of 195,150 MWh to NWPG and replace the same amount of electricity generated by fossil fuel fired power plants connected to NWPG;

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

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project is hydro power generation project and meets the relevant provisions of the Law of the People's Republic of China.

The main sectoral policy relevant to the project is the 'Renewable Energy Law of the People's Republic of China', which came into effect on 01/01/2006, and which aims to promote renewable energy in the Host Country. This Law demonstrates the Chinese Government's commitment to the development of renewable energy as part of the overall energy development strategy and encourages grid-connected power generation from renewable sources. Nevertheless, there are no direct incentives, such as financial grants, higher tariffs, or subsidized loans available for these types of project.

In addition, although energy efficiency and renewable energy were included in the agenda for the Host Country's 13th Five-Year Plan (2016-2020), there is no legislative requirement to meet the projections under this Plan.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has been registered as a Clean Development Mechanism (CDM) project in UNFCCC on 09/05/2010 (UNFCCC Ref. 3045), with the 7 years crediting period started from 09/05/2010. Total GHG emission reductions of 429,284 tCO_2 generated from 09/05/2010 to 28/04/2012 (both days included) by the project has been issued as CER under CDM program. Please refer to the following link for details.

https://cdm.unfccc.int/Projects/DB/RWTUV1256040897.46/view?cp=1

The project has been registered as an I-REC Device in 01/01/2019, with the Device ID-DAGUSHAN under the International REC Standard.

Please refer to https://v-1.evident.app/Public/ReportDevices/

1.15.2 Projects Rejected by Other GHG Programs

NA.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

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

1.16.2 Other Forms of Environmental Credit

Altogether 252,070MWh I-RECs have been issued under the International REC Standard with the details in the below table.

Production period	Issued volume (MWh)
01/01/2019~29/07/2019	147,136
01/08/2019~31/08/2019	37,186
01/09/2019~18/09/2019	25,219
19/09/2019~19/09/2019	1,189
01/01/2020~30/04/2020	41,340
Total	**252,070**

1.17 Additional Information Relevant to the Project

Leakage Management

NA.

Commercially Sensitive Information

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

Sustainable Development

The construction and operation of the project has brought prominent environmental and social benefit, and contribute to region sustainable development through following aspects:

- To act as a direct supplement to power grid capacity, and alleviate regional shortage of electricity in a sense;
- Compared with fossil fuel fired plants, the project does not release pollutants into the air, such as sulphur dioxide, nitrogen oxide and particulates, nor does it emit residuals that can give harmful impacts on soil, water etc.;
- Create new job opportunities for the local people during the project construction and operation.

Further Information

NA.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) Report for the project was compiled by Gansu Academy of Environmental Science and has been approved by the Gansu Provincial Environmental Protection Agency in March 2007. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during the project development, thus there are no negative environmental and/or socio-economic impacts due to the project. In fact, as a clean renewable energy project, the project can reduce greenhouse gas emissions and the environmental pollution caused by fossil fuels consumption. Meanwhile, the implementation of the project will improve local socio-economic development through creating job opportunities and increasing local tax revenues.

2.2 Local Stakeholder Consultation

100 questionnaires were distributed in October 2006, and by the end of December 2006 to collect local stakeholders' opinions and concerns on the monitored hydropower project in Su'nan county and Zhangye city. All of the distributed questionnaires had been returned, and the return rate is 100%. Investigated issues include:

- Key environmental problems currently existing in the project construction area
- Main impacts on the local environment of the project activity
- Contribution of the project to local economic development
- Necessity of the project activity
- Major impacts of the project on local public living quality
- Recommendations on the construction of the project and environmental protection in the construction area

With factors, such as age, civilizations, and occupations, considered, the scope of investigated stakeholders is well-rounded, including herdsman, forestry authority staff, residents, students, teachers, technicians, environmentalists and governmental officials in Su'nan county and Zhangye city.

It is the general opinion that the Dagushan hydropower plant is a feasible project that depends on viewpoints from experts and officials. The major public concerns regarding this project are landscape destroy (36%) and noise pollution (28%); regarding the attitude towards the project, 98% support it and only one person object (the attitude of another person is indifferent). The objection reason is that they worry about the possible negative impact on the local eco-environment. Most of the stakeholders think that it should be scientific design, make effort to protect the eco-environment and make full use of the hydro energy resource.

For the 2% stakeholders who worried about the possible negative impact on the local eco-environment, the project owner has taken effort to make them understand the little impact on the eco-environment as the EIA conclusion. The project owner keeps regular communication with the public regarding the construction and operation of this project. At the same time, according to the stakeholders' requirements, 2 stakeholders among them have been selected and assigned to be the volunteer supervisor of environment protection, who has been supervising the environment issue during the operation period.

2.3 Environmental Impact

The project entity had entrusted Gansu Academy of Environmental Science to assess the environmental impacts of the DHP, finally Gansu Provincial Environmental Protection Agency approved the environmental impact assessment (EIA) of DHP in form of official document (approved file NO. [2007]22), that shows the project in accordance with the claim to environment protection by the host party.

Major conclusions of the approved EIA report are summarized as follows:

1. Ecosystem impact

This project has little impact on vegetation and biodiversity since there's very sparse vegetation on the riverside mountains located by the project. After project construction, the rehabilitation of vegetation are conducted on the project site, which improves the vegetation further. Furthermore, the plant species in the construction site are common species existing in extensive areas and move near areas during the construction period with little negative impact.

The upstream view are altered as a result of the project. The diversion reroutes water away from the traditional route taken by the river. Although water is returned to the river after being diverted, the downstream water level is intermittently affected by the project. In order to protect the ecology system, the project developer ensures that minimum ecological waters flows will be maintained (4.43m3/s), according to the EIA10, therefore the negative impacts are not considered to be significant.

2. Wastewater

In order to protect the Heihe River from being polluted, the wastewater is not allowed to be discharged into the river directly. During the operation period, the waste water, mainly sanitary waste from the plant staffs, is treated by an integrated sewage disposal equipment of 10 cubic meters to meet the standard of GB8978-1996, and then is used for irrigation purpose in the project site.

3. Solid waste

During the construction period, the solid waste includes the engineering waste residue and the domestic garbage. The engineering waste residue is disposed in dumping sites. And the domestic garbage is collected and carried to designed dumpsites regularly for disposal.

4. Noise

Noise is mainly caused by the machines and vehicles during construction period. The construction personnel takes precautionary measures during the construction to avoid the negative impacts from noise. Furthermore, the construction site is located in deep gorge with seldom residents resulting in no quarrels of "disturbing of sweet dreams. Hence the noise impact of the project is insignificant.

5. Impact on Qilianshan Natural Reserve

The project is located in the experimental zone of Qilianshan Natural Reserve (QNR). The natural reserve area is classified into core, buffer and experimental zones according to the nature characteristics. In the core and buffer zone any kind of exploitation is prohibited, while in the experimental zone, production and living areas activities are allowed. The project area is not the habitat of wild animals, so through rationally designing and carrying out construction activities, the adverse impact on the wild animals will be very little.

6. Reduce the pollution resulting from coal-fired consumption

When the project is put into operation, the electricity displacement reduces 77.7 kilo tons of coal consumption, 17.7 tons of CO emission, 3.69 kilo tons of SO_2 emission and 680 tons of NO_x emission, which not only mitigates the local shortage pressure of coal and water, and also improves the local environment quality.

In a word, the project is a renewable energy project and will reduce both GHG emissions and local environmental pollutants caused by coal combustion. The project is a run-of-river hydropower plant flooding no soil or farmland and causing no migration. The project will have positive impact on local environment.

2.4 Public Comments

No negative comments have been received on the project during the public comment period has been taken.

2.5 AFOLU-Specific Safeguards

NA.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Following approved baseline & monitoring methodology is applied:

Methodology:

ACM0002 “Grid-connected electricity generation from renewable sources” (Version 20.0)

Reference: https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG

The applied tools:

Tools: “Tool for assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 3.0.1).

Reference:

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

Tools: “Tool to calculate the emission factor for an electricity system” (Version 07.0)

Reference:

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

3.2 Applicability of Methodology

The approved methodology ACM0002 (version 20.0) is applicable to the project activity and the project meets the applicability of the applied methodology as follows:

Clauses	Requirements of the ACM0002	Scenario of the project	Conclusion
1	This methodology is applicable to grid-connected renewable energy power generation project activities that: a) Install a Greenfield power plant; b) Involve a capacity addition to (an) existing plant(s); c) Involve a retrofit of (an) existing operating plants/units; d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or e) Involve a replacement of (an) existing plant(s)/unit(s).).	The project is a greenfield NWPG-connected renewable power generation project.	Applicable
2	The methodology is applicable under the following conditions: (a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power	The project is a newly built hydro power project with reservoir	Applicable

Clauses	Requirements of the ACM0002	Scenario of the project	Conclusion
	plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit 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, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.		
3	In case of hydro power plants, one of the following conditions must apply: (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (7), is greater than 4 W/m^2; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (7), is greater than 4 W/m^2; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4	The project activity results in a new single reservoir and the power density, calculated using equation (7), is greater than 4 W/m^2	Applicable

Clauses	Requirements of the ACM0002	Scenario of the project	Conclusion
	W/m², all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (8), is greater than 4 W/m²; (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m² shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.		
4	In the case of integrated hydro power projects, project proponent shall: Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and	Not applicable, the project is not an integrated hydro power plant, so this applicability condition does not need to be considered.	NA

Clauses	Requirements of the ACM0002	Scenario of the project	Conclusion
	rainfall for minimum five years prior to implementation of CDM project activity.		
5	The methodology is not applicable to: a) 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; b) Biomass fired power plants/units.	The project does not involve switching from fossil-fuels to renewable energy sources at the site of the project activity and the project is not a biomass-fired power project.	NA
6	In the case of retrofits, rehabilitations, 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, that is 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".	Not applicable, the project is a newly built hydro power project.	NA

In addition, the project meets the applicability conditions of the applied tools applied in the PD as follows:

Tool	Criteria	Applicability	Conclusion
Tool to calculate the emission factor for an electricity system	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The project is the installation of a hydro power plant supplying electricity to the grid.	Applicable
Tool to calculate the emission factor for an electricity system	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project electricity system is located in a non-Annex I country.	Applicable
Tool for assessment of the validity of the original/current	This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a	The validity of the baseline of the project is assessed by the	Applicable

Tool	Criteria	Applicability	Conclusion
baseline and update of the baseline at the renewal of the crediting period”	crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism. The tool consists of two steps: The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore for the next crediting period.	following two steps: Evaluate whether the current baseline is still valid for the next crediting period; Update the baseline in case that the current baseline is not valid anymore for the next crediting period.	

3.3 Project Boundary

According to ACM0002 (version 20.0), the spatial extent of the project boundary includes the project power plant and all the power plants connected physically and geographically to electricity system that the project power plant is connected to. According to the “Tool to calculate the emission factor for an electricity system (version 07.0)”, the electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that are covered by either single or layered dispatch area.

Electricity generated by the Project is delivered to Northwest Power Grid (NWPG). According to 2019 Baseline Emission Factors for Regional Power Grids in China issued by China’s DNA[2], the NWPG is composed of Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang power grids, therefore, NWPG is defined as the electricity system the project is connected to, and the spatial extent of the project boundary includes the project power plant and all the power plants connected physically and geographically to NWPG.

The greenhouse gases and emission sources included in or excluded from the above-identified project boundary are shown as below:

Source		Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel-fired power plants that is	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source

[2]http://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml

Source		Gas	Included?	Justification/Explanation
	displaced due to the project activity.	Other	No	Minor emission source
Project	The hydro power plant	CO_2	No	Minor emission source
		CH_4	No	the project is run-of-river hydropower plant, and the power density is greater than 10 W/m²
		N_2O	No	Minor emission source
		Other	No	Minor emission source

Figure 2 presents a flow diagram within the project boundary including all the equipment and systems.

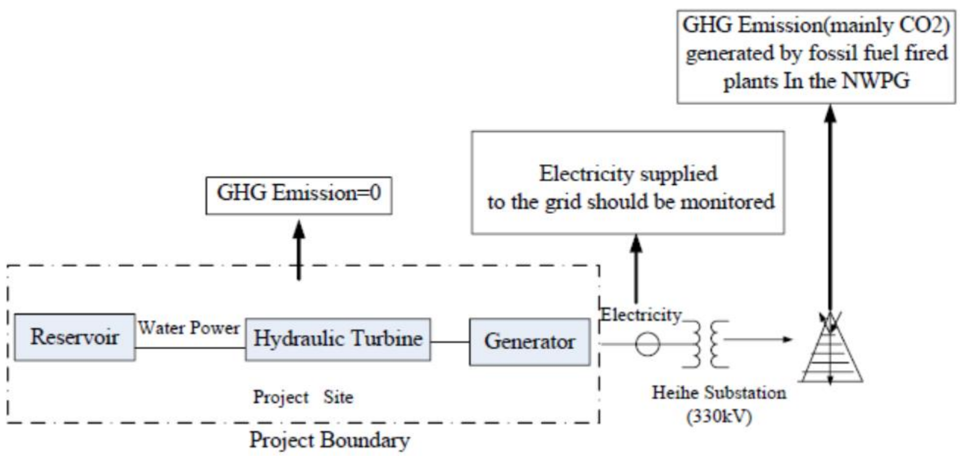

Figure 2 Project Boundary

3.4 Baseline Scenario

In accordance with "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 03.0.1), the validity of the current baseline is assessed using the following sub-steps:

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

There are no new national and/or sectoral policies that could affect the baseline scenario during the renewal of the crediting period. For total electricity generation produced by fossil fuel power plants, the average share of the five most recent years is more than 50% of total electricity generation in NWPG. Hence in the absence of the project activity, electricity would still have been generated in the existing grid-connected power plants or by the addition of new generation sources from NWPG. The current baseline still complies with all relevant mandatory national and sectoral policies which have come into effect after the submission of the project activity for validation and are applicable at the time of requesting renewal of the crediting period. Go to step 1.2.

Step 1.2: Assess the impact of circumstances

The baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment. The investment environment or market characteristics especially the feed-in tariff, the policy in terms of market access permit, these circumstances continue during the second crediting period and therefore, do not have an impact on the current baseline emissions. Hence the current baseline does not need to be updated. Go to step 1.3.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The project is a greenfield project with a lifetime of 30 operation years, with no baseline equipment(s) or an investment for the crediting period for which renewal is requested, this step is not applicable. Go to step 1.4.

Step 1.4: Assessment of the validity of the data and parameters

Assess whether data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated. Updates should be undertaken in the following cases:

- Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;
- Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.

If any of the data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are not valid anymore, the current baseline needs to be updated for the subsequent crediting period.

In accordance with the methodology, the grid emission factor and all the values in its calculation are updated in section 4.1.

Application of Steps 1.1, 1.2, 1.3 and 1.4 confirmed that the current baseline is valid for the second crediting period but data and parameters need to be updated. Therefore step 2 is used.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

As per the analysis in step 1 above, the current baseline does not need to be updated.

Step 2.2: Update the data and parameters

The updated baseline emission factor for the project ($EF_{grid,CM,y}$) is calculated in line with the "Tool to calculate the emission factor for an electricity system (version 07.0)", the data is calculated as 0.8922 tCO_2e/MWh, refer to section 4.1 for details.

3.5 Additionality

The project has demonstrated its additionality in the first crediting period and no changes affect the additionality of the project since its registration.

3.6 Methodology Deviations

There is a deviation on calculation of Build Margin when adopting the methodological tool – "Tool to calculate the emission factor for an electricity system" by the Chinese DNA in the "2019 Baseline Emission Factors for Regional Power Grids in China". The deviation has been approved by the EB Board in a response letter entitled "Request for clarification on use of approved methodology AM0005 for several projects in China"[3], thus the same deviation method has been adopted in the first and second crediting periods of the project by the Chinese DNA.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

According to the ACM0002 (Version 20.0), baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$ (1)

Where:

BE_y = Baseline emission in year y (tCO_2/yr)

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

$EG_{PJ,y}$	= 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 the latest version of the "Tool to calculate the emission factor for an electricity system"

The project activity is a Greenfield hydro power plant, then:

$EG_{PJ,y} = EG_{facility,y}$

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/unit to the grid in year y (MWh/yr)

$EF_{grid,CM,y}$ is calculated as per the latest version of "Tool to calculate the emission factor for an electricity system" (version 07.0). The baseline emission factor $EF_{grid,CM,y}$ is calculated ex ante and fixed for the second crediting period. Detailed as follows:

Step 1. Identify the relevant electricity system

According to the" Tool to calculate the emission factor for an electricity system (Version 07.0)", project participants may delineate the project electricity system using any of the following options:

Option 1. A delineation of the project electricity system and connected electricity systems published by the DNA or the group of the DNAs of the host country(ies), In case a delineation is provided by a group of DNAs, the same delineation should be used by all the project participants applying the tool in these countries;

Option 2. A delineation of the project electricity system defined by the dispatch area of the dispatch centre responsible for scheduling and dispatching electricity generated by the project activity.

Where the dispatch area is controlled by more than one dispatch centre, i.e. layered dispatch area, the higher level area shall be used as a delineation of the project electricity system (e.g. where regional dispatch centres are required to comply with dispatch orders of the national dispatch centre then area controlled by the national dispatch centre shall be used);

Option 3. A delineation of the project electricity system defined by more than one independent dispatch areas, e.g. multi-national power pools.

Since Chinese DNA has published a delineation of the project electricity system and connected electricity systems, Option 1 is applied for the project. According to the delineations, the Northwest Power Grid (NWPG) is identified as the relevant electric power system of the project, which includes Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang provincial Power Grids. The project is located in the middle of the upper steam of the Heihe River, within the territory of Su'nan Yugu Autonomous County of Gansu Province, approximately 102 km far from Zhangye City and covered by the Northwest Power Grid (NWPG). According to the "2019 Baseline Emission Factors for Regional Power Grids in China", there is no net electricity imports to NWPG, therefore, NWPG is chosen as the relevant electric power system.

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

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

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

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

Based on China's real situation, only grid power plants are included in the calculation.

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

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

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch Data Analysis OM, or

(d) Average OM.

In China, specific data from the grid or each power plant is treated as business confidential and thus not public available. Therefore, method (b) and method (c) is not suitable for the project.

According to ACM0002, the Simple OM method (a) can only be applied when low-cost/must run resources[4] constitute less than 50% of total grid generation in average of the five most recent years or based on long-term normal for hydroelectric production.

For the most recent 5 years (2013-2017), the share of low-cost/must-run generation in Northwest Power Grid is 23.47% in 2013, 23.54% in 2014, 24.13% in 2015, 24.29% in 2016 and 27.54%

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

in 2017[5] . The Simple OM method, therefore, is selected to calculate the Operating Margin emission factor of the project. As per the latest version of "Tool to calculate the emission factor for an electricity system", one of the following methods should be chosen to calculate the simple OM emission factor:

- **Ex ante option:** If the ex-ante option is chosen, the emission factor is determined once at the validation stage. Thus, no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the CDM-PDD for validation;
- **Ex post option:** If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emission factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of the year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

Here ex-ante vintage is chosen, and the $EF_{grid,OM}$ is fixed during the second crediting period

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

Based on the analysis of the step 3, the simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/ units. The simple OM may be calculated by one of the following two options:

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 activity, the required data for the exercise of Option A is not available and those of Option B can be obtained from official sources, and off-grid power plants are not included in the calculation, therefore, Option B is chosen to calculate the operating margin emission factor:

Option B can only be used if:

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

[5] China Electric Power Yearbook 2014~2018

(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.

As the data required by option A is not available in China, and the 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 in china, and off-grid power plants are not included in the calculation. Therefore, Option B is used for calculating project OM as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \qquad \text{............ (2)}$$

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 sources in the project electricity system in year y
y	= The relevant year as per the data vintage chosen in Step 3

If available, $NCV_{i,y}$ and $EF_{CO2,i,y}$ from the fuel supplier of the power plants in invoices may be used; or, regional or national average default values may be used. In this PDD, $NCV_{i,y}$ of different fuels are obtained from China Energy Statistical Yearbook 2017. With regard to the fuel types where $NCV_{i,y}$ fluctuate in a certain range, the floor values of the fluctuation range are used for conservatism. $EF_{CO2,i,y}$ of fossil fuel comes from IPCC default values.

The Simple OM Emission Factor ($EF_{grid,OMsimple,y}$) of the project is calculated on the basis of the fuel consumption data for electricity generation of the NWPG, not including those of low-operating cost and must-run power plants, such as wind power, hydropower and nuclear etc. These data are obtained from the China Electric Power Yearbook (2015~2017, published annually) and China Energy Statistical Yearbook (2015~2017). Based on these data, the Simple OM Emission Factor ($EF_{grid,OMsimple,y}$) of the NWPG is calculated as 0.8922 tCO_2e/MWh.

Step 5. Calculate the build margin emission factor

In terms of vintages of data, project participants can choose between one of the following two options:

Option 1 For the first crediting period, calculate the build margin emission factor, ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the second crediting period should be used. 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.

Option 2 For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The PDD chooses **Option 1,** which requires the project participant to calculate the Build Margin Emission Factor $EF_{grid,BM,y}$, ex-ante based on the most recent information available on units already built for sample group m at the time of PDD submission.

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

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

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

(c) From $SET_{5\text{-}units}$ and $SET_{\geq 20\ per\ cent}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20 per cent of the annual electricity generation of the project electricity system (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

If the annual electricity generation of that set is comprising at least 20 per cent of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20 per cent of the annual electricity generation of the project electricity system (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10yrs}$).

However, in China, it is very difficult to obtain the data of the five existing power plants built most recently or the power plants capacity additions in the electricity system that comprise 20 per cent of the system generation (in MWh) and that were built most recently, since no data of plant specific generation and fossil fuel consumption is currently available in China. As none of the above options can be selected, the following deviations are adopted to calculate the BM[6]:

First, to calculate the newly added installed capacity and the contribution component of other various power generation technologies, then calculate of the weight of newly added installed capacity of each power generation technology, and finally, to calculate BM emission factor using the commercially optimal efficiency level of each power generation technology.

According to the “Tool to calculate the emission factor for an electricity system”, the build margin emissions factor ($EF_{grid,BM,y}$) is calculated as 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. The calculation equation is as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \cdots\cdots \quad (3)$$

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)

[6]http://cdm.unfccc.int/UserManagement/FileStorage/6P0IAMGY0ED0TKW25TA20EHEKPR4DM

$EF_{EL,m,y}$ = 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

Since the generating capacity of coal-fired, oil-fired and gas-fired technologies can't be separated from the existing statistical data, the following measures are taken for the calculation:

First, based on the available data of the latest year, determine the ratio of CO_2 emissions from coal, oil, and gas consumption for power generation to the total CO_2 emission; Second, to calculate the emission factor of the thermal power based on the weight of CO_2 emission from coal, oil, and gas, and the emissions factors using commercial technologies with optimal efficiency. And finally, to multiply the thermal emission factor with the portion of the thermal power comprising 20 per cent of the newly added capacity.

Sub-step 5.1. Calculate the weights of CO_2 emission of solid, liquid and gaseous fossil fuels in total emissions for power generation

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}} \quad \text{............ (4)}$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}} \quad \text{.............. (5)}$$

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}} \quad \text{................ (6)}$$

Where:

$FC_{i,j,y}$ = Amount of fossil fuel type i consumed in province *j* in year *y* (mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/t or GJ/m^3)

$EF_{CO2,i,j,y}$ = CO_2 emission factor of fossil fuel type i in year *y* (tCO_2e/GJ)

Sub-step 5.2. Calculation of Emission Factor of Relevant Thermal Power

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad \text{......... (7)}$$

Where:

$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ refers to the emission factors representing best technologies commercially available for coal, oil and gas fired power plants, respectively.

Sub-step 5.3. Calculate of BM of the grid

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \text{ .... (8)}$$

Where:

$CAP_{Total,y}$	=	The total newly added electricity generation capacity (MW) in year y;
$CAP_{Thermal,y}$	=	The newly added electricity generation capacity of thermal power (MW) in year y

Key parameters used to calculate BM emission factor include the low calorific value of each fossil fuel, the oxidation rate, the potential emission factors, and the efficiency of various power generation technologies. The data of low calorific value of each fossil fuel and their oxidation rate comes from China Energy Statistical Yearbook 2017. The potential emission factors are sourced from "2006 IPCC Guidelines for National Greenhouse Gas Inventories" Table 1.3 and Table 1.4 of Page 1.21-1.24 in Chapter one, Volume 2 Energy.

According to the latest and available data at the time of this PD submission, $EF_{grid,BM,y}$ is calculated to be 0.4407 tCO_2e/MWh.

Step6. Calculate the combined margin emission factor

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

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

(a) The project activity is located in: (i) a Least Developed Country (LDC); or in (ii) a country with less than 10 registered CDM projects at the starting date of validation; or (iii) a Small Island Developing States (SIDS); and

(b) The data requirements for the application of step 5 above cannot be met.

The PDD choose option A.

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = \omega_{OM} \times EF_{grid,OM,y} + \omega_{BM} \times EF_{grid,BM,y} \text{ .... (9)}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor for the project electricity system in year *y*

		(tCO_2/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor for the project electricity system in year *y* (tCO_2/MWh)
ω_{OM}	=	Weighting of operating margin emissions factor (%)
ω_{BM}	=	Weighting of build margin emissions factor (%)

The combined margin emissions factor $EF_{grid,CM,y}$ should be calculated as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$), where ω_{OM}= 0.25 and ω_{BM} = 0.75 for hydro project (owing to their intermittent and non-dispatchable nature) for the second crediting period and for subsequent crediting periods. The ($EF_{grid,OM,y}$) and ($EF_{grid,BM,y}$) are calculated as described in Step 4 and 5.

$EF_{grid,CM,y}$ =0.8922 tCO_2e/MWh *0.25+0.4407 tCO_2e/MWh *0.75 = 0.5536 (tCO_2e/MWh)

4.2 Project Emissions

According to the methodology, project emission is calculated by using the following equation

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (10)$$

Where,

PE_y	=	Project emissions in year y (tCO_2/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year y (tCO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year y (tCO_2/yr)

The project activity is a hydro power plant, $PE_{GP,y}$ is no need to be considered, thus is 0. The project is a Greenfield hydro power plant. No fossil fuels are combusted during operation of the project. And as per the applied methodology, emissions due to the use of fossil fuel for the backup generators can be neglected. Hence $PE_{FF,y}$ is zero.

As per the applied methodology, if the power density of the project is greater than $10W/m^2$, $PE_{HP,y}$ is zero; if the power density is greater than $4W/m^2$ and less than or equal to $10W/m^2$, $PE_{HP,y}$ can be calculated as follows:

$$PE_y = PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \quad (11)$$

Where,

PE_y	=	Project emissions in year y (tCO_2)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year y (tCO_2)
EF_{RES}	=	Default emission factor for emissions from reservoirs of hydro power plant (kg CO_2/MWh)
TEG_y	=	Total electricity produced by the project, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh)

Power density of the project is calculated as below:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \qquad (12)$$

Where

PD	=	Power density of the project activity, in 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.

According to FSR, the installed capacity of the project (Cap_{PJ}) is 65,000,000W and the increased submerged area of the project (A_{PJ}) was measured to be 147,300m^2 , thus the power density of the project is calculated as (65,000,000 – 0) / (147,300 – 0)= 441 W/m^2, greater than 10W/m^2. Therefore, based on ACM0002, version 20.0., the project emission (PE_y) = 0 tCO_2e.

4.3 Leakage

According to ACM0002 (version 20.0), no leakage is considered.

4.4 Net GHG Emission Reductions and Removals

The annual emission reductions ER_y for the project activity are calculated as the baseline emissions minus the project emissions. Being the project of a greenhouse gas GHG zero-emission activity the final GHG emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$............... (13)

Where:

ER_y Emission reductions in year y (tCO_2)

BE_y Baseline Emissions in year y (tCO_2)

PE_y Project emissions in year y (tCO_2)

The summary of ex ante estimates of emission reductions is shown as follows:

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)
22/07/2019~21/07/2020	108,030	0	0	108,030
22/07/2020~21/07/2021	108,030	0	0	108,030
22/07/2021~21/07/2022	108,030	0	0	108,030
22/07/2022~21/07/2023	108,030	0	0	108,030
22/07/2023~21/07/2024	108,030	0	0	108,030
22/07/2024~21/07/2025	108,030	0	0	108,030
22/07/2025~21/07/2026	108,030	0	0	108,030
22/07/2026~21/07/2027	108,030	0	0	108,030
22/07/2027~21/07/2028	108,030	0	0	108,030
22/07/2028~21/07/2029	108,030	0	0	108,030
22/07/2020~21/07/2021	108,030	0	0	108,030
Total	1,080,300	0	0	1,080,300

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,OM,y}$

Data unit	tCO_2e/MWh
Description	The operating margin emission factor for Northwest Power Grid
Source of data	"2019 Baseline Emission Factors for Regional Power Grids in China" published by China DNA
Value applied	0.8922
Justification of choice of data or description of measurement methods and procedures applied	As per the requirements in "Tool to calculate the emission factor for an electricity system version 07.0"
Purpose of Data	Calculation of $EF_{grid,CM,y}$
Comments	Calculated ex ante and fixed for the second crediting period.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2e/MWh
Description	The build margin emission factor for Northwest Power Grid
Source of data	"2019 Baseline Emission Factors for Regional Power Grids in China" published by China DNA
Value applied	0.4407
Justification of choice of data or description of measurement methods and procedures applied	As per the requirements in "Tool to calculate the emission factor for an electricity system version 07.0"
Purpose of Data	Calculation of $EF_{grid,CM,y}$
Comments	Calculated ex ante and fixed for the second crediting period.

Data / Parameter	ω_{OM}
Data unit	-
Description	Weighting of operation margin emission factor
Source of data	"Tool to calculate the emission factor for an electricity system version 07.0"

Value applied	0.25
Justification of choice of data or description of measurement methods and procedures applied	As per the requirements in "Tool to calculate the emission factor for an electricity system version 07.0"
Purpose of Data	Calculation of $EF_{grid,CM,y}$
Comments	Calculated ex ante and fixed for the second crediting period.

Data / Parameter	ω_{BM}
Data unit	tCO_2e/MWh
Description	Weighting of build margin emission factor
Source of data	"Tool to calculate the emission factor for an electricity system version 07.0"
Value applied	0.75
Justification of choice of data or description of measurement methods and procedures applied	As per the requirements in "Tool to calculate the emission factor for an electricity system version 07.0"
Purpose of Data	Calculation of $EF_{grid,CM,y}$
Comments	Calculated ex ante and fixed for the second crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e/MWh
Description	The baseline grid emission factor
Source of data	"Tool to calculate the emission factor for an electricity system version 07.0"
Value applied	0.5536
Justification of choice of data or description of measurement methods and procedures applied	As per the requirements in "Tool to calculate the emission factor for an electricity system version 07.0"

Purpose of Data	Calculation of baseline emissions
Comments	Calculated ex ante and fixed for the second crediting period.

Data / 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
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 project emissions
Comments	-

Data / Parameter	A_{BL}
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data	Project Site
Value applied	0
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 emissions
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility, y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Calculated
Description of measurement methods and procedures to be applied	Measured through main meters including M1, M2, M5, M7, M9, measured through backup meters including M3, M4, M6, M8 and M10 with the formula showed in section 5.3 The accuracy of the electricity meters involved is 0.2s.
Frequency of monitoring/recording	Measured continuously and recorded on a monthly basis.
Value applied	-
Monitoring equipment	Electricity meter
QA/QC procedures to be applied	The meters will be calibrated according to the relevant national standard and regulations; net electricity generation supplied to the grid will be recorded by both the project owner and the grid company, and cross checked by sales invoices.
Purpose of data	Calculation of baseline emissions
Calculation method	The net electricity supplied by the project to the grid is calculated according to the equation (14) in section 5.3
Comments	-

Data / Parameter	CAP_{PJ}
Data unit	W
Description	Installed capacity of the hydropower 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 manufacturer's specifications or nameplate of the equipment

Frequency of monitoring/recording	Once at the beginning of each crediting period
Value applied	65,000,000
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of power density
Calculation method	-
Comments	-

Data / Parameter	A_{PJ}
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Project site
Description of measurement methods and procedures to be applied	Measured from topographical surveys, maps, satellite pictures, etc.
Frequency of monitoring/recording	Once at the beginning of each crediting period
Value applied	147,300[7]
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of power density
Calculation method	-
Comments	-

[7] As per the feasibility study report of the project, the submersed area is 147,300 m^2. Hence, this value is used as ex-ante value. The actual value is to be monitored at the beginning of the 2nd crediting period.

5.3 Monitoring Plan

An overall monitoring plan is put into place in order to guarantee the long-term precise measurement of the project's GHG emission reductions and to have a complete and reliable emission reductions calculation. The details of the monitoring plan are summarized as:

1. Operation and management structure of monitoring

The project owner has set up a VCS team/committee comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. The VCS team also comprises of a special group of operators who are assigned the responsibility of monitoring different parameters and record. On a weekly basis, the monitoring reports are checked and discussed by the seniors CDM team members/managers. In case of any irregularity observed by any of the VCS team member, it is informed to the concerned person for necessary actions.

2. Monitoring equipment and installation

Given the emission factor is ex-ante calculated and according to the ACM0002, the quantity of net electricity generation supplied by the project plant to the grid will be monitored.

The main data to be monitored is:

- Quantity of net electricity generation supplied by the project plant to the grid (NWPG) ($EG_{faciltiy,y}$)
- Installed capacity of the hydropower plant after the implementation of the project activity (Cap_{PJ})
- Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ})

The electricity generation is metered by the grid company and the project owner. An agreement has been signed between the project owner and the grid company that defines the metering arrangements and the required quality control procedures to ensure accuracy.

The power generated by the project is transmitted to Heihe Substation (330kV) together with the electricity of Erlongshan Hydropower Plant (hereinafter "EHP", a CDM project, located in the upper reaches of the project), and then to Gansu Power Grid and finally to NWPG.

The simple diagram of grid connection is as figure below:

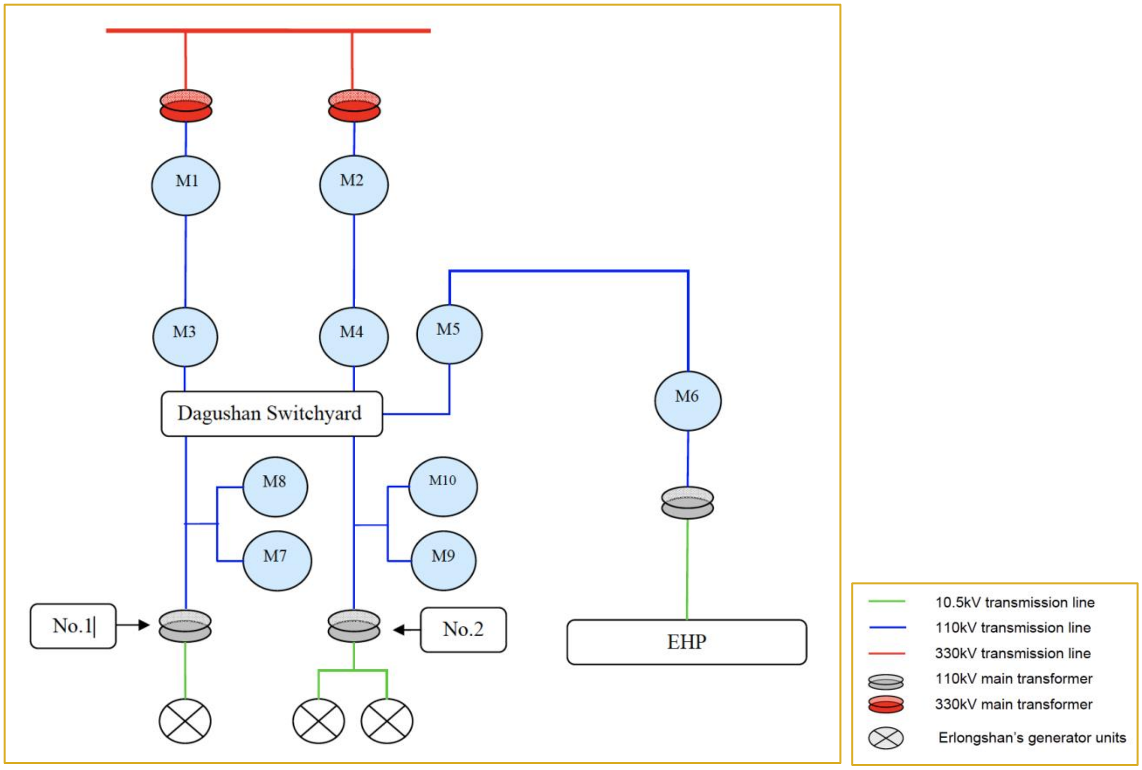

Figure 3. Monitoring system of the project.[8]

There are 10 meters, including both main and backup meters, installed to measure the electricity delivered from different sources:

M1 and M2 (0.2S, bi-directional): Owned by the grid company. M1 and M2 were installed at the Heihe Substation (330kV) of the Grid Company. Both of them measures the net electricity generation supplied to the grid by the DHP and EHP (M1+M2).

M3 and M4 (0.2S, bi-directional): Owned by the project owner. M3 and M4 are located at the exit of booster station of DHP, as the backup meter of M1 and M2.

According to Power Purchasing Agreement (PPA), once M1 and M2 have a breakdown, the electricity will be measured accordingly by M3 and M4. The caused line loss will be negotiated by project owner and the grid company.

M5 and M6 (0.2S, single-directional): M5 is owned by the grid company, which are located at the inlet of booster station of DHP on the transmission line from EHP to DHP. M6 is owned by the project owner, which is located in the booster station of EHP. The reading on M5 is employed to record the electricity generation supplied by EHP. M6 is the backup meter for M5.

M7 and M9 (0.2S, bi-directional): Owned by the grid company, which are located at the powerhouse of DHP. M7 and M9 measure the net electricity exported from No.1 and No.2 main transformer respectively of DHP.

[8] The monitoring system of the project has been revised and approved by CDM EB on 03/03/2011.

M8 and M10 (0.2S, bi-directional): Owned by the grid company, which are located at the powerhouse of DHP. Both of them are used as the backup meters of M7 and M9 correspondingly.

Refer to below table for the details of meter information.

Meter	Location	Calibration Frequency	Remarks
M1	Heihe 330kV Substation	Quarterly	Main meter for DHP and EHP, recording the electricity distributed through one of the transmission lines from Dagushan booster station.
M2	Heihe 330kV Substation	Quarterly	Main meter for DHP and EHP, recording the electricity distributed through one of the transmission lines from Dagushan booster station.
M3	The exit of booster station of DHP	Quarterly	Backup meter for M1
M4	The exit of booster station of DHP	Quarterly	Backup meter for M2
M5	The inlet of booster station of DHP on the transmission line from EHP to DHP	Quarterly	Meter to record the electricity from EHP before merge of electricity by DHP and EHP.
M6	The inlet of booster station of DHP on the transmission line from EHP to DHP	Quarterly	Backup meter for M5
M7	Powerhouse of DHP	Quarterly	Monitoring the electricity exported from No..1 main transformer of DHP, main meter
M8	Powerhouse of DHP	Quarterly	Monitoring the electricity exported from No.1 main transformer of DHP, backup meter of M7.
M9	Powerhouse of DHP	Quarterly	Monitoring the electricity exported from No.2 main transformer of DHP, main meter.
M10	Powerhouse of DHP	Quarterly	Monitoring the electricity exported from No.2 main transformer of DHP, backup meter of M9.

DHP=Dagushan Hydrpopwer Plant (The project)   EHP= Erlongshan Hydrpopwer Plant

3. Data calculation

According to Power Purchasing Agreement, the quantity of net electricity generation supplied by the project plant to the grid will be calculated as:

$$EG_{facility,y} = (EG_{M1,y} + EG_{M2,y}) * (EG_{M7,y} + EG_{M9,y}) / (EG_{M5,y} + EG_{M7,y} + EG_{M9,y}) \quad (14)$$

Where:

$EG_{facility,y}$	=	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)
$EG_{M1,y}$	=	The net electricity generation supplied to the grid by the DHP and EHP in year y (MWh), $EG_{M3,y}$ as the backup
$EG_{M2,y}$	=	The net electricity generation supplied to the grid by the DHP and EHP in year y (MWh), $EG_{M4,y}$ as the backup
$EG_{M7,y}$	=	The net electricity exported from No.1 main transformer of DHP in year y (MWh), $EG_{M8,y}$ as the backup.
$EG_{M9,y}$	=	The net electricity exported from No.2 main transformer of DHP in year y (MWh), $EG_{M10,y}$ as the backup.
$EG_{M5,y}$	=	The electricity generation supplied by EHP in year y (MWh), $EG_{M6,y}$ as the backup

The data of all the meters will be measured hourly, record monthly and archived electronically, in addition monthly data also will be printed in paper for a backup.

4. Quality assurance and quality control

The project owner and the grid company have signed an agreement to develop a set of quality control procedures regarding measurement and calibration so as to maintain the accuracy of the measurement. The electric meters should be examined and undergo regular field calibration according to the relevant standards “Technological management regulation for Metering equipment” (DL/T 448-2016) and regulations of the power industry so as to ensure the accuracy of the meters. After the examination, the meters should be sealed. The lift of the seals requires the presence of both the project owner and the Grid Company. One party must not lift the seals or fiddle with the meters without the presence of the other party.

All the meters installed shall be tested by a qualified metering verification institution commissioned jointly by the project owner and the Grid Company within 10 days after:

(a) Detection of a difference larger than the allowable error in the readings of both meters;

(b) The repair of all or part of meter caused by the failure of one or more parts to operated in accordance with the specifications.

In case that the main meters are out of service, the meter readings of the backup meters will be used. In case that both the main meter and the backup meter are out of service, the grid company and the project owner would jointly calculate a conservative estimation of the electricity. The malfunctioning electricity meters shall be maintained immediately and calibrated by qualified third party before putting back online for monitoring.

5. Monitoring results and verification

The verification of the monitoring results of the project activity is required for each crediting period. The monitoring results will be combined in a monitoring report that will be served as a basis for project verification in each crediting year.

6. Data Management System

This provides information on record keeping of the data collected during monitoring. Record keeping is the most important exercise in relation to the monitoring process. Without accurate and efficient record keeping, emission reductions of the proposed project cannot be verified. The data will be measured hourly, record monthly and archived electronically, in addition monthly data also will be printed in paper for a backup.

At the end of each month the monitoring data needs to be filed electronically. The electronic files need to have CD back-up or print-out. The project developer needs to keep electricity sale and purchase invoices.

All written documentation such as maps, drawings, the EIA and the Feasibility study, should be stored and should be available to the verifier so that the reliability of the information may be checked.

In order to make it easy for the verifier to retrieve the documentation and information in relation to the project emission reduction verification, the project developer should provide a document register. The document management system will be developed to ensure adequate document control for VCS purposes.

The dedicated VCS Manager of the project developer is responsible for checking the data (according to a formal procedure) and VCS Manager will be responsible for managing the collection, storage and archive of all data and records. A procedure will be developed to manage the VCS record keeping arrangements. All the data shall be kept until two years after the end of credit period.