



RUIJING GEOTHERMAL BASED SPACE HEATING SYSTEM



Document Prepared by Shenzhen CTI International Certification Co., Ltd

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Summary:

- *A description of the project*

The project activity developed in Zhoukou City, Henan Province, P. R. China, is to introduce geothermal energy based space heating system to realize heat supply to a series of new residential buildings over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area. The project activity involves the construction and operation of geothermal system with a total heating load of 399.48MW which can supply geothermal heat to 7,989.6 thousand m² of residential buildings. The project is expected to achieve 495,289 tCO_{2e} of emission reduction annually. The project started operation on 01-November-2020 with the VCS Ref. No. 2659.

- *A description of the validation and verification*

The approved CDM methodology AM0072 "Fossil Fuel Displacement by Geothermal Resources for Space Heating" (version 03.0) is applied to quantify the GHG removals achieved in this project. The calculation of the GHG emission reductions is carried out in a transparent and conservative manner. This project is being developed in conjunction with the validation and 1st periodic of verification.

- *The purpose and scope of validation and verification*

The validation objective is an independent assessment by a Third Party of a proposed project activity against all defined criteria set for the registration under the VCS. In order to confirm that the project activity, as documented, is sound reasonable and meets the identified criteria, the validation involves the assessment of: project conformance to VCS standards/programs, project conformance to the applied methodology, including the procedure for the demonstration of additionality specified in the methodology; and likelihood that methods and procedures set out in the project description will generate verifiable GHG data and information when implemented. Validation is a requirement and is seen as necessary to provide assurance to stakeholders of the quality of project and its intended generation of VCUs. Validation is part of the VCS project cycle and will finally result in a conclusion by the executing VVB whether a project activity is valid to be submitted for registration to VCS registry.

The objective of the verification is to have an independent review ex post determination by a VVB (Validation and Verification Body) of the monitored GHG emission reductions that have occurred as a result of the implementation of the project activity during a defined monitoring period.

- *The method and criteria used for validation and verification*

Validation and Verification is conducted using Shenzhen CTI International Certification Co., Ltd (CTI) procedures in line with the requirements specified in the latest version of the VCS Validation and Verification Manual and applying auditing techniques. The validation/verification team assessed the project activity's compliance against the VCS Standard Version 4.2, the selected CDM methodology and the joint project description and monitoring report. The project is eligible under Project Scope 14. The validation/verification criteria followed the guidance documents provided by VCS included the following:

VCS Standard Version 4.2, VCS Program Guide Version 4.1 and the applied CDM methodology AM0072 "Fossil Fuel Displacement by Geothermal Resources for Space Heating" (version 03.0).

- *The number of findings raised during validation and verification*

In the course of the validation and verification, 10 Corrective Action Requests (CARs), 7 Clarification Requests (CLs) were raised and successfully closed. The assessment is included in the report.

- *Any uncertainties associated with the validation and verification*

There are no restrictions of uncertainty for both validation and verification.

- *Summary of the validation and verification conclusions*

Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. has commissioned the Shenzhen CTI International Certification Co., Ltd to carry out the Verified Carbon Standard (VCS) validation joint with 1st periodical verification of the project, “Ruijing Geothermal Based Space Heating System” (VCS ID 2659) with regard to the relevant requirements of VCS standard Version 4.2. CTI confirms all validation and verification activities including objectives, scope and criteria, level of assurance, project description, monitoring and monitoring report adhere to VCS Standard Version 4.2 and all associated updated as documented in this report, are complete.

CTI concludes that the project activity “Ruijing Geothermal Based Space Heating System” in China, as described in the final version of Joint-Project-Description-Monitoring-Report, meets all relevant requirements for VCS validation and verification activity and correctly applied the methodology AM0072 Version 03.0. Hence CTI is able to certify that the GHG emission reductions from the project during the monitoring period from 01-November-2020 to 31-March-2022 were generated as 867,337 tCO₂e which can be claimed as VCUs.

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1 INTRODUCTION

1.1 Objective

Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. has commissioned the Shenzhen CTI International Certification Co., Ltd to carry out the Verified Carbon Standard (VCS) validation joint with 1st periodical verification of the project for the monitoring period from 01-November-2020 to 31-March-2022 (both days included).

The objective of validation is an independent assessment by a Third Party of a proposed project activity against all defined criteria set for the registration under the VCS. In order to confirm that the project activity, as documented, is sound reasonable and meets the identified criteria, the validation involves the assessment of: project conformance to VCS standards/programs, project conformance to the applied methodology, including the procedure for the demonstration of additionality specified in the methodology; and likelihood that methods and procedures set out in the project description will generate verifiable GHG data and information when implemented. Validation is a requirement and is seen as necessary to provide assurance to stakeholders of the quality of project and its intended generation of VCU. Validation is part of the VCS project cycle and will finally result in a conclusion by the executing VVB whether a project activity is valid to be submitted for registration to VCS registry.

The objective of verification is to have an independent review ex-post determination by a VVB of the monitored GHG emission reductions that have occurred as a result of the project activity implemented during a defined monitoring period. The evaluation is done against the requirements of the VCS Standard Version 4.2 based on the monitoring report. In order to confirm that the GHG emission reductions sound reasonable and meet the identified criteria, the verification involves the assessment of monitoring plan conformance to VCS rules and applied methodology. Verification is a requirement and is seen as necessary to provide assurance on the generation of VCUs.

1.2 Scope and Criteria

The validation scope is defined as an independent and objective review of the project description (PD) to validate that (a) the project design is actual, (b) the baseline scenario is correctly defined as per the applied methodology and relate tools, (c) the project is additional, (d) the monitoring plan can be implemented and is transparent and adequate and (e) all data and information used for ex-ante calculation of emission reductions is of projected and/or hypothetical nature. The Joint-PD-MR is reviewed against the criteria stated in VCS standard Version 4.2/63/and the approved baseline and monitoring methodology AM0072 Version 03.0/53/. The validation was based on the requirements VCS Validation and Verification Manual and VCS Standard version 4.2 applying auditing techniques. The validation is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the project design.

The scope of the verification is to verify that: (a) the actual monitoring system and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan; (b) the GHG emission reductions data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reductions data are free from material misstatement; (c) the reported GHG emissions data is sufficiently supported by evidence. Verification shall ensure that the reported GHG emission reductions are complete and accurate in accordance with the applicable VCS criteria in order to be certified. Verification is conducted using CTI procedures in line with the requirements specified in the VCS Program and ISO14064-3 requirements and applying auditing techniques. The VVB assessed and determined that the implementation and operation of the project activity, and steps to report GHG emission reductions comply with the VCS rules. The verification involved a document review of relevant documentation and interview with the project participants. Verification is not meant to provide any consultancy towards the project participants; however, stated request for clarifications and/or corrective actions may have provided input for improvement of the monitoring.

1.3 Level of Assurance

All GHG sinks, sources and GHG emissions equal to or greater than 1% of the total GHG assertions are considered. The project is expected to generate average GHG emission removal of 495,289 tCO₂e per year, and therefore can be considered as a “large project” per the VCS rules, in regards to its scale, subject to a 1% materiality threshold.

The assessment was conducted to provide a reasonable level of assurance of compliance against the defined audit criteria and materiality threshold within the audit scope. Based on the audit findings the validation and verification statement reasonably assure that the GHG assertion is materially correct and is a fair representation of the GHG data and information.

1.4 Summary Description of the Project

The project is implemented by Wanjiang New Energy Group Co. Ltd. which aims to introduce geothermal energy based space heating system to realize heat supply to a series of new residential buildings over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area in Zhoukou City, Henan Province, P.R. China. The project activity involves the construction and operation of geothermal system with a total heating load of 399.48MW which can supply geothermal heat to 7,989.6 thousand m² of residential buildings.

The project activity enables a series of new residential buildings to use of geothermal energy instead of the combustion of fossil fuel for space heating, finally provides the affordable and clean Energy to communities in China, which has been verified by on-site inspection, and checking the related documentations, interview with the project implementer. In the monitoring period from 01-November-2020 to 31-March-2022, CTI is able to certify that the GHG emission reductions from the project were generated as 867,337 tCO₂e which can be claimed as VCUs.

The project activity generates GHG emission reductions by displace heat supply from isolated coal-fired boilers. Thus the project generates GHG emission reductions and produces financial, social and environmental benefits. The project has resulted in the local sustainable development as described in Section 1 of the Joint Joint-PD-MR/1/. The project applied to be registered as a VCS project activity and

the 867,337 tCO₂e of emission reductions have been certified as verified carbon units (VCUs) for 1st monitoring period from 01-November-2020 to 31-March-2022.

2 VALIDATION AND VERIFICATION PROCESS

2.1 Method and Criteria

A project specific validation and verification plan was developed to guide the validation and verification auditing process to ensure efficiency and effectiveness.

The purpose of the validation and verification is to present a risk assessment for determining the nature and extent of validation and verification procedures necessary to ensure the risk of auditing error is reduces to a reasonable level. According to the ISO14064-3, the criteria are the policy, procedure or requirement used as reference against which evidence is compared. Therefore, validation of the project description and verification of the monitoring plan and the reported project results were measured for compliance against the following criteria:

- VCS Standard, v4.2/63/
- VCS Program Guide, v4.1/62/
- VCS Program Definitions, v4.1/61/
- VCS-Joint-Project-Description-Monitoring-Report-Template-v4.0/59/

The validation and verification process derived from all items in the validation and verification criteria stated above. Field inspection and techniques based on the project parameters, scope and best professional judgement of the validation and verification team in order to meet a reasonable level of assurance. The validation and verification consisted of the following three phase:

- Document review
- On-site assessment
- The resolution of outstanding issues and the issuance of the final joint validation and verification report and certification.

The validation and verification process derived from all items in the validation and verification criteria stated above. Field inspection and techniques based on the project parameters, scope and best professional judgement of the validation and verification team in order to meet a reasonable level of assurance.

There is no sampling approach utilized by PP and VVB during validation and verification.

2.2 Document Review

The VCS Joint-PD-MR/1/ of the project and supporting background documents related to the project implementation were reviewed. Documents review was conducted to ensure consistency with and identify any deviation from VCS program requirements. Desk review included an examination of the project design details, baseline scenario, additionality, ex ante and monitoring data and parameters, and quantification of GHG emission reductions.

Furthermore, the validation and verification team used additional documentation by third parties like host party legislation, technical reports referring to the project design details, baseline scenario, additionality, monitoring or to the basic conditions and technical data.

The references used in the course of this validation and verification are summarized in Appendix 3.

The validation and verification were performed basing on the documents check and site inspection/measurements, refer to the section 3 and 4 of this report for the validation and verification process detail and corresponding documents review.

2.3 Interviews

Describe the interview process and identify personnel, including their roles, who were interviewed and/or provided information additional to that provided in the Joint-PD-MR/1/ and any supporting documents.

The objective of the interview process was to solicit important information from personnel related to project and relevant to the validation and verification process.

Via desk review of the project related evidence including FSR/5/, project approval/6/, and carbon waiver in the heating supply contracts/9/before the site visit, CTI identified that there are total 7 local property management companies who handled 10 different sub-areas involved in the project. Hence the number of end users is identified as 7 companies. And by considering the characteristics of the 7 companies is homogeneous verified by checking the heating supply contracts/9/, CTI determined to interview sampled end users during site visit.

The sampling design (number of plots, location) is considered to be in line with the requirements for validation (IAF Guidance on the Application of ISO/IEC Guide 66 - G.5.3.12.: $x = \sqrt{y}$, where x is the sampling size by VVB and y is the total number of the property management companies, i.e. 7), and it has ensured a representative cross-section of the properties in the areas.

Sampled end users are selected by VVB is calculated as $X = \sqrt{7} = 3$.

Hence, before the site visit, VVB randomly selected 3 end user's names from the 7 heating supply contracts/9/ which has been interviewed during site visit as listed in below table.

Furthermore, to collect more information of the heating data in the buildings, VVB also determined to interview some end users in communities during the site visit to each of the sub-areas involved in the project and interviewed 6 heating end users in communities listed in below table.

Onsite interviews and information discussions were conducted with representatives from project implementer/I1/, Operation Staffs/I2/, local officers/I3/, representatives from local property management companies and communities/I4/ and VCS consultant/I5/. The interviews were performed by the validation and verification team on-site (within the project area, in Zhoukou City, Henan Province, P.R. China) and the following is a list of the main interviewees and subject.

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Xiang	Kang	Wanjiang New Energy Group		- Discussion on project financials,	Tong Dezheng
2.	Wang	Li'na				

3.	Ye	Fang	Co., Ltd. - Project Owner/Manager, Operation and Monitoring staff	25-April-2022~26-April-2022	project design and implementation, - Main equipment, - Technical parameters, - Baseline, Additionality, - Project boundary, - Monitoring plan, - Monitoring devices, - SDG impacts, - ER calculation, - Heat supply, - Heating season, - Local legislation to heat	
4.	Cheng	Jiawen				
5.	Lu	Guanghua				
6.	Zhou	Yao				
7.	Wu	Zizhe	Local Stakeholders, officer/ Zhoukou City Urban and Rural Construction Bureau	25-April-2022	- Local Stakeholder Consultation issues, - SDG impacts, - Continuous Inputs, - Grievances mechanism, - Heat supply, - Heating season, - Local legislation to heat, - Water Usage Permission	Tong Dezheng
8.	Liu	Wen	Local Stakeholders, officer/ Zhoukou City Environmental Protection Bureau	25-April-2022		
9.	Ye	Gang	Local Stakeholders, officer/ Zhoukou City Water Resources Utilization Bureau	25-April-2022		
10.	Zhang	Zhongyuan	Local Stakeholders, End user/Fajina Property Service Co., Ltd.	26-April-2022		
11.	Zhang	Nan	Local Stakeholders, End user/Henan Yatai Property	26-April-2022	- Heat supply, - Heating area, - Contracts Signed, - Heating Price - Heating season, - Carbon waiver - Scenario before the project started - Comments to the project	Tong Dezheng

			Service Co., Ltd.			
12.	Wang	Yiming	Local Stakeholders, End user/Henan Jianye Property Management Co., Ltd.	26-April-2022		
13.	Ma	Feiyu	Local Stakeholders/ End users in communities	25-April-2022~26-April-2022	- Heat supply, - Heating area, - Time of living - Temperature in home - Comments to the project	Tong Dezheng
14.	Ding	Wei				
15.	Fu	Yuanhang				
16.	Kong	Xingwang				
17.	Peng	Mao				
18.	Shen	Liangpeng				

2.4 Site Inspections

The joint validation and verification site inspection was conducted on 25-April-2022~26-April-2022. A ground inspection of the project was conducted during the site visit and the joint validation and VVB interviewed project implementer/I1/, Operation Staffs/I2/, local officers/I3/, representatives from local property management companies and communities /I4/ and VCS consultant/I5/.

During the site inspection, the project site was inspected and documents evidence were checked, details as following table,

Duration of on-site inspection: 25-April-2022~26-April-2022				
No.	Activity performed on-site	Site location	Date	Team member
1.	Opening meeting Interview with PP, experts, consultant representatives	Office in Wanjiang New Energy Group Co. Ltd. in Zhoukou City Henan Province, P.R. China	25-April-2022	Tong Dezheng
2	On-site inspection Interview with sampled farmers and technicians	Project Area in Zhoukou City, Henan Province, P.R. China	25-April-2022~26-April-2022	Tong Dezheng
3	Documents check	Project Area in Zhoukou City, Henan Province, P.R. China	26-April-2022	Tong Dezheng
4	Finding Summary	Project Area in Zhoukou City, Henan Province, P.R. China	26-April-2022	Tong Dezheng
5	Close Meeting	Office in Wanjiang New Energy Group Co. Ltd. in Zhoukou City Henan Province, P.R. China	26-April-2022	Tong Dezheng

2.5 Resolution of Findings

Material discrepancies identified in the course of the validation and verification are addressed either as CARs, CLs or FARs.

A Corrective Action Request (CAR) is established where:

- The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- The VCS Standard Version 4.2 requirements have not been met;
- There is a risk that the emission reductions cannot be monitored or calculated.

A Clarification Request (CL) will be issued where information is insufficient, unclear or not transparent enough to establish whether a requirement is met.

A Forward Action Request (FAR) will be issued when certain issues related to project implementation should be reviewed during the next verification.

A detailed list of the CARs CLs and FAR raised and discussed in the course of this validation and verification is included in Appendix 4 of this report.

In the course of the validation 10 Corrective Action Requests (CARs), 7 Clarification Requests (CLs) were raised and successfully closed. The assessment is included in the report.

2.5.1 Forward Action Requests

This is the joint validation and 1st VCS verification, thus there is no FAR raised previously.

3 VALIDATION FINDINGS

3.1 Project Details

- Project type, technologies and measures implemented, and eligibility of the project

Type:

Through the onsite visit, interviewing the project developer and reviewing the project description/1/, it was confirmed that the project is to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area in Zhoukou City, Henan Province, P.R. China.

Therefore, it was confirmed that the sectoral scope is scope 01: Energy industries (renewable - / non-renewable sources) as per the UNFCCC Standard “Applicability of sectoral scopes version 01.0”/74/.

It was confirmed that the project is not a grouped project.

- Technologies and measures implemented:

The information and descriptions reported in section 1.1 of the VCS Joint-PD-MR/1/ have been checked.

The project activity involves the construction and operation of geothermal system with a total heating load of 399.48MW which can supply geothermal heat to 7,989.6 thousand m² of residential buildings which has been verified by checking the Heating supply contracts/9/ and on-site inspection. The project is implemented in line with the Joint-PD-MR/1/.

The project uses geothermal resources in cascade levels. The high-temperature water can be used to supply heat directly through plate heat exchanger, and the low-temperature water enters the geothermal heat pumps after the heat exchange. Through the secondary heat exchange of the geothermal heat pumps, the temperature of the feed water can be increased to meet the requirements of the terminal heating design parameters. Total of 66 geothermal wells with a design depth of 2,300 meters were constructed and implemented confirmed during site visit, of which the 44 production wells with an average flow rate of 150 m³/h will supply the feed geothermal water at temperature of 75°C to 44 heat substations through primary heating network. The 22 re-injection wells will receive the return water at temperature of 9°C after secondary heat exchange. The 44 heat substations will supply the feed water at temperature of 45°C to the project buildings and receive the return water at temperature of 35°C from them.

Besides, a total of 44 heat substations in 10 sub-areas were constructed and implemented to enable the heat exchange between geothermal water transported by the primary heating network and the clean circulation water transported by the secondary network. In addition to water source geothermal heat pumps and air source geothermal heat pumps, the main equipment of the heat substations also includes deep well pumps, hydro-cyclones, plate heat exchangers, circulating pumps, make-up pumps, tanks and water-softening facilities. All the geothermal wells, heat substations and related facilities were newly constructed.

The technology is confirmed by site inspection and checking the FSR/5/, Contract for Construction of Geothermal Space Heating System/10/, Technical agreement and Operating Instruction of Geothermal Space Heating System/11/.

The project reduces fuel consumption through enables new residential buildings to use of geothermal energy instead of the combustion of fossil fuel for space heating. The technology employed is environmentally safe and sound as well as state of the art. Via checking the Business License/4/ of PP, FSR/5/, project approval/6/, and carbon waiver in the heating supply contracts/9/, it is verified that project owner invested in purchasing the geothermal system. By implementing the project, it has provided an opportunity for local community to generate steady and continual income for their livelihood.

The project is applicable to the applied CDM Methodology AM0072 “Fossil Fuel Displacement by Geothermal Resources for Space Heating” (Version 03.0)/53/.

The expected total emission reduction of the Project in the fixed crediting periods of 10 years (from 01-November-2020 to 31-October-2030) is 4,982,890 tCO₂e, and the annual emission reduction is estimated to be 495,289 tCO₂e.

In conclusion, it is verified that the summary description of the project in section 1.1 is in line with the Joint-PD-MR template requirements and all the information has been provided and verified as correct.

- Eligibility of the project:

The PP has described and justified how the project is eligible under the scope of the VCS Program in Joint-PD-MR as per the section 2.1.1 of VCS standard Version 4.2. The assessment is provided as below,

1. The project activity generates GHG emission reductions only including CO₂ which belong to the six Kyoto Protocol greenhouse gases.
2. “The scope of the VCS Program excludes projects that can reasonably be assumed to have generated GHG emissions primarily for the purpose of their subsequent reduction, removal or destruction.” Via checking the Joint-PD-MR of the project, it is verified that the project is implemented to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area, and the additionality is verified as actual, thus there is no assumption of having generated GHG emissions primarily for the purpose of their subsequent reduction, removal or destruction for this project.
3. The VCS Program also excludes the following project activities under the circumstances indicated in Table 1 of section 2.1.1 of VCS Standard Version 4.2, via checking all the excluded project activities in the table, it is verified that this project type is not excluded by the scope of VCS program.

In conclusion, the project is eligible to the scope of the VCS Program.

- Project design, including eligibility criteria for grouped projects

The project has not been designed to include a single installation of an activity, multiple project activity instances, or as a grouped project.

- Project proponent and other entities involved in the project

The project proponent (Wanjiang New Energy Group Co. Ltd., and the contact information reported in section 1.5 of the VCS Joint-PD-MR have been confirmed to be correct through checking the business license of the company/4/, the project approval/6/ and interviewing with the PP representative through the on-site visit/11/.

The other entities involved in the Project (Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.) and the contact information reported in section 1.6 of the VCS Joint-PD-MR have been confirmed to be correct through checking the business license of the Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd./4/ and interviewing the representative of this company during the on-site visit/15/.

- Ownership

The section 1.7 of the Joint-PD-MR has been checked, it is confirmed that the Project Proponent demonstrates that they have the legal right to control and operate project activity.

Via checking the National legal approval to the Environmental Impact Assessment (EIA)/8/, Project approval/6/, and the business license of the Wanjiang New Energy Group Co. Ltd./4/, it is verified that the PP has the legal right to control and operate the project activity.

Furthermore, via checking the Heating supply contracts/9/ which signed between the Wanjiang New Energy Group Co. Ltd. and all the end users, CTI confirmed that the contracts including carbon waiver agreement which ensure that Wanjiang New Energy Group Co., Ltd. has the legal ownership of the carbon credits generated by the project activity and this has been agreed by property owners.

Thus, it is confirmed that the project owner has the ownership of the project and has the legal ownership of the carbon credits generated by the project activity.

- Project start date

The project start date is 01-November-2020 which is verified as the date on which the project began generating GHG emission reductions or removals as per the concept in VCS Standard Version 4.2.

Via checking the operation log/12/, it is verified that 01-November-2020 is the date when all the geothermal space heating system of them started fully commissioning, hence the start date is correct and in line with the VCS standard.

- Project crediting period

For the VCS crediting period, PP has chosen 10 years fixed crediting period started from 01-November-2020 to 31-October-2030 which is in line with the concept for crediting period in section 3.8.2 of the VCS Standard version 4.2.

- Project scale and estimated GHG emission reductions or removals

The average annual ERs of the project are 495,289 tCO₂e, which is higher than the threshold of large-projects (300,000 tCO₂e per year). Therefore the project falls in the category of “Large Project” as per definition in VCS standard. And the estimated total Estimated GHG Emission Reductions or Removals during the 10 years of VCS fixed crediting period (01-November-2020 to 31-October-2030) is 495,289 tCO₂e.

- Project location

The project site is located at Zhoukou City, Henan Province, P. R. China. The geographical coordinates for the project site are between 114°05' and 115°39' east longitude and between 33°03' and 34°20' north latitude. The location of the project site is verified with on-site investigation by GPS devices and checking the google earth map/64/.

- Conditions prior to project initiation

Via site interview with end users and checking the Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/, CTI confirmed that the scenario prior to the implementation of the proposed project activity is that heat supplied to the building areas in winter was provided by isolated coal-fired boilers in BAU.

The baseline scenario is the same as the scenario existing prior to the implementation of the project activity, which has been confirmed during the site interview with local officer/12/ and checking the Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/. Thus it is verified that the baseline scenario is reasonable and correct.

Therefore, the project is confirmed not to be implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction.

- Project compliance with applicable laws, statutes and other regulatory frameworks

The Joint-PD-MR has stated that the project is in the field of renewable energy, this industry is confirmed as in line with the laws and regulations as listed in the Joint-PD-MR/46/,/47/,/48/.

Also the project is legally approved by Local government by checking the project approval/6/, Water drawing permit/20/ and EIA approval/8/, which means that the project is in line with the national and local laws and regulations based on the local expertise of the VVB. And as stated in the Joint-PD-MR/1/ and confirmed by interview with local officer/12/, CTI verified that the project will be subject to regular inspection by local government during the implementation period to ensure continuous compliance.

In conclusion, the project complies with all relevant local, regional and national laws, statutes and regulatory frameworks in China.

- Participation under other GHG programs:

-Projects registered (or seeking registration) under other GHG program(s)

The project has neither been registered nor seeking registration under any other GHG programs which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes' website. It is verified that the project is seeking registration only in VCS program/70/.

-Rejection by other GHG programs

The project has neither been rejected by any other GHG programs which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes' website.

• Other forms of credit:

-Emissions trading programs and other binding limits

The project proponent is not part of any emission trading program which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes' website. The net GHG emission reductions during this monitoring period from the project was not used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated under any other GHG programs which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes' website, it is verified that the implementation of the project is consistent with the description in the Joint-PD-MR and the monitoring system is fully functional to generate Verified Carbon Units (VCUs) without any double counting for this monitoring period from 01-November-2020 to 31-March-2022.

Besides, based on VVB's local expertise, China has a national emissions trading scheme only cover the high-emission industries, such as power generation sector that emitted at least 26,000 tons of CO₂e/year which has been verified in the public website/65/, and it is confirmed that the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner by checking the enforced company list in public information/66/. Hence, it is confirmed that the emission reductions will not be double counted.

-Other forms of environmental credit sought or received and eligible to be sought or received

Via interview with the project developer/I1/ and based on above assessment, it is confirmed that the project has not created any other form of environmental credit.

• Sustainable development contributions

Via on-site inspection, checking the evidence provided as below and interview with the project implementer, CTI verified that the project contributes the sustainable development through the following aspects:

1. *The local residents can have access to and rely on renewable energy (Goal 7 of UN SDG, Target 7.2) – verified by interview with local residents and by checking FSR/5/ and heating supply contracts/9/, it is confirmed that the local residents in actual heating area is 6,871,047.47m² from 01-November-2020 to 31-March-2022 and the actual heating area is 7,186,579.28m² from 01-November-2021 to 31-March-2022 have accesses to and relied on renewable energy during this monitoring period, hence the contribution to this SDG has been confirmed and the provisions for monitoring and reporting this goal is verified as reasonable;*

2. *The project activity provide job opportunities and equal pay for work of equal value will be made to both men and women (Goal 8 of UN SDG, Target 8.5) – verified by interview with staffs and checking the Labor Contracts/24/ and monthly payroll/25/, it is confirmed that 30 job opportunities (15 females and 15 males) have been provided during this monitoring period, hence the contribution to this SDG has been confirmed and the provisions for monitoring and reporting this goal is verified as reasonable;*
3. *Sequester greenhouse gas and mitigate climate changes (Goal 13 of UN SDG, Target 13.0) – verified by checking the Emission Reduction Calculation sheet/2/, it is confirmed that total 867,337 tCO₂e Emission Reduction have been achieved during this monitoring period, hence the contribution to this SDG has been confirmed and the provisions for monitoring and reporting this goal is verified as reasonable.*

• Additional information relevant to the project, including:

-Leakage management for AFOLU projects

According to the methodology, the leakage of the project is zero, thus the leakage management is not applicable to the project.

-Commercially sensitive information

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

Based on above assessment and demonstration, it is concluded that the description in the project description is accurate, complete, and the nature of the project is actual and understandable, and it is confirmed that the project has been implemented as described in the project description via site inspection.

CL 01, CL 02, CAR 01, CAR 02 and CAR 03 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.2 Participation under Other GHG Programs

The project has neither been registered nor seeking registration under any other GHG programs which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes' website. It is verified that the project is seeking registration only in VCS program/70/.

3.3 Safeguards

3.3.1 No Net Harm

In China, an Environmental Impacts Assessment is required according to Chinese legislation. The EIA was designed by Henan Juli Lianchuang Environmental Protection Technology Co., Ltd./7/ and approved by Zhoukou Ecological Environment Bureau on 26-May-2019/8/. The analysis of the environmental impacts of the project activity is sufficiently described according to EIA report/7/. The assessment is as below,

It is considered that the environmental impacts and the relevant mitigation methods have been comprehensively described in Section 2.1 and 2.3 of Joint-PD-MR including the air pollution and wastewater, noise, and solid waste impact on the ecosystem and environment of local area in project site for both construction and operation period according to the EIA report/7/.

Associated with the review of EIA report/7/, there was no adverse effect on the air, water and solid waste, for the project subject to the implementation of pollution mitigation measures according to the EIA report/7/. There was also no any endangered species found in the project location.

As per the approval of EIA/8/, it stated that the inspectors from the Zhoukou Ecological Environment Bureau have to carry out monitoring work for the environmental impact arisen from the project activity during CMM power plant commissioning periodically. Via interview with the local officers from Zhoukou Ecological Environment Bureau/12/, it is confirmed that they are satisfactory with the environmental protection and recovery work carried out by the project owner. The Zhoukou Ecological Environment Bureau also did not receive any public comment on the project activity during this monitoring period.

During the on-site interview, the local residents/13/ were interviewed if there was critical impact to their living environment. It is verified that the project activity does not cause adverse effect to their daily life.

Furthermore, via interview with local officer and stakeholders, it is confirmed that the implementation of the project will improve local socio-economic development through creating career opportunities and paying taxes to local government.

In conclusion, there were some impacts on environment during the construction and operation periods which has been demonstrated in the Joint-PD-MR/1/ and EIA/7/, also the proper measurements have been carried out by project implementer to mitigate such impacts.

3.3.2 Local Stakeholder Consultation

Local stakeholder consultation prior the project started construction

A stakeholder survey was carried out by the project developer in January 2020 which was prior to the start date of the construction.

Survey questionnaires were distributed to relevant personnel of local villagers and government officials by the Project owner in January 2020, totally 40 copies of questionnaires were issued to relevant personnel of local villagers and government officials with 40 pieces of reply received. The stakeholders' background information and comments from questionnaires were summarized and recorded in the Joint-PD-MR, Section 2.2.

Via checking the 40 filled questionnaires/21/, it is verified that all respondents knew or heard about the Project. Most of them are supportive of the project construction, and think the Project will bring more benefit than loss. And the survey shows that many local stakeholders think the Project will help improve the life of local people and promote local economic development without any adverse environmental impact.

Finally, it is verified that there is no one thinks that the Project will have a negative impact on the local life, local stakeholders are supportive of the project construction by checking the questionnaires/21/, and thus no need to change the project design based on the stakeholder inputs.

Mechanism for on-going communication and consultation during this monitoring period:

During the implementation stage of this monitoring period, via checking the local communication survey records/22/ and interview with the local officer/12/ and local residents/13/ during site visit, it is confirmed that the local authority has conducted follow-up interviews and ongoing communication with local stakeholders to collect any comments or inputs to the project implementation. Based on the VVB's local expertise, CTI confirmed that the local government agencies and competent authorities will conduct spot checks on the implementation of the project from time to time as per the request from the local government's regulations.

Moreover, the project owner carried out a stakeholder consultation meeting with questionnaire survey for the local stakeholder to collect the relevant comments and suggestions on 25-January-2021 during this 1st monitoring period. Via checking the meeting records/22/ and filled 40 filled questionnaires/22/, interview with the local officer and local stakeholders during site visit, it is verified that nearly all the respondents believe that the Project will not have any negative environmental impact.

But some stakeholders worried that the project would bring noise, land occupying and pollution on employees and local residents' living via checking the meeting records/22/ and filled 40 filled questionnaires/22/, for these impacts, via site inspection, it is confirmed that project owner has conducted the related mitigation measures as stated in the Joint-PD-MR, which is confirmed in line with the request of the EIA/7/. After explained these measures to the local stakeholders by PP, it is verified that all attendances to the meeting were satisfied to the measures which has been confirmed by site interview with local stakeholders.

The local officer from Zhoukou City Urban and Rural Construction Bureau and Zhoukou Ecological Environment Bureau/12/ has confirmed that the project was under supervised and the implementation of the project is in line with the local environment protection regulations and EIA/7/. And via checking the filled 40 questionnaires/22/, it is confirmed that no other negative impacts considered by local stakeholder to their local life.

As per the above assessment, CTI confirmed that PP has conducted the local stakeholder consultation survey before the project started and during the monitoring period including questionnaire survey and meeting, PP has informed local stakeholders through oral and written means about the meeting. The invitation letter was sent by email to participants which has been confirmed by checking the emails.

In addition, by considering to invite more comments from the maximized participation from stakeholders into the project's consultation, a grievance book is kept in property management centre of each community (total 10 books confirmed by site inspection). The continuous input & grievance mechanism were informed to the stakeholders during the local stakeholder consultation meeting and property management centre of each community also informed local stakeholders about this. All stakeholders are allowed to record their grievances or comments in the book. The project owner will reply to the related issue within 3 working days. Via site inspection of the books, VVB confirmed that there were no negative comments received during this monitoring period.

Via interview with the local officer/12/ and local residents/13/ during site visit, it is verified that there were no comments and issues from the local stakeholders during the implementation period and the project passed all the periodic spot checks by local government. Hence there is no need to change the project design based on the stakeholder inputs.

CL 03 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.3.3 Environmental Impact

In China, an Environmental Impacts Assessment is required according to Chinese legislation. The EIA was designed by Henan Juli Lianchuang Environmental Protection Technology Co., Ltd./7/ and approved by Zhoukou Ecological Environment Bureau on 26-May-2019/8/. The analysis of the environmental impacts of the project activity is sufficiently described according to EIA report/7/. The assessment is as below,

It is considered that the environmental impacts and the relevant mitigation methods have been comprehensively described in Section 2.3 of Joint-PD-MR including the air pollution and wastewater, noise, solid waste and impact on the ecosystem in local area of project site according to the EIA report.

The environmental impacts of the project were sufficiently assessed by means of an Environmental Impact Assessment (EIA) study report according to the Chinese laws & regulations such as “Environmental Protection Law of P.R. China” and “Law of the People's Republic of China on the Environmental Impact Assessment”. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development and operation.

During the construction period, via interview with the local officer from Zhoukou Ecological Environment Bureau, it is confirmed that the potential environmental impacts have been sufficiently identified for the construction period, such as air pollution, wastewater, noise and solid waste etc. The conclusion of the analysis has been described in the Joint-PD-MR as per the EIA report/7/ and the related mitigation measures have been listed as per the approval of EIA report/8/. Due to the project has been implemented during the site inspection, it is confirmed that the impact during the construction period has been solved and no significant environmental impacts are expected from the project activity.

During the site inspection, the project was implemented normally. The validator revealed that noise during operation is generated by the project mainly comes from the air source heat pump unit of the heat source station and the mechanical noise generated by the equipment of the heat supply station and the Noise emission from the project operation is confirmed during site inspection, PP has taken some mitigation measures including the low noise equipment is selected for heat source station. which has been verified by VVB during the site inspection, and via interview with local officer from Zhoukou Ecological Environment Bureau/12/, it is verified that the noise in the project site complies with the standard requirements of Class 2 limit of national standard “Emission standard for industrial enterprise noise at boundary” (GB12348-2008)/37/ and the sensitive points of sound environment meet the requirements of Class 2 standard of Sound Environment Quality Standard (GB3096-2008)/37/.

Associated with the review of EIA, there was no adverse effect on the ecology, air, water and solid waste, for the project subject to the implementation of pollution mitigation measures according to the EIA report. There was also no any endangered species found in the project location.

As per the approval of EIA, it stated that the inspectors from the Zhoukou Ecological Environment Bureau have to carry out monitoring work for the environmental impact arisen from the project activity during CMM power plant commissioning periodically. Via interview with the local officer from Zhoukou Ecological Environment Bureau /12/, it is confirmed that they are satisfactory with the environmental protection and recovery work carried out by the project owner. The EPB also did not receive any public comment on the project activity after the implementation of the project.

3.3.4 Public Comments

The project sought the registration with the VCS Program, according to VCS requirements the Project Description was submitted for public comment period. The project was allocated with VCS ID 2659. The public comment period started on 29-March-2022 and ended on 28-April-2022 (<https://registry.verra.org/app/projectDetail/VCS/2659>).

No comments were received during this period which has been verified by checking the dedicated website as above.

CAR 04 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.3.5 AFOLU-Specific Safeguards

N/A

3.4 Application of Methodology

3.4.1 Title and Reference

The approved consolidated methodology applied in the project activity is AM0072 – “Fossil Fuel Displacement by Geothermal Resources for Space Heating” (version 03.0)/53/.

This methodology also refers to the latest approved version of the following tools and guidelines:

Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)/54/

Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/55/

Tool 07 Tool to calculate the emission factor for an electricity system (Version 07.0)/56/

Tool 24 Common practice (Version 03.1)/57/

3.4.2 Applicability

Demonstration regarding the applicability of the methodology, and any tools selected by the project proponent as provided in below table.

Table 3-1 Assessment of Applicability conditions of AM0072 (version 03.0).

No.	Applicability conditions	Validation Assessment	Conclusion
1	The methodology is applicable for space heating in buildings by introducing	Via site inspection and checking the FSR/5/, project approval/6/ and	Applicable

No.	Applicability conditions	Validation Assessment	Conclusion
	centralized geothermal heat supply system. The methodology can apply to new build facilities, or to a geothermal district heating system seeking to expand its operations through the addition of extra geothermal wells to the system.	Contract for Construction of Geothermal Space Heating System/10/, CTI verified that this project activity is to introduce geothermal energy based space heating system to realize heat supply to a series of new residential buildings, and all the facilities related to the geothermal heating system were newly built which didn't involve any capacity expansion through the addition of extra geothermal wells. Hence this criteria is applicable for this project activity.	
2	The methodology is applicable under the following conditions: (a) The geographical extent of the project boundary can be clearly established, in terms of the location of buildings connected to existing heating systems and new buildings to be constructed that will use geothermal heat, in the case of expansion of existing facilities, the location and capacity of existing geothermal wells, and heating system infrastructure can be clearly identified;	Via site inspection and checking the FSR/5/, project approval/6/ and Contract for Construction of Geothermal Space Heating System/10/, CTI verified that geographical extent of the project boundary has been clearly established in Joint-PD-MR includes the newly built 66 geothermal wells, newly built 44 heat substations, 10 sub-areas of residential buildings that will use geothermal heat, and newly built primary networks and secondary network. The location of the geothermal heating system and 66 geothermal wells, 44 heat substations and 10 sub-areas have been verified by site inspection and measured by GPS device which is confirmed as consistent with the Satellite Picture and location information provided in Joint-PD-MR. Hence this criteria is applicable for this project activity.	Applicable
3	(b) Project will use geothermal resources for centralized space-heating system of residential areas, commercial areas and/or industrial areas;	Via site inspection and checking the FSR/5/ and project approval/6/, CTI verified that the project uses geothermal resources for centralized space-heating system of total of 10 sub-areas including 7,989.6 thousand m ² of newly built residential buildings.	Applicable

No.	Applicability conditions	Validation Assessment	Conclusion
		Hence this criteria is applicable for this project activity.	
4	(c) The methodology is applicable for installing new heating systems in new buildings and replacing existing fossil fuel space heating systems. Current use of fossil fuel(s) for space heating is partially or completely replaced by heat drawn from geothermal water, in the case of expansion of existing facilities the methodology is applicable to expanding the existing geothermal heating system;	Via site inspection and checking the FSR/5/, project approval/6/, Contract for Construction of Geothermal Space Heating System/10/ and heating supply contracts/9/, CTI verified that the project installs new heating systems in new buildings and replacing expected fossil fuel space heating systems completely by use of isolated coal-fired boilers in baseline scenario. Hence this criteria is applicable for this project activity.	Applicable
5	(d) The installed heat capacity may increase as a result of the project activity. But this increase is limited to 10 per cent of the previous existing capacity; otherwise a new baseline scenario has to be determined for the new capacity;	Via site inspection and checking the FSR/5/, project approval/6/, Contract for Construction of Geothermal Space Heating System/10/ and heating supply contracts/9/, CTI verified that there is no existing capacity prior to implementation of the project. Hence, this condition is not applicable.	Applicable
6	(e) All fossil fuel heat-only boiler(s) used in the baseline must operate to supply the heat to the district heating system which is only used for heating of buildings and/or hot tap water supply in the residential and/or commercial sector, but not for industrial processes;	Via site inspection and checking the FSR/5/, project approval/6/ and heating supply contracts/9/, CTI verified that only the Residential buildings were supplied by the fossil fuel heat-only boilers used in the baseline. No industrial processes were involved. Hence this criteria is applicable for this project activity.	Applicable
7	(f) The use of GHG emitting refrigerants is not permitted under this methodology.	Via site inspection of the technical flow chart in the project site/13/ and checking the FSR/5/ and project approval/6/, CTI verified that no GHG emitting refrigerants is used. Hence this criteria is applicable for this project activity.	Applicable
8	In addition, the applicability conditions included in the tools referred to below apply.	Refer to below assessments.	Applicable
Conclusion: Methodology AM0072 (Version 03.0) is applicable to the project activity.			

In addition, the project meets the applicability conditions of the applied tools as follow table,

Table 3-2 Assessment of Applicability conditions of methodological tool

Tool	Criteria	Validation Assessment	Conclusion
(a) Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)	The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established.	The tool is applicable to all types of proposed project activities, and in section 15 of the applied methodology, it requires project proponents determine the most plausible baseline scenario through the use of the “Combined tool to determine the baseline scenario and demonstrate additionality”. Thus this tool is applicable to the project.	Applicable
Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)	If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power	Via site inspection and checking the Agreement of Electricity Charges/14/ and Monthly Electricity Bills/19/, CTI verified that the project activity use electricity from grid Centre China Power Grid (CCPG), and emissions are calculated for electricity consumption, so the Scenario A: Electricity consumption from the grid and the electricity is purchased from the grid only, is applicable to the project. Hence this criteria is applicable for this project activity.	Applicable

Tool	Criteria	Validation Assessment	Conclusion
	plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.		
	This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	Via site inspection and checking the Agreement of Electricity Charges/14/ and Monthly Electricity bills /19/, CTI verified that the project activity only consumes electricity without generate, hence this criteria is not applicable.	Applicable
	This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO₂ emissions.	Via site inspection and checking the FSR/5/, project approval/6/ and heating supply contracts/9/, CTI verified that the project installs geothermal based space heating system to displace fossil fuel consumption. No captive renewable power generation technologies will be installed to provide electricity in the project activity. Hence this criteria is not applicable.	Applicable
Tool 07 Tool to calculate the	This tool may be applied to estimate the OM, BM and/or CM	Via site inspection and checking the Agreement of	Applicable

Tool	Criteria	Validation Assessment	Conclusion
emission factor for an electricity system (Version 07.0)	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).	Electricity Charges/14/, CTI verified that the project activity consumes electricity from grid CCPG, no baseline emissions related to supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid. Hence this criteria is not applicable for this project activity.	
	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in “Appendix 1: Procedures related to off-grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Via checking the tool and 2019 China regional power grid carbon dioxide baseline emission factor OM calculation instructions published by Ministry of Ecology and Environment of the People’s Republic of China/27/, CTI confirmed that the emission factor for the project electricity system is calculated for grid power plants only.	Applicable
	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.	Via site inspection, it is verified that the project electricity system is located totally in Henan Province of China, which is not an Annex I country.	Applicable

Tool	Criteria	Validation Assessment	Conclusion
		Hence this criteria is applicable for this project activity.	
	Under this tool, the value applied to the CO ₂ emission factor of biofuels is zero.	Via checking the tool and 2019 China regional power grid carbon dioxide baseline emission factor OM calculation instructions published by Ministry of Ecology and Environment of the People's Republic of China/27/, CTI confirmed that the value applied to the CO ₂ emission factor of biofuels is zero.	Applicable
Tool 24 Common practice (Version 03.1)	This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	As assessed above, the project applies the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" for the demonstration of additionality, the project can use the common practice test for the demonstration of additionality. Hence this criteria is applicable for this project activity.	Applicable
	In case the applied approved baseline and monitoring methodology defines approaches for the conduction of the common practice test that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	Via checking the section 31 of applied methodology, CTI confirmed that the methodology defines approaches for the conduction of the common practice test that are same to those described in this methodological tool. Hence this criteria is applicable for this project activity.	Applicable
Conclusion: All the relevant methodological tools are applicable to the project activity.			

3.4.3 Project Boundary

The project boundary basically defines the physical and geographical boundary of the project facility and it is well defined in the Joint-PD-MR/1/ (section 3.3) according to AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating (Version 03.0)/53/. The project boundary includes following,

- i) The project includes 44 production wells, 22 re-injection wells.
- ii) The project includes 44 substations, residential in 10 sub-areas.
- iii) The floor radiation system was installed in buildings connected to the substations. There is no decentralized heating equipment involved in the project boundary.

Via site inspection and checking the FSR/5/ and the technical flow chart in the project site/13/, it is verified that project boundary is clearly defined in the Joint-PD-MR/1/ as per the methodology/53/.

Emissions sources included in the project boundary have been appropriately included in the Joint-PD-MR/1/. CO₂ emissions due to combustion of baseline fuel (coal) in boilers is covered for baseline scenario and the project scenario has emissions due to electricity used for geothermal extraction /operations.

The main emission sources and gases included in the project boundary are determined as per the applied methodology, via the baseline scenario identification assessment as below section, CTI confirmed that the baseline emission sources included in baseline scenario is CO₂ emission from fossil fuel used for space heating. Via on-site inspection of the project and checking the FSR/5/, in the project scenario, the main emission source including the CO₂ emission from electricity used for project operations which has been confirmed by checking the Meter reading records of 44 meters/18/. And via on-site inspection of the project and checking the FSR/5/, CTI confirmed that no fuel is used for project operations due to the electricity used and no fugitive emissions need to be considered by the project as the low-temperature geothermal system is designed to operate by extracting geothermal water at approximately 75 °C.

GHG sources included and excluded from the project boundary is defined as correct and corresponding to the actual status of the project, via on-site inspection and checking the FSR/5/, it is verified that all the relevant sources have been selected.

It is concluded that the project boundary and selected sources are correctly justified for the project.

CAR 05 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.4 Baseline Scenario

The PP has applied an approved baseline and methodology AM0072 (Version 03.0) which is approved under CDM scheme.

The Joint-PD-MR applies the stepwise approach as given by section 5.2 of the AM0072/53/ and "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0)/54/.

Step 1: Identification of alternative scenarios

Step 1a: Define alternative scenarios to the proposed project

Due to the project installed new geothermal facility to supply heats to new buildings, hence the Joint-PD-MR follows the methodology by listing 4 main alternatives with for heat supply to buildings that should be considered at least.

No further scenario is considered reasonable under the given context.

As per the applied methodology,

Alternative 1

- the 1.(a) Implementation of the project activity without the benefits of Carbon is considered as a realistic and credible alternative scenario.

Alternative 2

- via site inspection and checking the public information from Henan Province People Government/49/ and interview with local officers and residents, CTI confirmed that location of the project is not in the central heating area, no existing networks for the project area due to all the residential buildings of the 10 sub-areas were newly constructed, hence Alternative 2 (i) and (ii) are ruled out accordingly.

Alternative 3

- via site inspection and checking the FSR/5/, project approval/6/, Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/ and heating supply contracts/9/ and interview with local officers and residents, CTI confirmed that 3(i) Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network is a realistic and credible alternative scenario.
- via checking the public information of current natural gas network in Henan province/73/, CTI verified that current natural gas network can't cover most of the area in Henan Province, the area where the project is located is temporarily not covered by natural gas pipe network, hence alternative 3(ii) is ruled out accordingly.
- via checking the public information of current oil-fired boiler/42/, CTI verified that cost of using an oil-fired boiler is twice that of a gas fired boiler to produce the same amount of heat, and transportation and storage of oil is dangerous hence alternative 3(iii) is ruled out accordingly.
- via checking the public information issued by China State Government/41/, CTI verified that small decentralized cogeneration plants are prohibited by Chinese government, hence alternative 3(iv) is ruled out accordingly.
- via site inspection and interview with local resident/13/ and officers/12/, CTI verified that renewable energy sources, such as biomass energy, wind energy, and solar energy, are not stable for space heating which can only be used as supplementary energy sources in long term in Henan Province by checking the public information/39/, hence alternative 3(v) is ruled out accordingly.

Alternative 4

- via checking the Three-year Action Plan to Win the Blue Sky Defense War/72/, CTI verified that old coal fired boilers for individual buildings should be eliminated gradually and new coal fired boilers built for individual buildings are forbidden by local government, hence alternative 4(i) is ruled out accordingly.

- Based on local expertise of the validation team, CTI confirmed that use of coal fired stoves inside the apartments is dangerous due to carbon monoxide poisoning, hence alternative 4(ii) is ruled out accordingly.
- via checking the public information of current natural gas network in Henan province/73/, CTI verified that current natural gas network cannot cover most of the project area in Henan Province, in addition, natural gas fired boilers have many disadvantages which have been verified by checking the related study “Review of Heating Methods for Rural Houses in China”/34/, hence alternative 4(iii) is ruled out accordingly.
- via checking the public information of price of natural gas in Henan province/38/, CTI verified that current price of natural gas is expensive and is increasing in Henan Province, then natural gas consumption is too expensive to be afforded by many residents, hence alternative 4(iv) is ruled out accordingly.
- via checking the public information of current oil-fired boiler/42/, CTI verified that cost of using an oil-fired boiler is twice that of a gas fired boiler to produce the same amount of heat, hence alternative 4(v) is ruled out accordingly.
- via checking the public information of current utilization of oil-fired stoves/43/, CTI confirmed that oil fired stoves are mainly used in the industrial field which is not yet completely mature for using in apartments, hence alternative 4(vi) is ruled out accordingly.
- via checking the public information of electricity-based heating technologies/45/, CTI confirmed that electricity-based heating technologies are more costly and thus not comparable with other alternatives in terms of cost-effectiveness. hence alternative 4(vii) is ruled out accordingly.
- CTI confirmed that Individual heating devices using renewable energy sources, such as solar thermal collectors are not stable for space heating due to the low solar energy density and there is no stable individual space heating devices using solar thermal collectors which has been verified by checking the public information of individual space heating/44/, hence alternative 4(viii) is ruled out accordingly.
- via site inspection and interview with local resident and officers, CTI verified that non-renewable biomass are not stable for space heating and no sufficient biomass in the project area by interview with local officers and residents, hence alternative 4(ix) is ruled out accordingly.

Existing geothermal based heat supply system is not involved in the project activity and is not applicable, therefore options for expansion of a geothermal heat supply system are eliminated from the baseline determination in the Joint-PD-MR.

Hence, based on above assessment, CTI confirmed that the remaining realistic and credible alternative scenarios for the geothermal heating system are

1 (a) Implementation of the project activity without the benefits of VCS; and

3 (i) Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network.

Step 1b: Consistency with mandatory applicable laws and regulations

Via checking the national regulation of Planning of Clean Heating in Winter of Northern China (2017-2021)/47/, CTI confirmed that the energy used for heating in northern China is mainly coal, and the areas that are not covered by central heating system mainly use coal-fired boilers supplying several buildings through a small heat distribution network as a supplement. Via site inspection, it is verified that the project is located in northern part of China and not covered by centralized district heating system.

Furthermore, via checking the regional regulation of Administrative Measures for Centralized Heating in Henan Province/48/, CTI confirmed that using coal-fired boilers supplying several buildings through a small heat distribution network is accepted by local government in areas not covered by central heating system, but building coal fired boilers for individual buildings and coal fired stoves for individual apartments are not allowed.

Besides, via checking the Guidance on Promoting Clean Heating in Northern Areas/46/, it is confirmed that the national government encouraged to use renewable energy such as geothermal resources which is the project scenario.

Thus, CTI confirmed that the above options of alternative 1(a) and 3(i) are considered to follow all mandatory applicable legal and regulatory requirements which are verified based in validation team's local expertise. The outcome of Step 1b is same to Step 1a.

Step 2: Barrier analysis

Step 2a: Identify barriers that would prevent the implementation of alternative scenarios

For alternative 3(i), heating supply to the project area would be provided by isolated coal fired boilers without the project, hence no barriers for alternative 3(i).

For alternative 1(a),

- (a) Technological barriers. Via site interview with the project owner, operation staffs and checking the project approval/6/, CTI confirmed that there are skilled and/or properly trained staffs to operate and maintain the geothermal technology and all the skilled technicians have ability to maintain and repair the related equipment and PP provided the technical training frequently/26/. Besides, as per the FSR/5/, it is confirmed that there are rich geothermal resources in Zhoukou City, which ensure the normal operation of the equipment with the perspective of renewable energy supply. Furthermore, via site inspection and based on the expertise of VVB, it is verified that the geothermal heating technology used in the project is relatively mature. Hence, it is confirmed that there are no technology barriers of the alternative 1(a).
- (b) Financial barriers, other than insufficient financial returns as analyzed in Step 3. Via checking the Guidance on Promoting Clean Heating in Northern Areas/46/, it is confirmed that the national government encouraged to use renewable energy such as geothermal resources which is the project scenario. And via checking the company information in National Enterprise Credit Information Publicity System/75/, CTI confirmed that the project owner is financial healthy. Hence CTI confirmed that no investment barriers, other than insufficient financial returns as analyzed in Step 3 prevent the project implementation. Hence, it is confirmed that there are no financial barriers of the alternative 1(a).

- (c) Acceptability barriers. Via checking the Renewable Energy Law of China, CTI confirmed that clean heating is promoted by China and geothermal energy is in line with the national policy orientation. Heating index is 50 W/m² for residential buildings used for project activity, which is confirmed in line with the requirement of CJJ 34-2010 Design Code for City Heating Network published by Ministry of Housing and Urban-Rural Development of the People's Republic of China/30/, and via checking the local stakeholder consultation results as assessed in 3.3.2, CTI confirmed that the geothermal space heating system is acceptable and welcome to the end-users. Hence, it is confirmed that there are no acceptability barriers of the alternative 1(a).

Step 2b: Identify barriers that would prevent the implementation of alternative scenarios

Based on above assessments in step 2a, it is concluded that both the two alternatives have no technology barriers, acceptability barriers and financial barriers.

Outcome of Step 2

There are still two alternative scenarios (1(a) and 3(ii)) remaining. Therefore, both alternatives come to Step 3.

Step 3: Investment analysis

The purpose of this step is to compare both the alternatives 1 (a) Implementation of the project activity without the benefits of VCS; and 3 (i) coal fired boilers in the boiler houses, supplying several buildings through a small heat distribution network to determine which one is economic attractive.

The levelized cost of heat (LCOH, RMB/GJ) is used as a financial indicator in the investment analysis for all alternatives according to the Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)/54/.

Via checking the calculation formula and calculation process of the value of LCOH in the calculation sheet/3/, CTI confirmed that the formula and inputs values are correct and actual by checking the FSR/5/, "Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City"/29/ and Economic Evaluation Method and Parameter of Construction Projects version 03/33/, thus CTI verified that the calculation results of the LCOH for both alternatives are correct.

The data for investment analysis is listed as below table to calculate LCOH. The assessment is listed as below,

Item	Value		VVB assessment
	Proposed project	Alternative baseline	
Investment expenditures (10,000 RMB)	68,698.00	19,974.00	The data source of project value is FSR/5/ and data source of baseline value is Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/ which are confirmed by CTI as correct and reasonable. For baseline, the value of investment in boiler

			house per m ² has been provided in the research and the final value is determined as area size multiply with unit value which is verified as reasonable.
O&M Cost (10,000 RMB/year)	6,156.00	3,635.27	The data source of project value is FSR/5/ and data source of baseline value is Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/ which are confirmed by CTI as correct and reasonable. For baseline, the value of O&M Cost in boiler house per m ² has been provided in the research and the final value is determined as area size multiply with unit value which is verified as reasonable.
Fuel expenditure (10,000 RMB/year)	0	1,914.13	There is no Fuel expenditure in project scenario due to the project use clean energy and the baseline value is from Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/ which are confirmed by CTI as correct and reasonable. For baseline, the value of coal price and coal consumption in boiler house per day has been provided in the research and the final value is determined as coal price multiply with coal consumption and multiply with days for heating which is verified as reasonable.
Residual value (10,000 RMB)	3,434.90	998.7	Residual value rate is 5% which is derived from FSR/5/, and the value is calculated by 5% multiply with investment which is confirmed in line with Economic Evaluation Method and Parameter of Construction Projects version 03/33/.
Annual heat supply (GJ)	5,177,260.80	5,177,260.80	The value is calculated based on the Heat supply space and Installation Capacity which has been clearly calculated in the LCOH calculation sheet/3/ which is verified by CTI as correct.
Discount rate	8%	8%	Discount rate is 8% which is derived from FSR/6/, and confirmed in line with Economic Evaluation Method and Parameter of Construction Projects version 03/33/.
Project lifetime	10 years	10 years	The lifetime of the project is defined as 10 years checked from the Technical agreement and Operating Instruction of Geothermal Space Heating System/11/

By comparing with the results, CTI confirmed that the levelized cost of alternative 3 (i) is the lowest.

Furthermore, a sensitivity analysis has been provided in the Joint-PD-MR and the calculation sheet/4/. The analysis is assessed as follow,

The sensitivity analysis was demonstrated through two manners:

1. Varying $\pm 10\%$ of three critical parameters (Investment expenditures, O&M cost and Total heat supply). The selection is checked as in line with the requirements in Investment analysis (version 11.0)/58/ of “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”, the Investment expenditures and Total heat supply are checked as constitutes more than 20% of total project costs. The total O&M throughout the project lifetime is checked as accounts for more than 20% of the project cost.

Via checking the sensitivity analysis for these three critical parameters as provided in Joint-PD-MR and the calculation sheet/3/, CTI verified that the LCOH values for Alternative baseline (3 (i)) are all lower than the Proposed project (1 (a)) by varying $\pm 10\%$ of three critical parameters.

2. Threshold analysis by varying the above three parameters to make the LCOH values for Proposed project (1 (a)) more economical attractive than Alternative baseline (3 (i)). The threshold analysis of each parameter is assessed individually by the validation team as below,
 - a) If the investment expenditure decreases by 77.90%, the project becomes economical attractive, however, via checking the price index of investment in fixed asset for Henan Province/40/, CTI confirmed that the price index was rising since 2015 to 2019. Therefore, it is not likely to implement the project activity with the investment expenditure reducing by 77.90% to make the project becomes economical attractive.
 - b) If the O&M Costs decrease by 110.00%, the project becomes economical attractive, however, via checking the FSR/5/, CTI confirmed that O&M costs mainly consist of salary for the employees, management fee etc. and via checking the average monthly salary level in Henan Province, CTI confirmed that the average monthly salary keeps increasing since 2015 to 2019. Therefore, it is not likely to implement the project activity with the O&M cost reducing by 110.00% to make the project becomes economical attractive.
 - c) If the Total Heat Supply decreases by 83.80%, the project becomes economical attractive, however, via checking the FSR/5/, CTI confirmed that the capacity load of the geothermal system is fixed, and the heating supply areas are also fixed, thus there is no possible for the project geothermal system to supply 83.80% more than its installed capacity. Therefore, it is not likely to implement the project activity with the total heat supply increasing by 83.80% to make the project becomes economical attractive.

In conclusion, the investment analysis concludes that the project activity is unlikely to be financially attractive. Threshold analysis is also used in sensitivity analysis. The sensitivity analysis was reproduced by the validation team and evaluated to be correct. Based above, it can confirm that the financial unattractiveness of the project is robust and thus the Alternative 3(i) is the most economically attractive option and plausible baseline scenario.

Hence the lowest levelized cost of provided heat (alternative 3 (i)) is considered as baseline scenario which is coal fired boilers in boiler houses, supplying several buildings through a heat distribution network.

Based on the checking the data provided in Joint-PD-MR and above related assessment, it proves that the baseline scenario determined in the section B.4 of the Joint-PD-MR is correct and reasonable. Therefore, baseline scenario is identified transparently for the project activity.

The assessment team has reviewed the Joint-PD-MR in line with the applied methodology and methodological tool and CTI confirmed that PP has correctly identified the baseline scenario.

CL 04 and CAR 06 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.5 Additionality

By means of comparison of the Joint-PD-MR with "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0)/54/, the validation team has assessed the additionality demonstration in accordance with applicable methodology and tool.

Step 1-3 of the tool were already done in section B.4 of this Joint-PD-MR for selection of alternative 1 (a) and 3 (i) as assessed in above section 3.3.4.

Then for the demonstration of additionality, the below step is assessed,

Step 4 Common practice analysis

The common practice analysis was checked strictly followed Methodological tool "Common practice" (Version 03.1)/57/.

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

The applicable capacity or output of Project is heating load of 399.48 MW, so the range will be projects with heating load between 199.74 MW-599.22 MW are considered as similar projects.

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

- (a) The projects are located in the applicable geographical area,
- (b) The projects apply the same measure as the proposed project activity,
- (c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity,
- (d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant,
- (e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1,

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

Demonstration as follow,

- (a) The region selected for common practice of Henan Province is assessed as appropriate and reasonable. A province is the second administrative level of China after central Government and it is authorized to execute administrative examination and approval for construction projects considering local regulations based on local expertise of the validation team; also by considering differences of economic development level, population size, industrial structure, fundamental infrastructure, strategic planning etc, the investment environment of each province, and unique geological conditions in Henan Province results in the different geothermal resource, thus region selected for common practice is Henan Province.
- (b) Same measure is defined as: Geothermal based space heating system
- (c) Same energy source/fuel and feedstock: Geothermal energy should be used in cascade levels. The heat exchanger medium can be water or air,
- (d) Geothermal based space heating system technology,
- (e) Out range: i. heating load between 199.74 MW-599.22 MW
- (f) Commercial operation started before 01-November-2020.

Thus, the projects operated before 01-November-2020 deliver the output or capacity as calculated in step 1 (range of 199.74 MW-599.22 MW) uses geothermal based space heating system in Henan Province are determined similar projects.

The information source UNFCCC website/69/, China CDM website/69/, China CER exchange info-platform/67/, GS website/68/, VCS/70/ and local DRC (Development and Reform Commission) of Henan province website/50/ for the common practice analysis is available and checked by the validation team. The information used is evaluated to be credible.

Via the source, CTI confirmed that there are no similar projects identified in Henan Province based on the above criteria.

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

There are no similar projects identified in Henan Province.

Hence $N_{all}=0$.

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

Due to $N_{all}=0$, $N_{all}=N_{diff}=0$.

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.

For this project, $F=1-N_{diff}/N_{all}=1-1=0$ and $N_{all}-N_{diff}=0$.

It can be concluded that the project is not a common practice.

In conclusion, the project meets the criteria and tool “Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)”, thus deemed as additional.

CAR 07 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.6 Quantification of GHG Emission Reductions and Removals

For validation of the estimated GHG emission reductions in the Joint-PD-MR/1/ and ER calculation sheet/2/,

Further, the VVB has downloaded from the UNFCCC website the applicable version of the CDM methodology,

Via verify the Joint-PD-MR/1/, it is confirmed the calculation of ERs is done as per the applied methodology (AM0072 ver. 03.0) with follow steps listed below.

Baseline emissions

Via checking the paragraph 39 of the applied methodology, there are three possibilities for the baseline as follows:

- (a) Baseline scenario is identified as a fossil fuel based centralized heat supply system, different than cogeneration, using a single decentralized heat supply fossil fuel technology;
- (b) The baseline scenario, is a fossil fuel based decentralized heat supply system with multiple technologies (of type i), the baseline emissions are specified as the summation over the technology suffix i;
- (c) The baseline scenario is identified as a combination of the two following alternatives:
 - (i) Fossil fuel based centralized heat supply systems, different than cogeneration, using a single decentralized heat supply fossil fuel technology (as described in baseline scenario a above); and
 - (ii) Existing geothermal centralized heat supply systems.

As above assessment of the baseline scenario of the project, CTI confirmed that the baseline scenario is the establishment of new isolated district heating networks using isolated coal-fired boilers in boiler houses, which falls into (a) of the above categories, and the baseline emissions BE_y in a year y are calculated as:

$$BE_y = \sum_i (HS_{i,y}^{BL}) \times EF_{CO2,i} / \eta_{BL,i} \quad (1)$$

Where:

BE_y = The baseline emissions from heat displaced by the project activity during the year y (t CO₂e/yr).

$EF_{CO_2,i}$ = The CO₂ emission factor per unit of energy of the fuel of technology i that would have been used in the baseline heating technology in (t CO₂/TJ). Where several fuel types are used in the boiler, use the fuel type with the lowest CO₂ emission factor.

$\eta_{BL,i}$ = The net thermal efficiency of the heating technology i using fossil fuel that would have been used in the absence of the project activity.

$HS^{BL}_{i,y}$ = The net output of heat generated by the baseline heat supply system using the technology i measured at the end point of the heat facility, during the year y (TJ/yr).

Relationship between the baseline scenario and the project activity

The relationship between the baseline scenario and the project activity that the heat demand at the end-use points is the same. For project activities that involve new heating systems:

$$HS_y - Loss_y^{PJ} = \sum_i HS^{BL}_{i,y} - Loss_y^{BL} \quad (2)$$

Where:

HS_y = Net quantity of heat supplied by the geothermal heat resource(s) in the project activity, during the year y (TJ/yr).

$Loss_y^{PJ}$ = The net distribution losses of the geothermal heat supply system during the year y (TJ/yr).

$Loss_y^{BL}$ = The net distribution losses of the heat supply system, in the absence of project activity, during the year y (TJ/yr).

Procedure to determine the heat generated by technology i ($HS^{BL}_{i,y}$)

$$HS^{BL}_{i,y} = w_i \times (HS_y - Loss_y^{PJ} + Loss_y^{BL}) \quad (3)$$

Where:

$HS^{BL}_{i,y}$ = The net output of heat generated by the baseline heat supply system using the technology i measured at the end point of the heat facility, during the year y (TJ/yr).

w_i = Assign weights for heat generated by technology i . As per section 4.1 of the Joint-PD-MR, the baseline scenario of the project is 3(i) "Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network". Only one technology will be used. According to *Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City*, the heating in winter of Residential buildings were supplied by coal fired boilers in suburb of Zhoukou City. As per paragraph 51(a)(ii) option 2 Assign weights based on available historical records of AM0072 (Version 03.0), w_i is equal to 1.

HS_y = Net quantity of heat supplied by the geothermal heat resource(s) in the project activity, during the year y (TJ/yr).

$Loss^{PJ}_y$ = The net distribution losses of the geothermal heat supply system during the year y (TJ/yr).

$Loss^{BL}_y$ = The net distribution losses of the heat supply system, in the absence of project activity, during the year y (TJ/yr).

The parameters used for calculating baseline emissions can be grouped as ex ante measurement and ex post measurement categories.

Ex ante measurement parameters

(a) $\eta_{BL,i}$;

(b) $EF_{CO2,i}$;

(c) $Loss^{BL}_y$.

Ex post measurement parameters

(a) HS_y ;

(b) $Loss^{PJ}_y$.

Following the applied methodology,

Step 1: Determine the baseline ex ante parameters of the project

Sub-step 1.a: For each identified technology i , efficiency of the baseline units shall be determined by adopting one of the following criteria:

The net thermal efficiency of the fossil fuel technology i ($\eta_{BL,i}$) remains fixed for the duration of the crediting period.

Project participants will determine $\eta_{BL,i}$ based on historical data of fuel consumption and output energy.

In the case that actual baseline data for a boiler at the project activity site is not available, the data in the applied methodology can be used (from highest to lowest priority), which has been assessed by CTI as below,

(a) Via site inspection and checking the FSR/5/, CTI confirmed that the boilers do not actually exist but would only exist in the assumed baseline scenario. This option is not applicable.

(b) Via checking the FSR/5/, Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/, CTI confirmed that other boilers used by the buildings in Zhoukou City were old boilers but the boilers used in the baseline of the proposed project would be new boilers. The efficiency of old boiler is lower than the efficiency of new boiler. Thus, it is not

reasonable to use the measured efficiency (low value) of old boiler instead of the efficiency (high) of new boiler in the calculation of the baseline emission, which is not conservative. This option is not applicable.

(c) Three manufacturers of coal-fired boiler/71/ were checked by CTI, and the efficiencies of their products are from 79% to 85%. Thus, the highest efficiency value provided by the three manufacturers is 85%.

(d) As per Table 4 Default baseline efficiency for different boilers of AM0072 (Version 03.0), CTI confirmed that the highest value of 85% for new coal-fired boiler is applicable for the proposed project.

Therefore, the $\eta_{BL,i}$ is determined as 85%.

Sub-step 1.b: Fossil fuel emission factors for each identified technology i , shall be determined using the following guidelines for data sources

Via checking the Table 5 Data source for fossil fuel emission factors for each identified technology in applied AM0072 (Version 03.0)/53/, CTI confirmed that Data source (a) and (b) are unavailable due to the boilers are not actually existing and there is no fuel supplier for the baseline coal-fired boilers which has been demonstrated in above section. Data source (c) is used for liquid fuels. Therefore, only data source (d) IPCC default values (87.3 tCO₂/TJ for coking coal) at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) of 2006 IPCC Guidelines on National GHG Inventories/52/ can be used as the data source.

Sub-step 1.c: Baseline Losses ($Loss^{BL}_{i,y}$) for each identified technology i shall be determined using the following guidelines

As per the methodology, Option 1 A conservative value of 0% of loss can be used due to historic information of baseline is not available.

Step 2: Determine the baseline ex post parameters of the project

Sub-step 2.a: Estimate net quantity of heat supplied by the geothermal heat resource in the project activity

The net quantity of heat supplied by the project activity is estimated based on the heat provided by the geothermal well. It considers flow rates, temperature and usage time for each geothermal well to be considered by the project activity.

$$HS_y = \min\{H_{CAP}, HS_{y,estimated}\} \quad (4)$$

$HS_{y,estimated}$ can be determined by the use of the flow and temperature of water supplied by the substation heat exchanger k to the demand side space heating.

$$HS_{y,estimated} = \sum_j (Q_{j,d,y} \times T_j \times CF) \quad (5)$$

Where:

$HS_{y,esti}$ = Estimated quantity of heat supplied by the geothermal heat resource(s) in the project

ated activity, during the year y (TJ)

$Q_{j,d,y}$ = Heat supplied at the downstream of heat exchanger (upstream of which is connected with water supply from the geothermal well j) (GW). It can be calculated as formula (7).

T_j = Number of hours per year heat utilization at well j.

CF = Conversion factor from GWh to TJ (3.6).

$$Q_{j,d,y} = \frac{FR_{j,d,y} \times \Delta t_{j,d,y} \times 4.18}{3.6} \times 10^{-9} \quad (6)$$

Where:

$FR_{j,d,y}$ = Average flow rate at the downstream of heat exchanger (upstream of which is connected with water supply from the geothermal well j) in year y (kg/hr).

$\Delta t_{j,d,y}$ = Heat supplied at the downstream of heat exchanger (upstream of which is connected with water supply from the geothermal well j) (°C).

To ensure that the geothermal well is providing the required amount of energy a cap is defined. The basis to define the cap is from the space heating design, which considers the net heating area, the heating index, the type of construction that will utilize the heat and the time used throughout the year for each construction type.

$$H_{CAP} = (\sum_m A_m \times HI_m \times T_j) \times CF + Loss_y^{PJ} - H_{ff} \quad (7)$$

Where:

H_{CAP} = The net quantity of heat supplied by the geothermal heat resource(s) in the project activity, during the year y (TJ).

A_m = Net heating area for construction type m (m²).

HI_m = Heating index for construction type m (W/m²).

T_j = Number of hours per year heat utilization at well j.

CF = Conversion factor from GWh to TJ (3.6).

$Loss_y^{PJ}$ = Heat distribution losses from substation k to space heating areas (To be determined in Sub-step 2.b).

H_{ff} = Heat supplied by fossil fuel boiler, in case a boiler is used to meet the heat demand of network. No fossil fuel boiler is utilized in the project activity and H_{ff} is 0 TJ.

Sub-step 2.b: Project emissions losses ($Loss_y^{PJ}$)

Heat distribution losses will be obtained as the difference between the heat supplied by the geothermal heat source and the aggregated heat demand of the end-use points.

$$Loss_y^{PJ} = HS_y - HD_y \quad (8)$$

Where:

HD_y = Aggregate space heat demand within the area of supplied heat (TJ).

It is not possible to determine HD_y , the heat losses ($Loss_y^{PJ}$) are determined based on heat losses from pipeline, valves, fittings based on maximum of option (a) 10% design heat losses provided by the engineering specifications of the manufacturer of the heat network.

Hence,

$$Loss_y^{PJ} = \sum_m 10\% \times A_m \times Hl_m \times T_j \times CF \times 10^{-9} \quad (9)$$

Step 3: Calculate baseline emissions from heat produced

Baseline emissions from displacement of fossil fuels are calculated as follows:

$$BE_y = \sum_i (HS_{i,y}^{BL} \times EF_{CO2,i} / \eta_{BL,i}) \quad (10)$$

Project Emissions

As per AM0072/53/, Project emissions are calculated taking into consideration fugitive carbon dioxide and methane released from geothermal vents (PE_{FE}), electricity consumption from the use the pumps to extract the geothermal water (PE_{EC}) and fossil fuel used to operate the geothermal facility (PE_{FF}).

$$PE_y = PE_{FE,y} + PE_{EC,y} + PE_{FF,y} \quad (11)$$

Step 1: Calculate project emissions from fugitive emissions resulting from non-condensable gases from the geothermal vents during the year y

The geothermal system of the proposed project is designed to operate by extracting geothermal water at approximately 75 °C, which is considered as a low-temperature system. Via the paragraph 84 of AM0072 (Version 03.0)/53/, fugitive emissions from low temperature geothermal system is considered negligible. Therefore, $PE_{FE,y} = 0$ tCO₂.

Step 2: Calculate project emissions from additional electricity consumption as a result of the project activity

Project emissions from electricity consumption (PE_{EC}) used to pump geothermal water and operate the geothermal facility shall be calculated using *Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation* (Version 03.0)/55/. Electricity consumption from each relevant source should be monitored and summed up to EC_y .

As per the tool/55/, project emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (12)$$

Where:

- $PE_{EC,y}$ = Project emissions from electricity consumption in year y (t CO₂/yr).
- $EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr).
- $EF_{EL,j,y}$ = Emission factor for electricity generation for source j in year y (t CO₂/MWh).
- $TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y.

Via checking the Agreement of Electricity Charges/14/, CTI confirmed that the electricity consumed by facilities of the geothermal system is sourced from local power grid connected to Central China Power Grid (CCPG). Hence, scenario A: Electricity consumption from the grid is applied to the proposed project. For project electricity consumption sources, a default value of 20% is used for $TDL_{j,y}$.

Determination of the emission factor for electricity generation ($EF_{EL,j,y}$)

The determination of the emission factor for generation is performed as per Option A1: Calculate the combined margin emission factor of the applicable electricity system using *Tool to calculate the emission factor for an electricity system* (Version 07.0)/56/. $EF_{EL,j,y} = EF_{grid,CM,y}$. While based on the tool/56/, $EF_{grid,CM,y}$ is calculated as below,

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times \omega_{OM} + EF_{grid,BM,y} \times \omega_{BM} \quad (13)$$

Where:

- $EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y, tCO₂/MWh. As per *2019 China regional power grid carbon dioxide baseline emission factor OM calculation instructions* published by Ministry of Ecology and Environment of the People's Republic of China on 29-December-2020/27/ which is verified by VVB as the latest available version by searching the China DNA website <https://www.mee.gov.cn/>, for CCPG, $EF_{grid,OM,y} = 0.8587$ tCO₂/MWh.
- $EF_{grid,BM,y}$ = Building margin CO₂ emission factor in year y, tCO₂/MWh. As per *2019 China regional power grid carbon dioxide baseline emission factor BM calculation instructions* published by Ministry of Ecology and Environment of the People's Republic of China on 29-December-2020/29/ which is verified by VVB as the latest available version by searching the China DNA website <https://www.mee.gov.cn/>, for CCPG, $EF_{grid,BM,y} = 0.2854$ tCO₂/MWh.

ω_{OM} = Weighting of operating margin emissions factor. As per paragraph 86(b) of *Tool 07* (Version 07.0), $\omega_{OM}=0.5$ is used for the 1st crediting period.

ω_{BM} = Weighting of build margin emissions factor. As per paragraph 86(b) of *Tool 07* (Version 07.0), $\omega_{BM}=0.5$ is used for the 1st crediting period.

Based on above, $EF_{grid,CM,y}$ can be calculated as $0.8587 \text{ tCO}_2/\text{MWh} \times 0.5 + 0.2854 \text{ tCO}_2/\text{MWh} \times 0.5 = 0.5721 \text{ tCO}_2/\text{MWh}$.

Step 3: Calculate project emissions from fossil fuel consumed as a direct result of the operations of the project activity

Via site inspection and checking the FSR/5/, CTI confirmed that no fossil fuel will be used to operate the geothermal facilities. Therefore, $PE_{FF,y}=0 \text{ tCO}_2$.

Leakage

No leakage emissions have been identified for the project activity by checking the applied methodology and site inspection of the project implementation. Therefore, $LE_y=0 \text{ tCO}_2$

Emission reductions:

$$ER_y = BE_y - PE_y - LE_y \quad (14)$$

Where:

ER_y Emission reductions in year y (t CO₂e/yr).

BE_y Baseline emissions in year y (t CO₂e/yr).

PE_y Project emissions in year y (t CO₂/yr).

LE_y Leakage emissions in year y (t CO₂/yr)

Ex ante calculation of emission reductions

For Baseline Emission calculation, based on above assessment, the baseline emissions can be calculated as follows:

$$BE_y = \sum_i (HS_{i,y}^{BL}) \times EF_{CO_2,i} / \eta_{BL,i} \quad (15)$$

Where:

- $EF_{CO_2,i}$ = The CO₂ emission factor per unit of energy of the fuel of technology i that would have been used in the baseline heating technology in (t CO₂/TJ). Where several fuel types are used in the boiler, use the fuel type with the lowest CO₂ emission factor. Values provided by the fuel supplier are unavailable. IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) of 2006 IPCC Guidelines on National GHG Inventories are used. For coking coal, it is 87.3 tCO₂/TJ.
- $\eta_{BL,i}$ = The net thermal efficiency of the heating technology i using fossil fuel that would have been used in the absence of the project activity. The highest efficiency of coal-fired boilers provided by Zozen Boilers (79%), Fengcheng Energy Equipment Factory (80%) and Henan Hengxin Boiler Manufacturing Co., Ltd (85%). As per Table 4 Default baseline efficiency for different boilers of AM0072 (Version 03.0), the highest value of 85% for new coal-fired boiler is applicable for the proposed project. In summary, the efficiency of 85% is applied for the proposed project.

Relationship between the baseline scenario and the project activity

$$HS_y - Loss_y^{PJ} = \sum_i HS_{i,y}^{BL} - Loss_y^{BL} \quad (16)$$

Procedure to determine the heat generated by technology i ($HS_{i,y}^{BL}$)

$$HS_{i,y}^{BL} = w_i \times (HS_y - Loss_y^{PJ} + Loss_y^{BL}) \quad (17)$$

Where:

- w_i = Assign weights for heat generated by technology i . As per section B.4 of this Joint-PD-MR, the baseline scenario of the project is 3(i) "Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network". Only one technology will be used. According to *Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City*, the heating in winter of Residential buildings were supplied by coal fired boilers in suburb of Zhoukou City. As per paragraph 51(a)(ii) option 2 Assign weights based on available historical records of AM0072 (Version 03.0), w_i is equal to 1.
- $Loss_y^{BL}$ = The net distribution losses of the heat supply system, in the absence of project activity, during the year y (TJ/yr). Option 1 A conservative value of 0% of loss is used as historic information is not available.

Estimate net quantity of heat supplied by the geothermal heat resource in the project activity

$$HS_y = \min\{H_{CAP}, HS_{y,estimated}\} \quad (17)$$

$$HS_{y,estimated} = \sum_j (Q_{j,d,y} \times T_j \times CF) \quad (18)$$

$$Q_{j,d,y} = \frac{FR_{j,d,y} \times \Delta t_{j,d,y} \times 4.18}{3.6} \times 10^{-9} \quad (19)$$

Where:

T_j = Number of hours per year heat utilization at well j . As per *Research on Heating in Winter of Zhoukou City* published by Housing and Urban-Rural Development Department of Zhoukou City, winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year (150 days). Therefore, T_j can be calculated as $150 \times 24 = 3,600$ h.

CF = Conversion factor from GWh to TJ (3.6).

For ex-ante calculation, based on the values from FSR/5/ which has been checked by CTI, CTI confirmed that the $HS_{y,estimated}$ is calculated as 6,257 TJ for ex ante estimation.

While for H_{CAP} , it is calculated as below,

$$H_{CAP} = \left(\sum_m A_m \times HI_m \times T_j \right) \times CF + Loss_y^{PJ} - H_{ff} \quad (20)$$

$$Loss_y^{PJ} = \sum_m 10\% \times A_m \times HI_m \times T_j \times CF \times 10^{-9} \quad (21)$$

Where:

A_m = Net heating area for construction type m (m^2). Heating area of residential buildings is 7,989.6 thousand m^2 .

HI_m = Heating index for construction type m (W/m^2). As per the FSR/5/, HI_m is 50 W/m^2 for residential buildings.

T_j = Number of hours per year heat utilization at well j . As per *Research on Heating in Winter of Zhoukou City* published by Housing and Urban-Rural Development Department of Zhoukou City, winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year (150 days). Therefore, T_j can be calculated as $150 \times 24 = 3,600$ h.

CF = Conversion factor from GWh to TJ (3.6).

H_{ff} = Heat supplied by fossil fuel boiler, in case a boiler is used to meet the heat demand of network. There are no fossil fuel boilers used to meet the heat demand of the project heating network. Therefore, $H_{ff} = 0$ TJ.

Hence, based on the above assessment of ex-ante determined values and checking the Joint-PD-MR and ER sheet, CTI confirmed that H_{CAP} is 5,695 TJ and HS_y is finally determined as 5,601.82 TJ.

Thus the baseline emissions from heat produced is calculated as below table, and the results are re-produced by validation team and verified as correct.

Year	1	2	3	4	5	6	7	8	9	10
HS_y (TJ)	5,601.82	5,601.82	5,601.82	5,601.82	5,601.82	5,601.82	5,601.82	5,601.82	5,601.82	5,601.82
$Loss^{PJ}_y$ (TJ)	517.73	517.73	517.73	517.73	517.73	517.73	517.73	517.73	517.73	517.73
$Loss^{BL}_y$ (TJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$HS^{BL}_{i,y}$ (TJ)	5,084.10	5,084.10	5,084.10	5,084.10	5,084.10	5,084.10	5,084.10	5,084.10	5,084.10	5,084.10
BE_y (tCO _{2e} /yr)	522,166	522,166	522,166	522,166	522,166	522,166	522,166	522,166	522,166	522,166

Project Emissions

Based on above assessment,

$$PE_y = PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (22)$$

For the value of $EC_{PJ,j,y}$, the ex-ante estimation is 39,149.04MWh which is confirmed as reasonable by checking the FSR/5/. And the actual value will be monitored during the verification process.

Thus the project emissions is calculated as below table, and the results are re-produced by validation team and verified as correct.

Year	1	2	3	4	5	6	7	8	9	10
$EC_{PJ,j,y}$ (kWh)	39,149,040	39,149,040	39,149,040	39,149,040	39,149,040	39,149,040	39,149,040	39,149,040	39,149,040	39,149,040
$EC_{PJ,j,y}$ (MWh)	39,149	39,149	39,149	39,149	39,149	39,149	39,149	39,149	39,149	39,149
$EF_{EL,j,y}$ (tCO ₂ /MWh)	0.5721	0.5721	0.5721	0.5721	0.5721	0.5721	0.5721	0.5721	0.5721	0.5721
$(1 + TDL_{j,y})$	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
$PE_{EC,y}$ (tCO _{2e} /yr)	26,877	26,877	26,877	26,877	26,877	26,877	26,877	26,877	26,877	26,877

Leakage

Based on above assessment, for the project, $LE_y=0$ tCO₂.

Emission reductions

$$ER_y = BE_y - PE_y - LE_y = BE_y - PE_y$$

Year	1	2	3	4	5	6	7	8	9	10
BE_y (tCO _{2e})	522,1 66	522,1 66	522,1 66	522,1 66	522,1 66	522,1 66	522,1 66	522,1 66	522,1 66	522,1 66
PE_y (tCO _{2e})	26,87 7	26,87 7	26,87 7	26,87 7	26,87 7	26,87 7	26,87 7	26,87 7	26,87 7	26,87 7
ER_y (tCO _{2e})	495,2 89	495,2 89	495,2 89	495,2 89	495,2 89	495,2 89	495,2 89	495,2 89	495,2 89	495,2 89

Based on the above assessment of the ex-ante determined values, it is verified that **the annual ex ante determined ERs calculated result is 495,289 tCO₂/yr.**

In conclusion, based on above values for each parameter for determine the ex-ante of emission reduction calculation, the CTI verified that results in Joint-PD-MR are correct for the ex-ante ER values during the fixed 10 years crediting period.

The ER calculation sheet/2/ has been duly checked. Further it has been checked whether the results have been correctly calculated in Joint-PD-MR for determination of ex-ante ER. The VVB has further checked the Joint-PD-MR against the latest version of the applicable methodology for consistency.

CAR 08 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.7 Methodology Deviations

There are no any methodology deviations applied to the project.

3.4.8 Monitoring Plan

1. Data and parameters available at validation

Please refer to the following tables for assessment of each parameter determined ex-ante only used to calculate the ex-ante emission reduction:

$EF_{CO_2,i}$	<i>The CO₂ emission factor per unit of energy of the fuel of technology i that would have been used in the baseline heating technology</i>
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes

Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The source is Option (d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) of 2006 IPCC Guidelines on National GHG Inventories/52/ is used as per Table 5 of the applied methodology AM0072 (Version 03.0).
Correct value provided?	Yes –87.3 tCO ₂ /TJ Derived from IPCC/52/
Has this value been verified?	Confirmed as correct for ex ante determination. Via checking the Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/, CTI confirmed that several fuel types are used in the boiler including bituminous coal, coking coal and sub-bituminous coal, and via the IPCC, CTI verified that fuel type with the lowest CO ₂ emission factor has been used. CO ₂ emission factor of other bituminous coal and sub-bituminous coal are 89.5 tCO ₂ /TJ and 92.8 tCO ₂ /TJ separately, which are higher than that of coking coal. Hence, it is reasonable and conservative that the fuel type used in the boiler only include coking coal for the ER calculation.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$\eta_{BL,i}$	<i>Net thermal efficiency of the boiler technology i using fossil fuel that would have been used in the absence of the project activity</i>
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The source is determined following the guidance given in the applied methodology AM0072 (Version 03.0)/53/. Three manufacturers of coal-fired boiler/71/ were checked by CTI, and the efficiencies of their products are from 79% to 85%. Thus, the highest efficiency value provided by the three manufacturers is 85%. As per Table 4 Default baseline efficiency for different boilers of AM0072 (Version 03.0), CTI confirmed that the highest value of 85% for new coal-fired boiler is applicable for the proposed project. Therefore, the $\eta_{BL,i}$ is determined as 85%.
Correct value provided?	Yes –85%
Has this value been verified?	Yes. Confirmed as correct for ex ante determination, data source of manufacturers of coal-fired boiler/71/ is verified and default baseline efficiency for different boilers of AM0072 (Version 03.0) is compared.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$Loss^{BL}_{i,y}$	<i>The net distribution losses of the heat supply system, in the absence of project activity, during the year y.</i>
Title in line with Methodology?	Yes

Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The historical information is not available, a conservative value of 0% of losses can be used as per paragraph 66 option 1 of AM0072 (Version 03.0)/53/.
Correct value provided?	Yes – 0 TJ/yr
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied methodology/31/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

Subscript i	Type of technology used in the baseline scenario.
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The source is FSR/5/. Heat supply system using coal-fired boilers is identified as the baseline scenario of the proposed project activity
Correct value provided?	Yes – Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network
Has this value been verified?	Yes. Confirmed as correct for ex ante determination. The baseline scenario is verified as reasonable which has been assessed in the section 3.4.4 of this report
Choice of data correctly justified?	Yes.
Measurement method correctly described?	N/A

Subscript j	Geothermal well number
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The source is FSR/5/. The value of total of 66 geothermal wells including 44 production wells and 22 re-injection wells in the boundary of the proposed project activity is derived from FSR which is verified as actual by site inspection.
Correct value provided?	Yes - 1 to 66
Has this value been verified?	Yes. Confirmed as correct for ex ante determination. The FSR/5/ is checked and confirmed by site visit.
Choice of data correctly justified?	Yes.
Measurement method correctly described?	N/A

Subscript m	Space heating construction type
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The source is FSR/5/. The space heating construction type of the proposed project activity only involves residential space heat derived from FSR which is verified as actual by site inspection.
Correct value provided?	Yes – Residential

Has this value been verified?	Yes. Confirmed as correct for ex ante determination. The FSR/5/ is checked and confirmed by site visit.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

Subscript k	Sub-station number
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The source is FSR/5/. The value of total of 44 sub-stations in the boundary of the proposed project activity is derived from FSR which is verified as actual by site inspection through unique identification code and GPS coordinates.
Correct value provided?	Yes – 1 to 44
Has this value been verified?	Yes. Confirmed as correct for ex ante determination. The FSR/5/ is checked and confirmed by site visit through unique identification code and GPS coordinates.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

Loss^{PJ}_y	Net distribution loss of the geothermal heat supply system during the year y.
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The value is calculated based on design heat losses from heat network manufacturer per the methodology formular $Loss_{y}^{PJ} = \sum_m 10\% \times A_m \times Hl_m \times T_j \times CF \times 10^{-9}$
Correct value provided?	Yes – Refer to ER calculation sheet/2/ for more details
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied methodology/53/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

W_i	Heat generation ratio for baseline heating technology i
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The value is derived from Paragraph 51(a)(ii) option 2 Assign weights based on available historical records of AM0072 (Version 03.0)/53/ As assessed above, baseline scenario of the project is 3(i) “Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network”. Only one technology would be used. Via checking the Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development

	Department of Zhoukou City/29/, CTI confirmed that the heating in winter of Residential buildings were supplied by coal fired boilers in Zhoukou City. As per paragraph 51(a)(ii) option 2 Assign weights based on available historical records of AM0072 (Version 03.0), w_i is equal to 1
Correct value provided?	Yes – 1
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied methodology/53/ and verified by Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

H_{ff}	<i>Heat supplied by fossil fuel boiler; in case a boiler is used to meet the heat demand of network</i>
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	There are no fossil fuel boilers used to meet the heat demand of the project heating network derived from on-site metering of heat (e.g. flow of steam/hot water multiplied by enthalpy) at the outlet of the boiler which is verified as actual by site inspection.
Correct value provided?	Yes – 0 TJ
Has this value been verified?	Yes. Confirmed as correct for ex ante determination. No fossil fuel boilers used to meet the heat demand of the project heating network is confirmed by site visit of metering of heat installed at the outlet of the boiler.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

CL 05 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

2. Data and Parameters Monitored

The monitoring parameters required by the methodology and applicable tools for the project are summarized in the below table.

$\Delta t_{j,d,y}$	<i>Average temperature difference between inlet and outlet temperatures at the downstream of each heat exchanger in year y</i>
Title in line with Methodology?	Yes
Ex-ante Value	66° C
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes-It will be monitored by ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger and the ex-ante value is estimated as 66° C derived from FSR/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - Temperatures to be monitored at inlet and outlet points at downstream of each heat exchanger j, the temperature readings

	should be taken at immediate inlet and outlet point of heat exchanger.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –Via site inspection of the monitoring device, CTI confirmed that the ultrasonic calorimeters have been installed accordingly and the monitoring will be conducted as per the request in the Joint-PD-MR which in compliance with the applied methodology.
Monitoring frequency correctly described?	Measured Hourly/ Recording Monthly - verified as per the applied methodology
Monitoring equipment correctly described?	Ultrasonic calorimeters - verified as per the applied methodology
QA/QC procedure correctly described?	Yes - Calibration of the ultrasonic calorimeters will be done according to national standard JJG 225-2001 Verification Regulation of Heat Meters/31/ by qualified organizations.
Purpose of data?	BE calculation

$FR_{i,d,y}$	<i>Average flow rate at the downstream of each heat exchanger (upstream of which is connected with water supply from the geothermal well j) in year y</i>
Title in line with Methodology?	Yes
Ex-ante Value	150,000 kg/h
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes - It will be monitored by ultrasonic calorimeters installed at downstream of each heat exchanger and the ex-ante value is derived from FSR/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - Flow rate to be monitored at downstream of each heat exchanger, the flow readings taken from ultrasonic calorimeters.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –Via site inspection of the monitoring device, CTI confirmed that the ultrasonic calorimeters have been installed accordingly and the monitoring will be conducted as per the request in the Joint-PD-MR which in compliance with the applied methodology.
Monitoring frequency correctly described?	Measured Hourly/ Recording Monthly - verified as per the applied methodology
Monitoring equipment correctly described?	Ultrasonic calorimeters - verified as per the applied methodology
QA/QC procedure correctly described?	Yes - Calibration of the ultrasonic calorimeters will be done according to national standard JJG 225-2001 Verification Regulation of Heat Meters/31/ by qualified organizations.
Purpose of data?	BE calculation

T_j	<i>Hours per hear heat utilization in well j</i>
Title in line with Methodology?	Yes
Ex-ante Value	3,600 hours
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes - The value used is 3,600 hours for ex-ante determination as per the estimation of 24 hours per day for 150 days. The actual number will be monitored through the statistical data

	of the geothermal base space heating system monthly which will be derived from Operation record of the geothermal space heating system.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante determined value is derived from the Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/, winter heating season of Zhoukou City is usually from November 1 st to March 31 st of the next year (150 days as last day is not included due to the cut-off time of winter heating usually to be 24:00 of the 30 th March of each year. The last day of March usually to be the settlement day), CTI confirmed that the ex-ante determined value has been used in the Zhoukou City of the project location.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes - The actual number will be monitored through the statistical data of the geothermal base space heating system monthly which will be derived from Operation record of the geothermal space heating system.
Monitoring frequency correctly described?	Monthly - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The measured data shall be cross-checked against applicable local policy and regulation on heat supply.
Purpose of data?	BE calculation

<i>HI_m</i>	<i>Heating index for construction type m.</i>
Title in line with Methodology?	Yes
Ex-ante Value	50 W/m ² for residential buildings
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes - The values used for ex-ante determination listed in the Joint-PD-MR as per FSR/5/, which is 50 W/m ² for residential buildings.
Correct value provided?	Yes
Has this value been verified?	Yes
Choice of data correctly justified?	Yes - As per the FSR/5/, Heating index is 50 W/m ² for residential buildings used for project activity, which is confirmed in line with the requirement of CJJ 34-2010 Design Code for City Heating Network published by Ministry of Housing and Urban-Rural Development of the People's Republic of China/30/.
Measurement method correctly described?	N/A
Monitoring frequency correctly described?	N/A
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - Data to be validated by space heating experts at the project site which is in line with the applied methodology.
Purpose of data?	BE calculation

$EC_{PI,j,y} (EC_y)$	Electricity consumption for the year y in operating the geothermal heating system
Title in line with Methodology?	Yes
Ex-ante Value	39,149.04MWh
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes - It will be monitored by electricity meters installed at the geothermal well and substation and the ex-ante value is estimated as 39,149.04 MWh derived from FSR/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - Electricity consumption to be monitored at geothermal well and substation, the electricity readings taken from electricity meters. Readings will be done monthly.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes -Via site inspection of the monitoring device, CTI confirmed that the electricity meters have been installed accordingly and the monitoring will be conducted as per the request in the Joint-PD-MR which in compliance with the applied methodology.
Monitoring frequency correctly described?	Hourly - verified as per the applied methodology
Monitoring equipment correctly described?	Electricity meters - verified as per the applied methodology
QA/QC procedure correctly described?	Yes - Calibration of the electricity meters will be done according to national standard JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy/32/ by qualified organizations
Purpose of data?	PE calculation

$EF_{EL,j,y} (EF_{grid,CM,y})$	Combined margin emission factor for the grid in year y.
Title in line with Methodology?	Yes
Ex-ante Value	0.5721 tCO ₂ /MWh
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes – The value used for ex-ante determination listed in the Joint-PD-MR as per Baseline emission factors of China's regional power grid for emission reduction projects in 2019 published by Ministry of Ecology and Environment of the People's Republic of China on 29-December-2020/27/ which is verified by VVB as the latest available version by searching the China DNA website, which is 0.5721 tCO ₂ /MWh calculated by (0.8587 tCO ₂ /MWh *0.5+0.2854 tCO ₂ /MWh *0.5) due to the project imported electricity from CCPG. The actual value will be monitored according to the Tool to calculate the emission factor for an electricity system (Version 07.0)/56/.
Correct value provided?	Yes
Has this value been verified?	Yes
Choice of data correctly justified?	Yes - The $EF_{grid,CM,y}$ calculation process from data source/27/ is confirmed as in line with Tool to calculate the emission factor for an electricity system (Version 07.0)/56/.
Measurement method correctly described?	Yes
Monitoring frequency correctly described?	Yes - Once each monitoring period

Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The data of CCPG's $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ were taken from Baseline emission factors of China's regional power grid for emission reduction projects in 2019/27/, which are the latest version published by Ministry of Ecology and Environment of the People's Republic of China. If new version issued, the value of $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ should be updated.
Purpose of data?	PE calculation

$TDL_{j,y}$	<i>Average technical transmission and distribution losses for providing electricity to source j in year y.</i>
Title in line with Methodology?	Yes
Ex-ante Value	20%
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes -The tool of Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/55/ is checked, CTI confirmed that different values applied to different scenarios.
Correct value provided?	Yes
Has this value been verified?	Yes
Choice of data correctly justified?	Yes - Via checking the Agreement of Electricity Charges/14/, CTI confirmed that the electricity consumed by facilities of the geothermal system is sourced from local power grid connected to Central China Power Grid (CCPG). Hence, scenario A: Electricity consumption from the grid is applied to the proposed project. For project electricity consumption sources, a default value of 20% is used for $TDL_{j,y}$ in line with the tool/55/.
Measurement method correctly described?	Yes
Monitoring frequency correctly described?	Yes - Annually
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
Purpose of data?	PE calculation

A_m	<i>Net heating area for construction type m</i>
Title in line with Methodology?	Yes
Ex-ante Value	7,989.6 thousand m ²
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes -The values used for ex-ante determination listed in the Joint-PD-MR as per FSR/5/. Actual measurements will be available from heating supply contracts/9/.
Correct value provided?	Yes
Has this value been verified?	Yes
Choice of data correctly justified?	Yes - Yearly measurement
Measurement method correctly described?	Yes

Monitoring frequency correctly described?	Yes - Yearly
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The data shall be cross-checked with local development plan and operational data of the project geothermal heating system
Purpose of data?	BE calculation

3. Monitoring plan

The VVB has checked the monitoring plan of the Joint-PD-MR against the applied methodology.

The monitoring plan in the Joint-PD-MR has been designed to comply with the latest applicable version of the methodology (AM0072 version 03.0).

The validation team evaluated the feasibility and sufficiency of the monitoring plan. The key components of the monitoring plan are as follows.

Parameters to be monitored:

Listed as above table and assessed by CTI.

Monitoring framework:

The Joint-PD-MR contains a diagram illustrating the Organization Structure of the Monitoring Team to be implemented by the project owner in order to implement the project activity. The VCS monitoring team will be responsible for the monitoring of all the parameters to be monitored. And all the data will be reviewed by the project developer and VVB. The organizational structure is considered sufficient to fulfil the monitoring requirements of the methodology and to ensure that emission reductions can be verified.

Principle of Monitoring:

Listed as above table for each monitored value and assessed by VVB.

Monitoring equipment and installation:

Measurement instruments are described in the monitoring plan as subject to appropriate national standards with respect to installation, accuracy and calibration interval. Main instruments ultrasonic calorimeters and electricity meters are used to monitor $\Delta t_{j,d,y}$, $FR_{j,d,y}$ and $EC_{PJ,j,y}$ (EC_y).

This equipment setup is considered sufficient to carry out the monitoring requirements of the methodology, and the appropriate national standards will be followed.

Quality assurance and quality control procedures:

The Joint-PD-MR contains sufficient description on how quality will be controlled and assured in the monitoring of emission reductions.

Training:

Training will be provided to relevant personnel.

Data management:

All data collected as part of monitoring plan will be archived electronically on hard disks and be kept at least 2 years after the end of the last crediting period.

Corrective actions:

In case of nonconformities would be observed, a corrective action plan will be established and the whole VCS monitoring team will follow recognized standard data evaluation methods to guarantee that the data is reliable and accurate.

Emergency Procedure

Project proponents will take actions to make sure the emission calculations to be conservative. 0 value will be used for the missing data of $\Delta t_{j,d,y}$ and $FR_{j,d,y}$. And conservative approach will be used for determine $EC_{PJ,j,y}$ (EC_y).

CAR 09 and CL 06 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.5 Non-Permanence Risk Analysis

N/A

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

Through the onsite visit, interviewing the project developer and reviewing the project description in Joint-PD-MR/1/, it was confirmed that the project was implemented to introduce geothermal energy based space heating system with a total heating load of 399.48MW which can supply geothermal heat to 7,989.6 thousand m² of residential buildings.

By means of an in-depth review of the Joint-PD-MR and the checks carried out during the on-site visit, an assessment has been carried out whether the project has been implemented and operated in line with the Joint-PD-MR and whether all physical features of the project are in place. The following has been checked: implemented technology, project equipment as well as monitoring equipment.

The verifier has performed a site visit to check the project equipment and interview with end users and staffs, in addition by all the provided evidence, it is found that the project started construction on 01-March-2020 which has been confirmed by checking the Contract for Construction of Geothermal Space Heating System/10/, and started test run and put into operation on the same day 01-November-2020 (winter season) which has been confirmed by checking the operation log of the project/12/. The factors and parameters used during this monitoring period to arrive at the emission reduction calculations are transparently described in the Joint-PD-MR/1/.

The utilization hours of the geothermal heating system were 7,248 hours during this monitoring period (01-November-2020-31-March-2022). It provided geothermal heat to 6,871,047.47 m² of residential buildings with a total heating load of 343.55MW for 2020-2021 heating season (01-November-2020 to 31-March-2021) and provided geothermal heat to 7,186,579.28 m² of residential buildings with a total heating load of 359.33MW for 2021-2022 heating season (01-November-2021 to 31-March-2022) which is confirmed as in line with the heating supply contract/9/ due to not all residential buildings access to geothermal energy-based space heating system in the early of 2020-2021 and 2021-2022 winter seasons.

The actual operations are found in accordance with the descriptions provided in the Joint-PD-MR with only not all the residential buildings access to geothermal energy-based space heating system in the early of 2020-2021 and 2021-2022 winter seasons. There is no deviation / change evidenced during this monitoring period and there were no delays compared to information in approved project.

This verification covers the period from 01-November-2020 to 31-March-2022 (including both days). 867,337 tCO₂e emission reductions are claimed as VCU during this monitoring period.

CAR 10 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

4.2 Accuracy of GHG Emission Reduction and Removal Calculations

1. Assessment of Data and parameters available at validation

Via checking the Joint-PD-MR/1/, it is confirmed that all the ex-ante data and parameters are same to the Joint-PD-MR which is verified as correct. Refer to section 3.4.8 for the detail assessment of ex-ante parameters.

2. Assessment of Data and parameters monitored

During the verification all relevant monitoring parameters (as listed in chapter 3.4.8 of this report) have been verified with regard to the

- (i) appropriateness of the applied measurement / determination method,
- (ii) the correctness of the values applied for ER calculation,
- (iii) the accuracy, and applied QA/QC measures.

The monitoring results as well as the verification procedure are described parameter-wise in the below tables,

$\Delta t_{j,d,y}$	<i>Average temperature difference between inlet and outlet temperatures at the downstream of each heat exchanger in year y</i>
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – °C
Appropriate description?	Yes
Monitored Value?	Refer to Joint-PD-MR
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– it is monitored by ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger
Choice of data correctly justified?	Yes – to determine by collecting data from Operation record of the geothermal based space heating system/17/.
Measurement method and procedures correctly described?	Yes – Monitoring parameter of $\Delta t_{j,d,y}$ was derived from Operation record of the geothermal based space heating system/17/. The temperature difference is outlet temperature minus inlet temperature at the downstream of each heat exchanger, all the temperature data were measured by the ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger. Monitoring team read the readings of ultrasonic calorimeters hourly, the average daily inlet and outlet temperature were calculated based on the 24-hourly temperature data separately. The average monthly inlet and outlet temperature were calculated based on all the daily inlet and outlet temperature of this month, and then the average temperature difference is calculated for each month. Finally, the operation record of the geothermal heating system during the related heating season were summarized by all the monthly record. Via checking the measuring method by reviewing the operation record of the geothermal based space heating system/17/ and interview with monitoring staff as stated in the Joint-PD-MR. Above mentioned evidences were provided to the VVB during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Measured Hourly/Recording Monthly
Monitoring equipment correctly described?	Ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger Measurement range: 4~95°C Accuracy: 0.01°C

For each ultrasonic calorimeter, the calibration information and validity are listed as below table

Serial No.	Calibrated Date	Validity
RJ00000158	06-October-2020	05-October-2025
RJ00000159	06-October-2020	05-October-2025
RJ00000160	06-October-2020	05-October-2025
RJ00000161	06-October-2020	05-October-2025
RJ00000162	06-October-2020	05-October-2025
RJ00000163	06-October-2020	05-October-2025
RJ00000164	06-October-2020	05-October-2025
RJ00000165	06-October-2020	05-October-2025
RJ00000166	06-October-2020	05-October-2025
RJ00000167	06-October-2020	05-October-2025
RJ00000168	06-October-2020	05-October-2025
RJ00000169	06-October-2020	05-October-2025
RJ00000170	06-October-2020	05-October-2025
RJ00000171	06-October-2020	05-October-2025
RJ00000172	06-October-2020	05-October-2025
RJ00000173	06-October-2020	05-October-2025
RJ00000174	06-October-2020	05-October-2025
RJ00000175	06-October-2020	05-October-2025
RJ00000176	06-October-2020	05-October-2025
RJ00000177	06-October-2020	05-October-2025
RJ00000178	06-October-2020	05-October-2025
RJ00000179	06-October-2020	05-October-2025
RJ00000180	07-October-2020	06-October-2025
RJ00000181	07-October-2020	06-October-2025
RJ00000182	07-October-2020	06-October-2025
RJ00000183	07-October-2020	06-October-2025
RJ00000184	07-October-2020	06-October-2025
RJ00000185	07-October-2020	06-October-2025
RJ00000186	07-October-2020	06-October-2025
RJ00000187	07-October-2020	06-October-2025
RJ00000188	07-October-2020	06-October-2025
RJ00000189	07-October-2020	06-October-2025
RJ00000190	07-October-2020	06-October-2025
RJ00000191	07-October-2020	06-October-2025
RJ00000192	07-October-2020	06-October-2025
RJ00000193	07-October-2020	06-October-2025
RJ00000194	07-October-2020	06-October-2025
RJ00000195	07-October-2020	06-October-2025
RJ00000196	07-October-2020	06-October-2025
RJ00000197	07-October-2020	06-October-2025
RJ00000198	07-October-2020	06-October-2025
RJ00000199	07-October-2020	06-October-2025
RJ00000200	07-October-2020	06-October-2025
RJ00000201	07-October-2020	06-October-2025
RJ00000246	08-October-2020	07-October-2025
RJ00000247	08-October-2020	07-October-2025
RJ00000248	08-October-2020	07-October-2025
RJ00000249	08-October-2020	07-October-2025
RJ00000250	08-October-2020	07-October-2025

	RJ00000251	08-October-2020	07-October-2025
	RJ00000252	08-October-2020	07-October-2025
	RJ00000253	08-October-2020	07-October-2025
	RJ00000254	08-October-2020	07-October-2025
	RJ00000255	08-October-2020	07-October-2025
	RJ00000256	08-October-2020	07-October-2025
	RJ00000257	08-October-2020	07-October-2025
	RJ00000258	08-October-2020	07-October-2025
	RJ00000259	08-October-2020	07-October-2025
	RJ00000260	08-October-2020	07-October-2025
	RJ00000261	08-October-2020	07-October-2025
	RJ00000262	08-October-2020	07-October-2025
	RJ00000263	08-October-2020	07-October-2025
	RJ00000264	08-October-2020	07-October-2025
	RJ00000265	08-October-2020	07-October-2025
	RJ00000266	08-October-2020	07-October-2025
	RJ00000267	08-October-2020	07-October-2025
	RJ00000268	09-October-2020	08-October-2025
	RJ00000269	09-October-2020	08-October-2025
	RJ00000270	09-October-2020	08-October-2025
	RJ00000271	09-October-2020	08-October-2025
	RJ00000272	09-October-2020	08-October-2025
	RJ00000273	09-October-2020	08-October-2025
	RJ00000274	09-October-2020	08-October-2025
	RJ00000275	09-October-2020	08-October-2025
	RJ00000276	09-October-2020	08-October-2025
	RJ00000277	09-October-2020	08-October-2025
	RJ00000278	09-October-2020	08-October-2025
	RJ00000279	09-October-2020	08-October-2025
	RJ00000280	09-October-2020	08-October-2025
	RJ00000281	09-October-2020	08-October-2025
	RJ00000282	09-October-2020	08-October-2025
	RJ00000283	09-October-2020	08-October-2025
	RJ00000284	09-October-2020	08-October-2025
	RJ00000285	09-October-2020	08-October-2025
	RJ00000286	09-October-2020	08-October-2025
	RJ00000287	09-October-2020	08-October-2025
	RJ00000288	09-October-2020	08-October-2025
	RJ00000289	09-October-2020	08-October-2025
QA/QC procedure correctly described?	Yes- The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified third parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the ultrasonic calorimeters are calibrated based on JJG 225-2001 Verification Regulation of Heat Meters/31/. And based on this regulation, if the ultrasonic calorimeter can be used normally, recalibration is not required. The validity is five years. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period. The operation record of the geothermal based space heating system/17/ is cross-checked with the design temperature difference		

	of the end-user (10-15°C). Via checking the experts' reply/23/, CTI confirmed that the average temperature change of the 44 heat exchange system of the Zhoukou geothermal heating system is about 11°C.
Purpose of data?	BE calculation
Comments?	N/A

$FR_{j,d,y}$	Average flow rate at the downstream of each heat exchanger (upstream of which is connected with water supply from the geothermal well j) in year y.																				
Title in line with Methodology?	Yes																				
Data unit correctly expressed?	Yes – kg/h																				
Appropriate description?	Yes																				
Monitored Value?	Refer to Joint-PD-MR																				
Correct value provided?	Yes																				
Source clearly referenced? (appropriate?)	Yes– it is monitored by ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger																				
Choice of data correctly justified?	Yes – to determine by collecting data from Operation record of the geothermal based space heating system/17/.																				
Measurement method and procedures correctly described?	Yes – Monitoring parameter of $FR_{j,d,y}$ was derived from Operation record of the geothermal based space heating system/17/. The volume flow rate data (m³/h) were measured by the ultrasonic calorimeters installed at downstream of each heat exchanger. Density of the water is 1,000 kg/m³. Hence, the final mass flow values are calculated as volume flow rate times density of water. Monitoring team read the readings of ultrasonic calorimeters hourly and recorded temperatures of outlet and inlet monthly, and then the average temperature difference is calculated for each month. Finally, the operation record of the geothermal heating system during the related heating season were summarized by all the monthly record. Via checking the measuring method by reviewing the operation record of the geothermal based space heating system/17/ and interview with monitoring staff as stated in the Joint-PD-MR, CTI verified that the method is in line with the monitoring plan and applied methodology/53/. Above mentioned evidences were provided to the verification team during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.																				
Calculation method?	N/A																				
Monitoring frequency correctly described?	Measured Hourly/Recording Monthly																				
Monitoring equipment correctly described?	Ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger Measurement range: 0-1,000m³/h Accuracy: 0.01m³/h For each ultrasonic calorimeter, the calibration information and validity are listed as below table <table><tr><th>Serial No.</th><th>Calibrated Date</th><th>Validity</th></tr><tr><td>RJ00000246</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>RJ00000247</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>RJ00000248</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>RJ00000249</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>RJ00000250</td><td>08-October-2020</td><td>07-October-2025</td></tr></table>			Serial No.	Calibrated Date	Validity	RJ00000246	08-October-2020	07-October-2025	RJ00000247	08-October-2020	07-October-2025	RJ00000248	08-October-2020	07-October-2025	RJ00000249	08-October-2020	07-October-2025	RJ00000250	08-October-2020	07-October-2025
Serial No.	Calibrated Date	Validity																			
RJ00000246	08-October-2020	07-October-2025																			
RJ00000247	08-October-2020	07-October-2025																			
RJ00000248	08-October-2020	07-October-2025																			
RJ00000249	08-October-2020	07-October-2025																			
RJ00000250	08-October-2020	07-October-2025																			

	RJ00000251	08-October-2020	07-October-2025
	RJ00000252	08-October-2020	07-October-2025
	RJ00000253	08-October-2020	07-October-2025
	RJ00000254	08-October-2020	07-October-2025
	RJ00000255	08-October-2020	07-October-2025
	RJ00000256	08-October-2020	07-October-2025
	RJ00000257	08-October-2020	07-October-2025
	RJ00000258	08-October-2020	07-October-2025
	RJ00000259	08-October-2020	07-October-2025
	RJ00000260	08-October-2020	07-October-2025
	RJ00000261	08-October-2020	07-October-2025
	RJ00000262	08-October-2020	07-October-2025
	RJ00000263	08-October-2020	07-October-2025
	RJ00000264	08-October-2020	07-October-2025
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	RJ00000268	09-October-2020	08-October-2025
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	RJ00000277	09-October-2020	08-October-2025
	RJ00000278	09-October-2020	08-October-2025
	RJ00000279	09-October-2020	08-October-2025
	RJ00000280	09-October-2020	08-October-2025
	RJ00000281	09-October-2020	08-October-2025
	RJ00000282	09-October-2020	08-October-2025
	RJ00000283	09-October-2020	08-October-2025
	RJ00000284	09-October-2020	08-October-2025
	RJ00000285	09-October-2020	08-October-2025
	RJ00000286	09-October-2020	08-October-2025
	RJ00000287	09-October-2020	08-October-2025
	RJ00000288	09-October-2020	08-October-2025
	RJ00000289	09-October-2020	08-October-2025
QA/QC procedure correctly described?	Yes- The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified third parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the ultrasonic calorimeters are calibrated based on JJG 225-2001 Verification Regulation of Heat Meters/31/. And based on this regulation, if the ultrasonic calorimeter can be used normally, recalibration is not required. The validity is five years. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period. The operation record of the geothermal based space heating system/17/ is cross-checked with the rated flow of the circulating		

	pumps which has been provided in the Joint-PD-MR and via checking the experts' reply/23/, CTI verified that all the data provided for cross-check are correct and reasonable.
Purpose of data?	BE calculation
Comments?	N/A

T_j	Hours per hear heat utilization in well j
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – hours
Appropriate description?	Yes
Monitored Value?	2020-2021 Heating Season: 3,624 2021-2022 Heating Season: 3,624
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Monitoring parameter of T_j was derived from Operation record of the geothermal based space heating system/17/.
Choice of data correctly justified?	Yes – The measuring and reporting frequency are in line with the monitoring plan and applied methodology/53/.
Measurement method and procedures correctly described?	Yes –Monitoring staff record the heating hours into the operation record of the geothermal based space heating system/17/ monthly, and then the final values are sum of the monthly data. Via checking the operation record of the geothermal based space heating system/17/ and interview with monitoring staff, CTI verified that the method is in line with the monitoring plan and applied methodology/53/. Above mentioned evidences were provided to the verification team during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	Yes- Refer to equations in below section 4.4.3 for calculation process which is verified in line with Joint-PD-MR/1/ and applied methodology/53/.
Monitoring frequency correctly described?	Monthly
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes. The operation record of the geothermal based space heating system/17/ is cross-checked with Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/.
Purpose of data?	BE _s calculation
Comments?	-

HI_m	Heating index for construction type m
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – W/m ²
Appropriate description?	Yes
Monitored Value?	50
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Monitoring parameter of HI_m was derived from FSR/5/
Choice of data correctly justified?	Yes

Measurement method and procedures correctly described?	Yes – As per the FSR/5/, Heating index is 50 W/m ² for residential buildings used for project activity, which is also confirmed in line with the requirement of <i>CJJ 34-2010 Design Code for City Heating Network</i> published by Ministry of Housing and Urban-Rural Development of the People's Republic of China/30/, hence CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	N/A
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes. The CJJ 34-2010 Design Code for City Heating Network published by Ministry of Housing and Urban-Rural Development of the People's Republic of China/30/ is used for cross check with FSR/5/.
Purpose of data?	BE calculation
Comments?	-

$EC_{PJ,j,y}$ (EC_y)	<i>Electricity consumption for the year y in operating the geothermal heating system</i>																										
Title in line with Methodology?	Yes																										
Data unit correctly expressed?	Yes – MWh																										
Appropriate description?	Yes																										
Monitored Value?		<table><tr><td>01-November-2020~30-November-2020</td><td>8,085.02</td></tr><tr><td>01-December-2020~30-December-2020</td><td>8,563.62</td></tr><tr><td>01-January-2021~31-January-2021</td><td>8,612.29</td></tr><tr><td>01-February-2021~28-February -2021</td><td>8,814.54</td></tr><tr><td>01-March-2021~31-March-2021</td><td>7,913.73</td></tr><tr><td>01-April-2021~31-October-2021</td><td>0</td></tr><tr><td>01-November-2021~30-November-2021</td><td>8,248.69</td></tr><tr><td>01-December-2021~30-December-2021</td><td>8,772.92</td></tr><tr><td>01-January-2022~31-January-2022</td><td>8,729.70</td></tr><tr><td>01-February-2022~28-February -2022</td><td>8,993.57</td></tr><tr><td>01-March-2022~31-March-2022</td><td>8,171.34</td></tr><tr><td>01-November-2020~31-March -2021</td><td>84,905.43</td></tr></table>	01-November-2020~30-November-2020	8,085.02	01-December-2020~30-December-2020	8,563.62	01-January-2021~31-January-2021	8,612.29	01-February-2021~28-February -2021	8,814.54	01-March-2021~31-March-2021	7,913.73	01-April-2021~31-October-2021	0	01-November-2021~30-November-2021	8,248.69	01-December-2021~30-December-2021	8,772.92	01-January-2022~31-January-2022	8,729.70	01-February-2022~28-February -2022	8,993.57	01-March-2022~31-March-2022	8,171.34	01-November-2020~31-March -2021	84,905.43	
01-November-2020~30-November-2020	8,085.02																										
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01-February-2021~28-February -2021	8,814.54																										
01-March-2021~31-March-2021	7,913.73																										
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01-March-2022~31-March-2022	8,171.34																										
01-November-2020~31-March -2021	84,905.43																										
Correct value provided?	Yes																										
Source clearly referenced? (appropriate?)	Yes– it is monitored by electricity meters installed at each substation																										
Choice of data correctly justified?	Yes – the measuring and reporting frequency are in line with the monitoring plan and applied methodology/53/.																										
Measurement method and procedures correctly described?	Yes –Monitoring parameter of $EC_{PJ,j,y}$ was derived from meter reading records/18/. The electricity consumptions were measured by the electricity meter installed at each substation (total 44 meters). Monitoring staff read the readings of electricity monthly and recorded meter reading data into meter reading records/18/ monthly, and then the electricity consumption is calculated for each month, then the electricity costs during the heating season were settled by the project owner and local power grid company, which includes the electricity consumption of the geothermal heating system of each community property service company, finally the local power grid company issued electricity bill/19/ to the project owner related community property service company for confirmation.																										

	Via checking the measuring method by reviewing the meter reading records/18/ and electricity bills/19/ during the heating season and interview with monitoring staff, CTI verified that the method is in line with the monitoring plan and applied tool/55/. Above mentioned evidences were provided to the verification team during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.																																																																																																																		
Calculation method?	N/A																																																																																																																		
Monitoring frequency correctly described?	Hourly																																																																																																																		
Monitoring equipment correctly described?	Electricity meters installed at each substation Accuracy: 0.5s For each electricity meter, the calibration information and validity are listed as below table <table><tr><th>Serial No.</th><th>Calibrated Date</th><th>Validity</th></tr><tr><td>110238121130</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121131</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121132</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121133</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121134</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121135</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121136</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121137</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121138</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121139</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121140</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121141</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>110238121311</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121312</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121313</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121314</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121315</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121316</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121317</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121318</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121319</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121320</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121321</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121322</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>110238121323</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121324</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121325</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121326</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121327</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121328</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121329</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121330</td><td>10-October-2020</td><td>09-October-2025</td></tr><tr><td>110238121331</td><td>11-October-2020</td><td>10-October-2025</td></tr><tr><td>110238121332</td><td>11-October-2020</td><td>10-October-2025</td></tr><tr><td>110238121333</td><td>11-October-2020</td><td>10-October-2025</td></tr><tr><td>110238121334</td><td>11-October-2020</td><td>10-October-2025</td></tr><tr><td>110238121335</td><td>11-October-2020</td><td>10-October-2025</td></tr></table>	Serial No.	Calibrated Date	Validity	110238121130	08-October-2020	07-October-2025	110238121131	08-October-2020	07-October-2025	110238121132	08-October-2020	07-October-2025	110238121133	08-October-2020	07-October-2025	110238121134	08-October-2020	07-October-2025	110238121135	08-October-2020	07-October-2025	110238121136	08-October-2020	07-October-2025	110238121137	08-October-2020	07-October-2025	110238121138	08-October-2020	07-October-2025	110238121139	08-October-2020	07-October-2025	110238121140	08-October-2020	07-October-2025	110238121141	08-October-2020	07-October-2025	110238121311	09-October-2020	08-October-2025	110238121312	09-October-2020	08-October-2025	110238121313	09-October-2020	08-October-2025	110238121314	09-October-2020	08-October-2025	110238121315	09-October-2020	08-October-2025	110238121316	09-October-2020	08-October-2025	110238121317	09-October-2020	08-October-2025	110238121318	09-October-2020	08-October-2025	110238121319	09-October-2020	08-October-2025	110238121320	09-October-2020	08-October-2025	110238121321	09-October-2020	08-October-2025	110238121322	09-October-2020	08-October-2025	110238121323	10-October-2020	09-October-2025	110238121324	10-October-2020	09-October-2025	110238121325	10-October-2020	09-October-2025	110238121326	10-October-2020	09-October-2025	110238121327	10-October-2020	09-October-2025	110238121328	10-October-2020	09-October-2025	110238121329	10-October-2020	09-October-2025	110238121330	10-October-2020	09-October-2025	110238121331	11-October-2020	10-October-2025	110238121332	11-October-2020	10-October-2025	110238121333	11-October-2020	10-October-2025	110238121334	11-October-2020	10-October-2025	110238121335	11-October-2020	10-October-2025
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	110238121340	11-October-2020	10-October-2025
	110238121341	11-October-2020	10-October-2025
	110238121342	11-October-2020	10-October-2025
QA/QC procedure correctly described?	Yes- The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified third parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the ultrasonic calorimeters are calibrated based on JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy/32/. And based on this regulation, if the electricity meters can be used normally, recalibration is not required. The validity is five years. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period. The meter reading records/18/ is cross-checked with monthly electricity bills/19/ and the data in both evidence are confirmed as consistent.		
Purpose of data?	PE calculation		
Comments?	N/A		

$EF_{EL,j,y}$ ($EF_{grid,CM,y}$)	Combined margin emission factor for the grid in year y
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes –tCO ₂ /MWh
Appropriate description?	Yes
Monitored Value?	0.5721
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Monitoring parameter of $EF_{EL,j,y}$ was derived from Baseline emission factors of China's regional power grid for emission reduction projects in 2019 published by Ministry of Ecology and Environment of the People's Republic of China/27/
Choice of data correctly justified?	Yes
Measurement method and procedures correctly described?	Yes –As per the Tool 07 Tool to calculate the emission factor for an electricity system (Version 07.0)/56/, the monitoring parameter of $EF_{EL,j,y}$ ($EF_{grid,CM,y}$) is calculated by $EF_{grid,OM,y} * 0.5 + EF_{grid,BM,y} * 0.5$, and $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ were derived from Baseline emission factors of China's regional power grid for emission reduction projects in 2019 published by Ministry of Ecology and Environment of the People's Republic of China/27/. Baseline emission factors of China's regional power grid for emission reduction projects in 2019 published by Ministry of Ecology and Environment of the People's Republic of China/27/ is the latest public available EF data issued by China DNA, hence as per the Tool 07 Tool to calculate the emission factor for an electricity system (Version 07.0)/56/, the values from this source is applicable to this monitoring period. Via checking the Baseline emission factors of China's regional power grid for emission reduction projects in 2019 published by Ministry of

	Ecology and Environment of the People's Republic of China/27/, CTI confirmed that the calculation methods used by China DNA is in line with the tool/56/ and via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	Yes - the monitoring parameter of $EF_{EL,j,y}$ ($EF_{grid,CM,y}$) is calculated by $EF_{grid,OM,y} * 0.5 + EF_{grid,BM,y} * 0.5$
Monitoring frequency correctly described?	Once each monitoring period
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The calculation methods used by China DNA/27/ is in line with the tool/56/.
Purpose of data?	PE calculation
Comments?	-

$TDL_{j,y}$	<i>Average technical transmission and distribution losses for providing electricity to source j in year y.</i>
Title in line with Methodology?	Yes
Data unit correctly expressed?	-
Appropriate description?	Yes
Monitored Value?	20%
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes- Value is derived from the tool of Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/55/
Choice of data correctly justified?	Yes
Measurement method and procedures correctly described?	Yes - As per the tool of Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/55/, CTI confirmed that different values applied to different scenarios. Via checking the Agreement of Electricity Charges/14/, CTI confirmed that the electricity consumed by facilities of the geothermal system is sourced from local power grid connected to Central China Power Grid (CCPG). Hence, scenario A: Electricity consumption from the grid is applied to the proposed project. For project electricity consumption sources, a default value of 20% is used for $TDL_{j,y}$ in line with the tool/55/. Via checking the Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/55/, CTI confirmed that the data in Joint-PD-MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A
Purpose of data?	PE calculation
Comments?	-

A_m	<i>Net heating area for construction type m</i>
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Title in line with Methodology?	Yes
Data unit correctly expressed?	m ²
Appropriate description?	Yes
Monitored Value?	2020-2021 Heating Season: 6,871,047.47 2021-2022 Heating Season: 7,186,579.28
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Heating supply contracts/9/
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/53/.
Measurement method and procedures correctly described?	Yes – Via checking the Heating supply contracts/9/ and interview with representatives from property management companies, CTI confirmed that the net heating area data in MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Yearly
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes. The data was cross-checked with Certificate of Enterprise Investment Project in Henan Province issued by Zhoukou City Development and Reform Commission/28/, and CTI confirmed that the net heating area sourced from the heating supply contracts/9/ were lower than that of the government approval. Because all the communities covered by the project are newly built, some of the local residents haven't moved in yet, and there is no need for heating during the 2020-2021 and 2021-2022 heating season.
Purpose of data?	BE calculation
Comments?	-

CAR 11 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3. Assessment of GHG emission reductions Quantity

Calculation of baseline GHG emissions or removals

According to the methodology and above all the formulars listed in section 3.4.6, baseline emissions are calculated using the following formula:

$$BE_y = \sum_i (HS_{i,y}^{BL}) \times EF_{CO2,i} / \eta_{BL,i}$$

The values monitored during monitoring survey are transparently shown in the Section 6.1 of Joint-PD-MR. During onsite, CTI cross-checked these values in detail using various supporting records and documents. Refer to the above section 3.4.8 of this report for ex-ante and above section 4.1 for ex-post parameters' assessment.

The Baseline Emissions during this monitoring period is summarized as below,

Date	$HS_{i,y}^{BL}$ (TJ)	$EF_{CO2,i}$ (t CO ₂ /TJ)	$\eta_{BL,i}$	BE_y (tCO ₂ e/yr)
01-November-2020~30-November-2020	812.43	87.3	85%	83,441
01-December-2020~30-December-2020	920.17	87.3	85%	94,507

01-January-2021~31-January-2021	920.17	87.3	85%	94,507
01-February-2021~28-February-2021	831.12	87.3	85%	85,361
01-March-2021~31-March-2021	920.17	87.3	85%	94,507
01-April-2021~31-October-2021	0	87.3	85%	0
01-November-2021-30-November-2021	904.48	87.3	85%	92,895
01-December-2021-31-December-2021	962.43	87.3	85%	98,847
01-January-2022-31-January-2022	962.43	87.3	85%	98,847
01-February-2022-28-February-2022	869.29	87.3	85%	89,281
01-March-2022-31-March-2022	909.82	87.3	85%	93,444
01-November-2020-31-December-2020	1,732.60	87.3	85%	177,947
01-January-2021-31-December-2021	4,538.37	87.3	85%	466,114
1-January-2022-31-March-2022	2,741.54	87.3	87.3	281,570
01-November-2020~31-March-2022	9,012.51	87.3	85%	925,631

Total Baseline emissions of the 1st monitoring period is thus verified as 925,631 tCO₂e.

In conclusion, the calculations of baseline GHG emissions have been carried out in accordance with the formulae and methods described in the registered monitoring plan, the applied methodology and, where applicable, the applied standardized baseline. Any assumptions used in emission calculations have been justified. Appropriate emission factors and other reference values have been correctly applied. No errors, miscalculations, omissions, misstatements or incomplete information has been identified. It can be confirmed that the baseline calculation is overall correct.

Calculation of project GHG emissions or actual net GHG removals by sinks

According to the methodology, the project emissions are calculated using the following formula:

$$PE_y = PE_{FE,y} + PE_{EC,y} + PE_{FF,y} = PE_{EC,y}$$

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

The values monitored during monitoring survey are transparently shown in the Section 6.1 of Joint-PD-MR. During onsite, CTI cross-checked these values in detail using various supporting records and documents. Refer to the above section 3.4.8 of this report for ex-ante and above section 4.1 for ex-post parameters' assessment.

So Project Emissions during this monitoring period is calculated as below table

Date	$EC_{PJ,j,y}$ (kWh)	$EC_{PJ,j,y}$ (MWh)	$EF_{EL,j,y}$ (tCO ₂ /MWh)	(1+TDL _{j,y}) /	$PE_{EC,y}$ (tCO ₂ e/yr)
01-November-2020~30-November-2020	8,085,019.41	8,085.02	0.5721	1.2	5,551
01-December-2020~30-December-2020	8,563,619.95	8,563.62	0.5721	1.2	5,880
01-January-2021~31-January-2021	8,612,291.88	8,612.29	0.5721	1.2	5,913
01-February-2021~28-February-2021	8,814,543.72	8,814.54	0.5721	1.2	6,052

01-March-2021~31-March-2021	7,913,728.04	7,913.73	0.5721	1.2	5,433
01-November-2020-31-December-2020	16,648,639.36	16,648.64	0.5721	1.2	11,431
01-January-2021-31-March-2021	25,340,563.64	25,340.56	0.5721	1.2	17,398
01-November-2020-31-March-2021	41,989,203.00	41,989.20	0.5721	1.2	28,829
01-April-2021~31-October-2021	0	0	0.5721	1.2	0
01-November-2021-30-November-2021	8,248,691.05	8,248.69	0.5721	1.2	5,663
01-December-2021-31-December-2021	8,772,924.35	8,772.92	0.5721	1.2	6,023
01-January-2022-31-January-2022	8,729,699.29	8,729.70	0.5721	1.2	5,994
01-February-2022-28-February-2022	8,993,572.71	8,993.57	0.5721	1.2	6,175
01-March-2022-31-March-2022	8,171,339.09	8,171.34	0.5721	1.2	5,610
01-November-2020-31-December-2020	16,648,639.36	16,648.64	0.5721	1.2	11,431
01-January-2021-31-December-2021	42,362,179.04	42,362.18	0.5721	1.2	29,084
01-January-2022-31-March-2022	25,894,611.09	25,894.61	0.5721	1.2	17,779
01-November-2020~31-March-2022	84,905,429.49	84,905.43	0.5721	1.2	58,294

In conclusion, the calculations of project GHG emissions have been carried out in accordance with the formulae and methods described in the registered monitoring plan, the applied methodology and, where applicable, the applied standardized project. Any assumptions used in emission calculations have been justified. Appropriate emission factors and other reference values have been correctly applied. No errors, miscalculations, omissions, misstatements or incomplete information has been identified. It can be confirmed that the project calculation is overall correct.

Calculation of leakage GHG emissions

In accordance with AM0072 ver. 03.0, it is confirmed that no leakage for this project was identified.

CTI confirmed that the no leakage emissions for this monitoring period ($LE_y = 0$).

Summary of calculation of GHG emission reductions or net anthropogenic GHG removals by sinks

The VVB has checked the Joint-PD-MR includes a summary table of the emission reductions calculation.

Summary of emission reductions during the monitoring period,

$$ER_y = BE_y - PE_y$$

Hence, the emission reductions during this monitoring period from 2020 to 2022 are summarized in the table below

Parameters Period	Baseline Emissions BE_y	Project Emissions PE_y	Leakage Emissions LE_y	Net GHG emission reductions or removals ER
	(tCO _{2e})	(tCO _{2e})	(tCO _{2e})	(tCO _{2e})
01-November-2020~30-November-2020	83,441	5,551	0	77,890
01-December-2020~30-December-2020	94,506	5,880	0	88,626
01-January-2021~31-January-2021	94,506	5,913	0	88,593
01-February-2021~28-February-2021	85,361	6,052	0	79,309
01-March-2021~31-March-2021	94,506	5,433	0	89,073
01-April-2021~31-October-2021	0	0	0	0
01-November-2021~30-November-2021	92,895	5,663	0	87,232
01-December-2021~31-December-2021	98,846	6,023	0	92,823
01-January-2022~31-January-2022	98,846	5,994	0	92,852
01-February-2022~28-February-2022	89,281	6,175	0	83,106
01-March-2022~31-March-2022	93,443	5,610	0	87,833
01-November-2020~31-December-2020	177,947	11,431	0	166,516
1-January-2021~31-December-2021	466,114	29,084	0	437,030
1-January-2022~31-March-2022	281,570	17,779	0	263,791
01-November-2020~31-March-2022	925,631	58,294	0	867,337

All the figures as per the monitoring report were cross-checked by the VVB against basic monitored data. Refer to section 4.4.1 and 4.4.2 of this report for assessment details.

Comparison with ex ante calculated Emission Reductions

CTI confirmed that the actual value during this monitoring period was found to be 12.44% lower than ex-ante estimated value for this project during this monitoring period, via comparing with the estimated value, CTI verified that the change of five parameters, i.e. A_m , $\Delta t_{j,d,y}$, $FR_{j,d,y}$, T_j and $EC_{PJ,j,y}$ impact the actual emission reduction calculation, however, the actual outcome was 6,871,047.47 m² of residential buildings can access to geothermal energy (A_m) based space heating system in 2020-2021 heating season and the actual outcome was 7,186,579.28 m² of residential buildings can access to geothermal energy (A_m) based space heating system in 2021-2022 heating season which is determined by the Heating supply contracts/9/, and another four parameters depend on the local heating duration and the continuous heating hours of different building types and heating demand of the end-users, which are affected by atmospheric environment temperature, running status of the geothermal heating system and other aspects which changes over time. Hence CTI verified that the actual value lower than estimated one is reasonable and acceptable.

Therefore, for the total 1st Monitoring period from 01-November-2020 to 31-March-2022, 867,337 tCO_{2e} equivalent of credits eligible for issuance as VCU.

Via checking the values in Joint-PD-MR/1/ against the ER calculation sheet/2/, CTI confirmed that the emission reductions calculation is overall correct.

CL 07 and CAR 11 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals

Refer to section 4.1 above for the detail assessment of each monitoring parameters and Appendix 3 for the supporting evidence used to determine the GHG emission reductions.

For each reported data, the evidence is provided and verified as sufficient and quality is appropriate. Also, the cross-checks have been performed on the reported data with different source of evidence. The information flow from data generation and aggregation, to recording, calculation and final transposition into the monitoring report has been assessed by VVB in section 4.1 for each parameter and also the calibration have been conducted as per the frequency of monitoring equipment defined in the registered PD.

Therefore, it is concluded that the evidence provided are verified as sufficient and quality is appropriate and thus the evidence can be used to determine the GHG emission reductions and removals for this monitoring period.

5 VALIDATION AND VERIFICATION CONCLUSION

Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. has commissioned the CTI to carry out the Verified Carbon Standard (VCS) joint validation and 1st periodic verification of the project activity Ruijing Geothermal Based Space Heating System (VCS ID 2659), for the monitoring period from 01-November-2020 to 31-March-2022, with regard to the relevant requirements for VCS Standard Version 4.2.

Based on the reviewing the documented evidence and by an on-site assessment, CTI can confirm that:

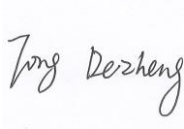
- the baseline scenario is correctly defined as per the applied methodology and relate tools;
- the project is additional;
- all data and information used for ex-ante calculation of emission reductions is of projected and/or hypothetical nature;
- the monitoring plan in the validated Joint-PD-MR is as per the applied baseline and monitoring methodology.
- the project has been implemented and operated as per the VCS Joint-PD-MR;
- the project complies with the validation and verification criteria for projects set out in VCS Standard Version 4.2;
- the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable VCS requirement and AM0072 (version 03.0);
- the monitoring is in place as per the applied baseline and monitoring methodology AM0072 (version 03.0);
- the monitoring complies with the monitoring plan in the validated PD;

It is certified that the GHG emission reductions from the project during the monitoring period amount as follows:

Verification period: From 01-November-2020 to 31-March-2022

Verified GHG emission reductions and removals in the above verification period by vintage is

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
01-November-2020~31-December-2020	177,947	11,431	0	166,516
01-January-2021~31-December-2021	466,114	29,084	0	437,030
01-January-2022~31-March-2022	281,570	17,779	0	263,791
01-November-2020~31-March-2021	925,631	58,294	0	867,337

A handwritten signature in black ink, reading 'Tong Dezheng' in a cursive style.

Tong Dezheng

CTI

Verification Team Leader

25-September-2022

A handwritten signature in black ink, reading 'Zhou Lu' in a cursive style.

Zhou Lu

CTI

Final Approval

25-September-2022

APPENDIX 1: ABBREVIATIONS

Abbreviations	Full texts
BE	Baseline Emission
CAR	Corrective Action Request
CCER	China Certified Emission Reduction
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CL	Clarification Request
CO ₂	Carbon dioxide
CP	Crediting Period
DNA	Designated National Authority
EB	Executive Board
EIA	Environmental Impact Assessment
ER	Emission Reduction
ETS	Emission Trading Scheme
FAR	Forward Action Request
FSR	Feasibility Study Report
GHG	Green House Gas
GS	Gold Standard
GSC/GSP	Global Stakeholder Consultation Process
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LSC	Local Stakeholder Consultation
MoV	Means of Validation
MP	Monitoring Plan
ODA	Official Development Assistance
PA	Project Activity
PE	Project Emission
PP	Project Participant
PS	Project Standard
QC/QA	Quality control/Quality assurance
SD	Sustainable Development
SDG	Sustainable Development Goals
tCO ₂ e	Tonnes of Carbon di oxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard
VCS	Verified Carbon Standard
VCSA	Verified Carbon Standard Association
VCU	Verified Carbon Unit
VVB	Validation/Verification Body

APPENDIX 2: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS

Mr. Dezheng TONG

Satisfies the requirements of competence management system of CTI Certification, and is hereby appointed as:

Qualification					
GHG Auditor	Validator	Verifier	Team Leader	Technical Reviewer	Technical Expert
√	√	√	√	-	√

Scope	Technical Area
SS 1: Energy industries (renewable/non-renewable sources)	TA 1.2: Energy generation from renewable energy sources
SS 8: Mining/mineral production	TA 8.1: Mining/mineral production
SS 10: Fugitive emissions from fuels (solid, oil and gas)	TA 10.1: Fugitive emissions from oil and gas

This appointment is valid for 3 years from its date of approval below and is bound by internal requirements of management system of the Certification Body of CTI.

Approved by: *Wu Lin*

Wu LIN

Technical Competent Manager

Shenzhen, 01/07/2019

Ms. Shunrong Lin

Satisfies the requirements of competence management system of CTI Certification, and is hereby appointed as:

Qualification					
GHG Auditor	Validator	Verifier	Team Leader	Technical Reviewer	Technical Expert
√	√	√	√	√	√

Scope	Technical Area
SS 1: Energy industries (renewable/non-renewable sources)	TA 1.2: Energy generation from renewable energy sources
SS 14: Afforestation and reforestation	TA 14.1: Afforestation and reforestation
SS 15: Agriculture	TA 15.1: Agriculture

This appointment is valid for 3 years from its date of approval below and is bound by internal requirements of management system of the Certification Body of CTI.

Approved by:

Wu Lin

Wu LIN

Technical Competent Manager

Shenzhen, 01/01/2021

APPENDIX 3: DOCUMENTS REVIEWED OR REFERENCED

No	Author	Title	References to the document	Provider
1.	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.	Joint-PD-MR	Joint-PD-MR of Ruijing Geothermal Based Space Heating System - Draft Version 1.0, dated 20-April-2022 - Version 2.0, dated 01-June-2022 - Final Version 3.0, dated 22-September-2022	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
2.	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.	Emission Reduction Calculation Sheets	Emission Reduction Calculation sheet (related to ex-ante) - Draft Version 1.0, dated 20-April-2022 - Final Version 2.0, dated 01-June-2022 Emission Reduction Calculation sheet (related to this monitoring period) - Draft Version 1.0, dated 20-April-2022 - Version 2.0, dated 01-June-2022 - Final Version 3.0, dated 22-September-2022	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
3.	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.	LCOH calculation sheet	Version 1.0, dated 26-April-2022	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
4.	Local Market Supervision and Administration Bureau	Business License	Business License of Wanjiang New Energy Group Co., Ltd. and Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.	PP
5.	China Urban Construction Research Institute Co., Ltd.	Feasibility Study Report	Issued in March 2019	PP
6.	Zhoukou City Development and Reform Commission	Project Approval	Issued in January 2019	PP
7.	Henan Juli Lianchuang Environmental Protection Technology Co., Ltd.	Environment Impact Assessment	Issued in March 2019	PP
8.	Zhoukou Ecological Environment Bureau	EIA approval	Issued on 26-May-2019	PP

No	Author	Title	References to the document	Provider
9.	Project owner with end users	Heating supply contracts	Signed by project owner with 7 local property management companies who handled 10 different sub-areas for both 2020-2021 heating season and 2021-2022 heating season 1. Fajina Property Service Co., Ltd. dated in 2020 and 2021 2. Henan Wan'an Property Management Co., Ltd. dated in 2020 and 2021 3. Henan Shengshi Property Management Co., Ltd. dated in 2020 and 2021 4. Henan Jinbi Property Management Co., Ltd. dated in 2020 and 2021 5. Henan Jianye Property Management Co., Ltd. dated in 2020 and 2021 6. Henan Yatai Property Management Co., Ltd. dated in 2020 and 2021 7. Lvdu Property Management Co., Ltd. dated in 2020 and 2021	PP
10.	Zhejiang Haiheng Pipe Industry Technology Co., Ltd. and Project Owner	Contract for Construction of Geothermal Space Heating System	Signed on 20-February-2020	PP
11.	Manufacturer	Technical agreement and Operating Instruction	Technical agreement and Operating Instruction of Geothermal Space Heating System	PP
12.	PP	Operation log of the project	Hourly and Daily Operation log of the project	PP
13.	PP	Technical flow chart	Technical flow chart in the project site	PP
14.	State Grid Henan Electric Power Company Zhoukou Power Supply Company and project owner	Agreement of Electricity Charges	Agreement of Electricity Charges dated in August 2020	PP
15.	Henan Institute of Metrology & State Grid Metrology Center Co., Ltd.	Calibration Reports	Calibration Reports to all the ultrasonic calorimeters with validity covering this monitoring period issued by Henan Institute of Metrology. Calibration Reports to all the electronical meters with validity	PP

No	Author	Title	References to the document	Provider
			covering this monitoring period issued by State Grid Metrology Center Co., Ltd.	
16.	General Administration of Quality Supervision, Inspection and Quarantine and CNAS	Certificate of Metrological Authorization	Certificate of Metrological Authorization of Henan Institute of Metrology issued by General Administration of Quality Supervision, Inspection and Quarantine on 01-November-2017 valid to 31-October-2022 Certificate of Metrological Authorization of State Grid Metrology Center Co., Ltd. issued by CNAS on 05-November-2019 valid to 19-May-2023	PP
17.	PP	Operation record	Operation record of the geothermal based space heating system covering this monitoring period	PP
18.	PP	Meter reading records	Meter reading records of 44 meters covering this monitoring period	PP
19.	State Grid Henan Electric Power Company Zhoukou Power Supply Company	Monthly Electricity bills	Monthly Electricity bills issued by State Grid Henan Electric Power Company Zhoukou Power Supply Company for this monitoring period	PP
20.	Henan Provincial Department of Water Resources	Water drawing permit	Water drawing permit issued on 01-June-2020	PP
21.	PP	Local Stakeholder Consultation Records prior to the project construction	Filled version of local stakeholder consultation process survey questionnaires prior to the project construction	PP
22.	PP	Local Stakeholder Consultation Records for this monitoring period	Meeting records of the stakeholder meeting for this monitoring period	PP
23.	Local expert	Email screenshot	Email screenshot of the expert's feedback. Mr. Wang participated in testing of the whole geothermal space heating system during the test run period	PP
24.	PP and employees	Labor contracts	Labor contracts signed with employees for implementation of this project	Project Owner
25.	PP	Salary slips	Monthly salary slips for employees	Project Owner

No	Author	Title	References to the document	Provider
26.	PP	Technical Training Records	Technical Training Records of project 1. Training Records dated on 18-October-2020 2. Training register list	Project Owner
27.	Ministry of Ecology and Environment of the People's Republic of China	Baseline emission factor of China	2019 China regional power grid carbon dioxide baseline emission factor OM calculation instructions http://www.mee.gov.cn/ywgz/xdqhbh/wsqtgz/202012/t20201229_815386.shtml	Project Owner
28.	Zhoukou Development and Reform Commission	Certificate	Certificate of Enterprise Investment Project in Henan Province	PP
29.	Housing and Urban-Rural Development Department of Zhoukou City	Research on Heating in Winter of Zhoukou City	Research on Heating in Winter of Zhoukou City published on 11-March-2019	PP
30.	Ministry of Housing and Urban-Rural Development of the People's Republic of China	CJJ 34-2010	Design Code for City Heating Network	Public Website
31.	General Administration of Quality Supervision, Inspection and Quarantine	JJG 225-2001	Verification Regulation of Heat Meters	Public Website
32.	General Administration of Quality Supervision, Inspection and Quarantine	JJG 596-2012	Electrical Meters for Measuring Alternating-current Electrical Energy	Public Website
33.	National Development and Reform Commission and Ministry of Construction	Economic Evaluation Method and Parameter of Construction Projects	Version 03	Public Website
34.	Guozhong Zheng, Wentao Bu.	"Review of Heating Methods for Rural Houses in China"	Review of Heating Methods for Rural Houses in China. Energies 11(12):3402. December 2018.	Public Website
35.	PP	Declaration of No Double Counting	Declaration of No Double Counting issued on 10-March-2022	PP
36.	PP	Declaration of not involved in other GHG scheme	Declaration of not involved in other GHG scheme issued on 10-March-2022	PP

No	Author	Title	References to the document	Provider
37.	Ministry of Environmental Protection	National standard	“Emission standard for industrial enterprise noise at boundary” (GB12348-2008) Sound Environment Quality Standard (GB3096-2008)	Public Website
38.	Public Website	Public information of price of natural gas in Henan province	https://4g.dahe.cn/news/20180724349019 https://www.xyj321.com/zx/127988.html	Public Website
39.	Public Website	Public information of energy sources in long term in Henan Province	http://222.143.52.128/zcfg/1451.jhtml	Public Website
40.	Public Website	Price index of investment in fixed asset for Henan Province	http://calendar.hexun.com/area/dqzb_410000_B1540000.shtml	Public Website
41.	China State Government	Public information issued by China State Government	http://www.gov.cn/gongbao/content/2016/content_5092473.htm	Public Website
42.	Public Website	Public information of current oil-fired boiler	http://rq.reenry.com/xinwenzixun/xingyedongtai/616.html	Public Website
43.	Public Website	Public information of current utilization of Oil fired stoves	https://www.sohu.com/a/355884111_99999190	Public Website
44.	Public Website	Public information of individual space heating	https://www.ixueshu.com/h5/document/10a911bfed7419ce82f3a2eb1bb17fed318947a18e7f9386.html	Public Website
45.	Public Website	Public information of electricity-based heating technologies	https://www.zzboiler.com/baike/explanation/3750.html	Public Website
46.	Ministry of Housing and Urban-Rural Development National Development and Reform Commission Ministry of Finance Energy Administration	Guidance on Promoting Clean Heating in Northern Areas	http://www.chic.org.cn/Home/In dex/detail?id=55	Public Website
47.	National Government	Planning of Clean Heating in Winter of	https://www.ndrc.gov.cn/xxgk/zcfb/tz/201712/W020190905503624116481.pdf	Public Website

No	Author	Title	References to the document	Provider
		Northern China (2017-2021)		
48.	Henan Province Government	Administrative Measures for Centralized Heating in Henan Province	http://www.npcxj.com/index.php/Mobile/Lew/info/type1/difangxin_gfaguiguizhang/id/31924.html	Public Website
49.	Henan Province People Government	Public information of the urban heating system "one city, one network" pattern	https://www.henan.gov.cn/2020/11-16/1890415.html	Public Website
50.	Development and Reform Commission of Henan province	Common Practice data source	http://fgw.henan.gov.cn/	Public Website
51.	VVB	Site Visit Photo	Photo taken by VVB during site visit including main equipment, monitoring devices, etc.	N/A
52.	IPCC	IPCC	2006 IPCC Guidelines for National Greenhouse Gas Inventories	Project Owner
53.	UNFCCC	CDM Approved Methodology AM0072	"AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating" (Version 03.0)	Project Owner
54.	UNFCCC	Methodological tool	Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)	Project Owner
55.	UNFCCC	Methodological tool	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)	Project Owner
56.	UNFCCC	Methodological tool	Tool to calculate the emission factor for an electricity system (Version 07.0)	Project Owner
57.	UNFCCC	Methodological tool	Common practice (Version 03.1)	Project Owner
58.	UNFCCC	Methodological tool	Investment analysis (version 110)	Project Owner
59.	VERRA	Joint-PD-MR Template	VCS-Joint-Project-Description-Monitoring-Report-Template-v4.1	VERRA
60.	VERRA	Registration and Issuance Process	Registration and Issuance Process version 4.1	VCS website
61.	VERRA	VCS Program Definitions	VCS Program Definitions, v4.1	VCS website
62.	VERRA	VCS Program Guide	VCS Program Guide, v4.1	VCS website
63.	VERRA	VCS Standard	VCS Standard version 4.2	VCS website

No	Author	Title	References to the document	Provider
64.	Google	Google Earth Map	earth.google.com	Website
65.	Ministry of Ecology and Environment of China	China cap & trade scheme	http://www.mee.gov.cn/xxgk2018/xxgk/xxgk02/202101/t20210105_816131.html	Public Website
66.	Ministry of Ecology and Environment of China	Enforced company list	http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf	Public Website
67.	China CER Exchange Info-platform	China CER	http://cdm.ccchina.org.cn/ccer.aspx	Website
68.	GS	Gold Standard	http://www.goldstandard.org/	Website
69.	UNFCCC	UNFCCC	http://cdm.unfccc.int	Website
70.	VCS	VCS	https://verra.org/project/vcs-program/	Website
71.	Three manufacturers	Three manufacturers of coal-fired boiler	Zozen Boilers 79%. https://www.zhongzhengguolu.cn/product/DZL-ran-mei-zheng-qi.html , Fengcheng Energy Equipment Factory 80%. https://www.nyglrq.com/CWNGre-shuiguolu/270.html , Henan Hengxin Boiler Manufacturing Co., Ltd 85%. http://hxglzz.com/3g/show.asp?m=1&d=3439 .	Public Website
72.	State Council of China	Three-year Action Plan to Win the Blue Sky Defense War	http://www.gov.cn/zhengce/content/2018-07/03/content_5303158.htm	Public Website
73.	Public Website	Public information of current natural gas network in Henan province	http://www.bulletin.cas.cn/publi sh article/2020/9/20200914.pdf	Public Website
74.	UNFCCC	CDM Standard	Applicability of sectoral scopes version 01.0	Public Website
75.	National System	National Enterprise Credit Information Publicity System	National Enterprise Credit Information Publicity System http://www.gsxt.gov.cn/	National Public Website

APPENDIX 4: CLARIFICATION REQUESTS, CORRECTIVE ACTION REQUESTS AND FORWARD ACTION REQUESTS

Table 1.Remaining FAR from validation and/or previous verification

FAR ID	N/A	Section no.		Date:
Description of FAR				
Project participant response				Date:
Documentation provided by project participant				
VVB assessment				Date:

Table 2.CL from this verification

CL ID	01	Section no.	1.15.2	Date : 05/05/2022
Description of CL				
If the project rejected by Other GHG Programs is not clarified in section 1.15.2.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: The project activity is not participating in other environment credits, other GHG programs and has not been rejected by any other GHG Programs.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that the clarification has been added. The project has neither been rejected by any other GHG programs which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes' website. CL 01 is closed.				

CL ID	02	Section no.	1.16.1	Date : 05/05/2022
Description of CL				
PP is not to clarify that how to avoid double counting of the project by considering China has a national emissions trading scheme.				
Project participant response				Date : 18/05/2022
Based on comments, the related content of Joint PD-MR has been modified, and the complete content is as follows: The project proponent is not part of any emission trading program. The net GHG emission reductions from the project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated under any other GHG programs. The project proponent is not part of any emission trading program. The net GHG emission reductions from the project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated under any other GHG programs. There is a cap & trade scheme in China. However, the project activity is not included the mandatory emission control scheme since the scheme only cover the high-emission industries, such as power generation sector that emitted at least 26,000 tons of CO ₂ e/year. There is no emission cap enforced for the project				

owner. In addition, the heating system of each heat substation can be identified through its GPS coordinates and unique identification code, which will prevent the geothermal heating system counted in the project activity to be part of any other voluntary market or emission reduction mechanism (CDM, CCER, GS etc.) as well. The project will not apply for emission reduction credits or labels under any other schemes except VCS. In addition, the project owner provided “Declaration of No Double Counting” and “Declaration of not involved in other GHG scheme”. In addition, the project owner provided “Declaration of No Double Counting” and “Declaration of not involved in other GHG scheme”.	
Documentation provided by project participant	
/1/- version 2.0 /35/ /36/	
VVB assessment	Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that the clarification has been added. The project proponent is not part of any emission trading program which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes’ website. The net GHG emission reductions during this monitoring period from the project was not used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated under any other GHG programs which has been confirmed via checking the UNFCCC/69/, GS/68/, VCS/70/ and other GHG schemes’ website, it is verified that the implementation of the project is consistent with the description in the Joint-PD-MR and the monitoring system is fully functional to generate Verified Carbon Units (VCUs) without any double counting for this monitoring period from 01-November-2020 to 31-March-2022. Besides, based on VVB’s local expertise, China has a national emissions trading scheme only cover the high-emission industries, such as power generation sector that emitted at least 26,000 tons of CO₂e/year which has been verified in the public website/65/, and it is confirmed that the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner by checking the enforced company list in public information/66/. Besides, the “Declaration of No Double Counting”/35/ and “Declaration of not involved in other GHG scheme”/36/ have been checked, CTI verified that PP promised not to double counting the project in any other scheme. Hence, it is confirmed that the emission reductions will not be double counted. CL 02 is closed.	

CL ID	03	Section no.	2.2	Date : 05/05/2022
Description of CL				
In section 2.2, the actual local stakeholder consultation process for this monitoring period is not clarified.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: Place and date of the meeting The stakeholder consultation was held from 9:00 a.m. to 11:30 a.m. on 25-January-2020 at Conference room, Shidai Building (101 Ziqi North Road, Luyi County, Zhoukou City, Henan Province, China). Meeting Participants The meeting was attended by local residents and representatives from the following stakeholder categories: 1. Local residents/farmers 2. Local government representatives 3. Representative of the project owner Meeting procedure ● Registration (30 min) ● Opening (15 min) ● Introduction by Wanjiang New Energy Group Co., Ltd. (15 min) ● Description of the project and environmental impacts (30 min)				

● Purpose of VCS, and relation of the project and VCS (30 min) ● Questions and Answers session (10 min) ● Completing questionnaire (20 min)
Documentation provided by project participant
/1/- version 2.0
VVB assessment Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that the actual local stakeholder consultation process for this monitoring period has been clarified. Refer to section 3.3.2 of this report for detail assessment. CL 03 is closed.

CL ID	04	Section no.	3.4	Date : 05/05/2022
Description of CL				
The demonstration of alternative 2 (i) is not clear. Clarification is requested.				
Project participant response				Date : 18/05/2022
It has been supplemented. In fact, the location of the project is not in the central heating area. District heating is not provided in the project area. Based on the comment, the related content of Joint PD-MR has been modified, and the complete content is as follows: Form the urban heating system "one city, one network" pattern, heating penetration rate of about 90%. The location of the project is not in the central heating area. District heating is not provided in the project area.				
Documentation provided by project participant				
/1/- version 2.0				
/49/				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that clarification is added. Via site inspection and checking the public information from Henan Province People Government/49/ and interview with local officers and residents, CTI confirmed that location of the project is not in the central heating area, no existing networks for the project area due to all the residential buildings of the 10 sub-areas were newly constructed, hence Alternative 2 (i) is ruled out accordingly. CL 04 is closed.				

CL ID	05	Section no.	5.1	Date : 05/05/2022
Description of CL				
For parameter EF _{CO2,i} , the PD is requested to clarify why the fuel type used in the boiler only include coking coal.				
Project participant response				Date : 18/05/2022
Based on the comment, the related content of Joint PD-MR has been modified, and the complete content is as follows: Where several fuel types are used in the boiler, use the fuel type with the lowest CO₂ emission factor. CO₂ emission factor of other bituminous coal and sub-bituminous coal are 89.5 tCO₂/TJ and 92.8 tCO₂/TJ separately, which are higher than that of coking coal. Coking coal and brown coal briquettes have the same CO₂ emission factor, coking coal is usually used for heating in coal boiler.				
Documentation provided by project participant				
/1/- version 2.0				
/29/				
VVB assessment				Date: 27/05/2022

The revised Joint-PD-MR is checked, CTI confirmed that clarification is added.
Via checking the Research on Heating in Winter of Zhoukou City published by Housing and Urban-Rural Development Department of Zhoukou City/29/, CTI confirmed that several fuel types are used in the boiler including bituminous coal, coking coal and sub-bituminous coal, and via the IPCC, CTI verified that fuel type with the lowest CO₂ emission factor has been used. CO₂ emission factor of other bituminous coal and sub-bituminous coal are 89.5 tCO₂/TJ and 92.8 tCO₂/TJ separately, which are higher than that of coking coal. Hence, it is reasonable and conservative that the fuel type used in the boiler only include coking coal for the ER calculation.
CL 05 is closed.

CL ID	06	Section no.	5.3	Date : 05/05/2022
Description of CL				
Emergency procedure is missing in monitoring plan.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: -For conservativeness, 0 value will be used for the missing data of $\Delta t_{j,d,y}$ and $FR_{j,d,y}$. -For $EC_{PJ,j,y}$ (EC_y), average monthly electricity consumption in the Joint-PD-MR (84,867.02MWh/10=8,486.70 MWh) or average electricity consumption of the previous months whichever is higher will be used for missing data. This is the most conservative approach.				
Documentation provided by project participant				
/1/- version 2.0 /29/				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that emergency procedure is added. Project proponents will take actions to make sure the emission calculations to be conservative. 0 value will be used for the missing data of $\Delta t_{j,d,y}$ and $FR_{j,d,y}$. And conservative approach will be used for determine $EC_{PJ,j,y}$ (EC_y). The procedure is confirmed as actual and reasonable. CL 06 is closed.				

CL ID	07	Section no.	6.5	Date : 05/05/2022
Description of CL				
The comparison between the ex-ante determined ER value and actual ER value achieved is not clarified clearly due to the parameter A_m is not considered.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: The estimated outcomes for the 1 st monitoring period (01-November-2020~31-March-2022) is 867,342 tCO ₂ e. The actual heating area lost due to the influence of the actual occupancy rate in year y (A_m), average temperature difference between inlet and outlet temperatures at the downstream of each substation heat exchanger in year y ($\Delta t_{j,d,y}$), average flow rate at the downstream of each heat exchanger in year y ($FR_{j,d,y}$), hours per hear heat utilization in well j (T_j) and electricity consumption for the year y in operating the geothermal heating system($EC_{PJ,j,y}$ (EC_y)) should be monitored. Emission reductions for the 1 st monitoring period was 867,342 tCO ₂ e. Net heating area for construction, and the changes of the five parameters lead to the difference between the estimated value and actual value for emission reductions.				
Documentation provided by project participant				
/1/- version 2.0 /9/				
VVB assessment				Date: 27/05/2022

The revised Joint-PD-MR is checked, CTI confirmed that comparison has been updated. CTI confirmed that the actual value during this monitoring period was found to be 12.44% lower than ex-ante estimated value for this project during this monitoring period, via comparing with the estimated value, CTI verified that the change of five parameters, i.e. A_m , $\Delta t_{j,d,y}$, $FR_{j,d,y}$, T_j and $EC_{PJ,j,y}$ impact the actual emission reduction calculation, however, the actual outcome was 6,871,047.47 m² of residential buildings can access to geothermal energy (A_m) based space heating system in 2020-2021 heating season and the actual outcome was 7,186,579.28 m² of residential buildings can access to geothermal energy (A_m) based space heating system in 2021-2022 heating season which is determined by the Heating supply contracts/9/, and another four parameters depend on the local heating duration and the continuous heating hours of different building types and heating demand of the end-users, which are affected by atmospheric environment temperature, running status of the geothermal heating system and other aspects which changes over time. Hence CTI verified that the actual value lower than estimated one is reasonable and acceptable.

CL 07 is closed.

Table 3.CAR from this verification

CAR ID	01	Section no.	1.1	Date : 05/05/2022
Description of CAR				
The actual ER achieved and VCUs claimed for this monitoring period are not provided in section 1.1.				
Project participant response				Date : 18/05/2022
Based on the comment, the related content of Joint PD-MR has been modified, and the complete content is as follows: Emission reduction credits will be earned using geothermal energy instead of the combustion of fossil fuel for space heating. The annual average CO ₂ emission reductions are estimated as 495,289 tCO ₂ e, and total GHG emission reductions for the fixed 10 years crediting period are 4,817,400 tCO ₂ e. The date of crediting period is 01-November-2020 to 31-October-2030. The actual Emission reductions achieved. The date of monitoring period is 01-November-2020 to 31-March-2022.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that actual ER achieved and VCUs claimed for this monitoring period are provided accordingly, the values are confirmed as correct and have been confirmed in line with other parts of the Joint-PD-MR. CAR 01 is closed.				

CAR ID	02	Section no.	1.14	Date : 05/05/2022
Description of CAR				
How the project complies with all the related Chinese relevant laws and regulations is not specified in detail.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, please refer to section 1.14 of Joint PD-MR.				
Documentation provided by project participant				
/1/- version 2.0 /6/ /8/ /20/				
VVB assessment				Date: 27/05/2022

The revised Joint-PD-MR is checked, CTI confirmed that the compliance has been specified in detail. The Joint-PD-MR has stated that the project is in the field of renewable energy, this industry is confirmed as in line with the laws and regulations as listed in the Joint-PD-MR/46/,/47/,/48/. Also the project is legally approved by Local government by checking the project approval/6/, Water drawing permit/20/ and EIA approval/8/, which means that the project is in line with the national and local laws and regulations based on the local expertise of the VVB. And as stated in the Joint-PD-MR/1/ and confirmed by interview with local officer/12/, CTI verified that the project will be subject to regular inspection by local government during the implementation period to ensure continuous compliance. In conclusion, the project complies with all relevant local, regional and national laws, statutes and regulatory frameworks in China. CAR 02 is closed.

CAR ID	03	Section no.	1.17	Date : 05/05/2022
Description of CAR				
PP is requested to demonstrate that a project contributes to at least three SDGs by the end of the first monitoring period, and in each subsequent monitoring period as per the section 3.16 of VCS Standard version 4.2.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, please refer to Section 1.17.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that actual project contributes to three SDGs by the end of the first monitoring period has been specified and verified as in line with the section 3.16 of VCS Standard version 4.2/63/. Refer to section 3.1 of this report for detail assessment. CAR 03 is closed.				

CAR ID	04	Section no.	2.4	Date : 05/05/2022
Description of CAR				
The actual information of public comments from VCS GSC is not specified.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: As per section 3.16.5 of the VCS Standard (Version 4.2), all projects are subject to a 30-day public comment period. The date on which the project is listed on the project pipeline marks the beginning of the project's 30-day public comment period. This project has been put up for public comment on the verra website and no public comment has been received. This project has been put up for public comment on the verra website and no public comment has been received. This project was open for public comment from 29-March-2022 to 28-April-2021				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that the information has been added. The project sought the registration with the VCS Program, according to VCS requirements the Project Description was submitted for public comment period. The project was allocated with VCS ID 2659. The public comment period started on 29-March-2022 and ended on 28-April-2022 (https://registry.verra.org/app/projectDetail/VCS/2659). No comments were received during this period which has been verified by checking the dedicated website as above. CAR 04 is closed.				

CAR ID	05	Section no.	3.3	Date : 05/05/2022
Description of CAR				

PP is requested to provide the correct source type regarding the 'Electricity used for geothermal extraction/operations' in table 3-1, section 3.3 of the PD-MR as it is described in paragraph 37 of the AM0072 v03.0.	
Project participant response	Date : 18/05/2022
According to paragraph 37 of AM0072 V03.0, the PP has corrected about the source of 'Electricity used for geothermal extraction /operations'.	
Documentation provided by project participant	
/1/- version 2.0	
VVB assessment	Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that the source of 'Electricity used for geothermal extraction /operations' has been added correctly which is confirmed in line with the paragraph 37 of the AM0072 v03.0. CAR 05 is closed.	

CAR ID	06	Section no.	3.4	Date : 05/05/2022
Description of CAR				
1. For demonstration all the alternatives, 4 (ix) as listed in the applied methodology is not stated.				
2. For step 1b, how the remaining alternatives consistent with mandatory laws and regulations is not specified.				
3. The date sources for all the key inputs to calculate LCOH are missing.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been supplemented, and the complete content is as follows:				
1.				
(ix) Individual heating devises using non-renewable biomass.		As illustration of 3 (v) above, there is no sufficient biomass in the project area. Technical barriers for the commercialization of household biomass heating devices are still existing.	Excluded	
2. Step 1b: Consistency with mandatory laws and regulations				
As per Planning of Clean Heating in Winter of Northern China (2017-2021), the energy used for heating in northern China is mainly coal, which accounts for about 83% of the total heating area. In urban areas, central heating facilities such as cogeneration unit and regional boiler houses are used to supply heat in winter. The areas that are not covered by central heating system mainly use coal-fired boilers supplying several buildings through a small heat distribution network as a supplement.				
The General Office of the People's Government of Henan Province issued the Implementation Plan of Air Pollution Prevention and Control in 2018, pointing out that the development of "double substitute" heating will be accelerated. In areas not covered by natural gas pipelines, great efforts should be made to develop electric heating methods such as heat pumps, electric boilers and air conditioners.				
In summary, alternative 1(a) and 3(i) are considered to follow all mandatory applicable legal and regulatory requirements. The outcome of Step 1b is unchanged from Step 1a.				
3. The date sources for all the key inputs to calculate LCOH are provided clearly in the updated Joint-PD-MR.				
Documentation provided by project participant				
/1/- version 2.0				
WB assessment				Date: 27/05/2022

1. The revised Joint-PD-MR is checked, CTI confirmed that the demonstration for 4(ix) has been added.
 2. The revised Joint-PD-MR is checked, CTI confirmed that the remaining alternatives consistent with mandatory laws and regulations has been specified clearly.
 3. The revised Joint-PD-MR is checked, CTI confirmed that the data sources have been added which is confirmed consistent with the LCOH calculation sheet/3/. The sources are confirmed as correct and relevant and all the input values are verified as consistent with the source.
- Refer to section 3.4.4 of this report for detail assessment.
CAR 06 is closed.

CAR ID	07	Section no.	3.5	Date : 05/05/2022
Description of CAR				
The formula for define N_{all} is not consistent with the determination of N_{all} in step 2. Revision is requested.				
Project participant response				Date : 18/05/2022
The part about N_{all} has been consistent with step 2, and in fact the range of N_{all} is as follows: In Henan province, all geothermal based space heating system that deliver the same output or capacity as calculated in step 1 (range of 199.74 MW-599.22 MW), the projects use the same energy source/fuel and feedstock as the proposed project activity, and it have started commercial operation before the start date of the project (01-November-2020).				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR is checked, CTI confirmed that the determination of N_{all} has been revised. Refer to section 3.4.5 of this report for detail assessment. CAR 07 is closed.				

CAR ID	08	Section no.	4.4	Date : 05/05/2022
Description of CAR				
The ex ante calculation of ER value is not correct due to the values of $HS_{y,estimated}$ are not correctly calculated, revision is requested.				
Project participant response				Date : 18/05/2022
The table format of ER value has been unified with the template of Joint PD-MR, please refer to Section 4.4.				
Documentation provided by project participant				
/1/- version 2.0 /2/- version 2.0				
VVB assessment				Date: 27/05/2022
The revised Joint-PD-MR and ER sheet are checked, CTI confirmed that the calculation has been updated and the final value of ER is verified as correct in both Joint-PD-MR and ER sheet. CAR 08 is closed.				

CAR ID	09	Section no.	5.3	Date : 05/05/2022
Description of CAR				
The monitored parameters listed in the section of "Parameters to be monitored" are not consistent with the section 5.2.				
Project participant response				Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: Parameters to be monitored The monitoring requirements for this methodology include the monitoring of parameters for both baseline and project emissions calculations. All provisions in the methodology and relevant tools shall apply, as described for each parameter in section 5.2 of the Report.				

For the parameters of A_m , net heating area for construction type m (A_m) will be determined based on heating supply contracts.

Heating index for construction type m (HI_m) is sourced from the conservative standard index as provided by the FSR. The values should be updated according to the latest national and local standards. Local standards take precedence over national standards.

Average technical transmission and distribution losses for providing electricity to source j in year y ($TDL_{j,y}$) shall be determined using the latest version of Tool 05.

Hours per hear heat utilization in well j (T_j) will be sourced from data logged in the Geothermal system (Operation Record of the Geothermal Space Heating System). Monthly operation time of the 44-heat exchange system will be exported by the GS monitoring team at the beginning of the next month. The operation record of the geothermal heating system during the related heating season will be summarized by all the monthly record. Besides, the winter heating season is fixed by local regulations, which is usually from November 1 to March 31 of the next year, last day not included (150 days). The actual number of heating hours are sourced from operation record of the geothermal based space heating system.

Combined margin emission factor for the grid in year y ($EF_{EL,j,y}$ ($EF_{grid,CM,y}$)) is calculated using the procedures in the latest version of Tool 07. It shall be determined as per the latest Baseline emission factors of China's regional power grid for emission reduction projects published by Ministry of Ecology and Environment of the People's Republic of China.

Above all, the monitoring system only need to address the monitoring of parameter $\Delta t_{j,d,y}$, $FR_{j,d,y}$ and $EC_{PJ,j,y}$ (EC_y).

Documentation provided by project participant

/1/- version 2.0

VVB assessment

Date: 27/05/2022

The revised Joint-PD-MR is checked, CTI confirmed that all the monitored parameters have been added which are confirmed as consistent with the section 5.2.

CAR 09 is closed.

CAR ID	10	Section no.	1.11	Date	: 05/05/2022
Description of CAR					
The actual area of residential buildings that supplied with geothermal heat and actual heating load for this monitoring period are not specified.					
Project participant response					Date : 18/05/2022
The related content of Joint PD-MR has been modified, and the complete content is as follows: The project started construction on 01-March-2020 and has put into test run operation on 01-November-2020. Operation start date and test run period are the same and start on 01-November-2020. It can supply geothermal heat to 7,989.6 thousand m² of residential buildings with a total heating load of 399.48 MW. It is affected by the actual occupancy rate. The residential area where the project is located is newly built and the occupancy rate is 86.6% from 01-November-2020 to 31-March-2021, 89.9% from 01-November-2021 to 31-March-2022, which leads to the actual heating area and load in the first monitoring period being smaller than the design value. For the monitoring period from 01-November-2020 to 31-March-2021, 6,871,047.47m² of residential buildings with a heating load of 343.55MW. For the monitoring period from 01-November-2021 to 31-March-2022, 7,186,579.28 m² of residential buildings with a heating load of 359.33MW.					
Documentation provided by project participant					
/1/- version 2.0					
/9/					
VVB assessment					Date : 27/05/2022

The revised Joint-PD-MR is checked, CTI confirmed that all the actual values are provided. The utilization hours of the geothermal heating system were 7,248 hours during this monitoring period (01-November-2020-31-March-2022). It provided geothermal heat to 6,871,047.47 m² of residential buildings with a total heating load of 343.55MW for 2020-2021 heating season (01-November-2020 to 31-March-2021) and provided geothermal heat to 7,186,579.28 m² of residential buildings with a total heating load of 359.33MW for 2021-2022 heating season (01-November-2021 to 31-March-2022) which is confirmed as in line with the heating supply contract/9/ due to not all residential buildings access to geothermal energy-based space heating system in the early of 2020-2021 and 2021-2022 winter seasons.
CAR 10 is closed.

CAR ID	11	Section no.	6	Date : 05/05/2022
Description of CAR				
- The actual monitoring values for parameter $EC_{PJ,j,y}$ (EC_y) are not listed for the whole monitoring period, there are 8 months gap. Revision and clarification is requested. - For BE, PE and ER calculation results listed, the monitoring period is not continuous, there are 8 months gap. Revision and clarification is requested.				
Project participant response				Date : 18/05/2022
- The actual monitoring values for parameter during 01-April-2021-31-October-2021 have been added in the related content of Joint PD-MR. - The related content of Joint PD-MR has been modified, please refer to section 6 of Joint PD-MR.				
Documentation provided by project participant				
/1/- version 2.0				
/2/- version 2.0				
VVB assessment				Date: 27/05/2022
- The revised Joint-PD-MR and ER sheet are checked, CTI confirmed that the values for the gap months have been added, due to the project is only operated during the heating season from November to March, hence no heating figures and electricity used during the 8 months from April to October, the final value of monitoring is verified as correct in both Joint-PD-MR and ER sheet. - The revised Joint-PD-MR and ER sheet are checked, CTI confirmed that the BE, PE and ER calculation results for gap months have been added, due to the project is only operated during the heating season from November to March, hence no BE, PE and ER during the 8 months from April to October, the final values of BE, PE and ER are verified as correct in both Joint-PD-MR and ER sheet.				
CAR 11 is closed.				

Table 4.FAR from this verification

FAR ID	N/A	Section No.	-	Date: -
Description of FAR				
Project participant response				Date: -
Documentation provided by project participant				
VVB assessment				Date: