



RUIJING GEOTHERMAL BASED SPACE HEATING SYSTEM



Document Prepared by Profit Carbon Environmental Energy Technology
(Shanghai) Co., Ltd.

Project Title	Ruijing Geothermal Based Space Heating System
Version	03
Date of Issue	22-September-2022
Prepared By	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
Contact	No.2815 Longteng Avenue, Baihui Park full river view office building, Shanghai, China Telephone: +86 21 6127 2386 Email: info@profitcarbon.com http:// www.profitcarbon.com/

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1 PROJECT DETAILS

1.1 Summary Description of the Project

It is pointed out in *the Plan for Clean Heating in Winter in Northern China (2017-2021) (Development and Reform of Energy resources (2017) No. 2100)*¹ that, at present, the proportion of clean heating in northern China is low, especially in some areas, where bulk burning coal is used in winter and air pollutant emissions are high, so it is urgent to promote clean heating. This will have a bearing on the winter warmth of the people in northern China and whether smog can be reduced. It is an important part of the revolution in energy production and consumption and the revolution in rural lifestyles.

According to the requirements of the above Plan, Zhoukou municipal government will take a series of measures to improve the environment and residents' living conditions. The project activity is designed to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings in Zhoukou city 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 owner is Wanjiang New Energy Group Co. Ltd. It can supply geothermal heat to 7,989.6 thousand m² of newly built residential buildings with a total heating load of 399.48 MW. The scenario prior to the implementation of the proposed project activity is that heat supplied to the building areas in winter would be provided by isolated coal-fired boilers.

Emission reduction credits will be earned using geothermal energy instead of the combustion of fossil fuel for space heating. The annual average CO₂ emission reductions are estimated as 495,289 tCO₂e, and total GHG emission reductions for the fixed 10 years crediting period are 4,952,890 tCO₂e. The date of crediting period is 1-November-2020–31-October-2030.

Emission reductions achieved in the first monitoring period (1-November-2020–31-March-2022 (first and last days included)) is 867,337 tCO₂e.

1.2 Sectoral Scope and Project Type

The project is not a grouped project, sectoral scope and methodologies are as follows:

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

The project type of this project falls into Type II: End-use energy efficiency project improvement.

Project Methodology: AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating (Version 03.0)

¹ <https://www.gov.cn/xinwen/2017-12/20/5248855/files/7ed7d7cda8984ae39a4e9620a4660c7f.pdf>

1.3 Project Eligibility

The scope of the VCS Program includes:

1) The six Kyoto Protocol greenhouse gases: The project only considers the reduction of Carbon Dioxide (CO₂) Emissions for VCS Standard crediting. Refer to section 3.3 of the Report for further details. Thus, the project applicable to this scope.

2) Ozone-depleting substances: NA.

3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process: NA.

4) Project activities supported by a methodology approved under a VCS approved GHG

program, unless explicitly excluded under the terms of Verra approval: The methodology AM0072 (Version 03.0) of the project utilized is a methodology approved under CDM Program, that is a VCS approved GHG program.

5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program

document Jurisdictional and Nested REDD+ (JNR) Requirements: NA.

Meanwhile, the project is not belonged to the projects excluded in Table 1 of VCS Standard 4.2. Thus, the project is eligible under the scope of VCS program.

Eligibility of the project under VCS Standard:

The proposed project falls under section 3.1 General Requirements of VCS Standard with the following eligibility criteria:

Eligibility Criteria	Justification
Section 3.1.1 of VCS Standard (Version 4.2) Projects shall meet all applicable rules and requirements set out under the VCS Program, including this document. Projects shall be guided by the principles set out in Section 2.2.1.	The project meets all applicable rules and requirements as set out under the VCS Program.
Section 3.1.2 of VCS Standard (Version 4.2) Projects shall apply methodologies eligible under the VCS Program. Methodologies shall be applied in full, including the full application of any tools or modules referred to by a methodology, noting the exception set out in Section 3.13.1. The list of methodologies and their validity periods is available on the Verra website.	The project applies CDM approved methodology AM0072 (version 03.0) which is an eligible VCS methodology along with tool or modules as applicable. Refer to section 3.1 and 3.2 of the PD below for more details.
Section 3.1.3 of VCS Standard (Version 4.2)	Projects are following currently applicable laws. According to the environmental impact

Projects and the implementation of project activities shall not lead to the violation of any applicable law, regardless of whether or not the law is enforced.	assessment report (EIA) of the project, the project complies with all Chinese relevant laws and regulations. Refer to section 1.14 of the PD below for more details.
Section 3.1.4 of VCS Standard (Version 4.2) Where projects apply methodologies that permit the project proponent its own choice of model (see the VCS Program document Program Definitions for definition of model), such model shall meet with the requirements set out in the VCS Program document VCS Methodology Requirements and it shall be demonstrated at validation that the model is appropriate to the project circumstances (i.e., use of the model will lead to an appropriate quantification of GHG emission reductions or removals).	Not applicable. There is no model need to be chosen by the project proponent as per the applied methodology AM0072 (version 03.0).
Section 3.1.5 of VCS Standard (Version 4.2) Where projects apply methodologies that permit the project proponent its own choice of third party default factor or standard to ascertain GHG emission data and any supporting data for establishing baseline scenarios and demonstrating additionality, such default factor or standard shall meet with the requirements set out in the VCS Program document VCS Methodology Requirements.	Not applicable. There is no third-party default factor or standard need to be chosen by the project proponent as per the applied methodology AM0072 (version 03.0).
Section 3.1.6 of VCS Standard (Version 4.2) Projects shall preferentially apply methodologies that use performance methods (see the VCS Program document VCS Methodology Requirements for further information on performance methods) where a methodology is applicable to the project that uses a performance method for determining both additionality and the crediting baseline (i.e., a project shall not apply a methodology that uses a project method where such a performance method is applicable to the	Baseline scenario and additionality have been analysed as per the applied methodology AM0072 (version 03.0) and tool 02 (Version 07.0). Refer to section 3.4 and 3.5 of the PD for more details.

project).Methodologies approved under the VCS Program that use performance methods provide a list of similar methodologies that use project methods (that were approved under the VCS Program or an approved GHG program at the time the performance method was developed). Such lists are not necessarily exhaustive but can serve as the starting point for determining whether a performance method is applicable to the project. Following the approval of a methodology that uses a performance method, projects may use any applicable pre-existing methodology that uses a project method for a six-month grace period.	
Section 3.1.7 of VCS Standard (Version 4.2) Where the rules and requirements under an approved GHG program conflict with the rules and requirements of the VCS Program, the rules and requirements of the VCS Program shall take precedence.	Not applicable.
Section 3.1.8 of VCS Standard (Version 4.2) Where projects apply methodologies from approved GHG programs, they shall comply with any specified capacity limits (see the VCS Program document Program Definitions for definition of capacity limit) and any other relevant requirements set out with respect to the application of the methodology and/or tools referenced by the methodology under those programs.	Not applicable. There is no specified capacity limits and any other relevant requirements set out as per the applied methodology and tools.
Section 3.1.9 of VCS Standard (Version 4.2) Where Verra issues new requirements relating to projects, registered projects do not need to adhere to the new requirements for the remainder of their project crediting periods (i.e., such projects remain eligible to issue VCUs through to the end of their project crediting period without revalidation against the new requirements). The new requirements	This is the fixed crediting period of the project, and it has fellow all the latest requirements of Verra.

shall be adhered to at project crediting period renewal, as set out in Section 3.8.9.	
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1.4 Project Design

The project is designed to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings in Zhoukou city over winter season. There are totally 10 communities involved in the project activity, the project has been designed to include the single project activity.

Eligibility Criteria

The project is not a grouped project. So, it's not applicable.

1.5 Project Proponent

Organization name	Wanjiang New Energy Group Co., Ltd.
Contact person	Xiang kang
Title	General Manager
Address	Room 1201, 1202, 1203, 1206, 12 / F, Yizhong Building, No.75 Qilihe South Road, Zhengzhou (East of Zhengzhou), Henan Pilot Free Trade Zone.
Telephone	+86 18861818351
Email	sharkshark999@163.com

1.6 Other Entities Involved in the Project

Organization name	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
Role in the project	VCS Consultant
Contact person	Joanna zhu
Title	Project Manager

Address	No.2815 Longteng Avenue, Baihui Park full river view office building, Shanghai, China
Telephone	+86 (0)21 6127 2386
Email	yanan.zhu@profitcarbon.com

1.7 Ownership

As per business license of Wanjiang New Energy Group Co., Ltd., the business scope of it includes development and utilization of geothermal resources for heating supply. As per approval of Environmental Impact Assessment (EIA) and Feasibility Study Report (FSR) of the project, the whole geothermal space heating system were invested by Wanjiang New Energy Group Co., Ltd. It will offer a heating fee lower than the market price for the end users. Heating supply contracts including carbon waiver agreement were signed with each community to make sure Wanjiang New Energy Group Co., Ltd. has the legal ownership of the carbon credits generated by the project activity. .

1.8 Project Start Date

As per section 3.7 of VCS Standard (Version 4.2), the project start date of a non-AFOLU project is the date on which the project began generating GHG emission reductions or removals. The project has been designed to include single project activity instance. There are 10 communities involved in the project activity and all the geothermal space heating system of them started fully commissioning on 1-November-2020. Thus, the project start date is 1-November-2020.

1.9 Project Crediting Period

This project adopts fixed crediting periods of 10 years. The crediting period is 10 years from 1-November-2020 to 31-October-2030 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The project annual average CO₂ emission reductions are estimated as 495,289 tCO₂e, which is larger than 300,000 tCO₂e. As per Section 3.1.9 of VCS Standard (Version 4.2), it is a large project.

Project Scale	
Project	
Large project	×

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
1-November-2020-31-October-October-2021	495,289
1-November-2021-31-October-October-2022	495,289
1-November-2022-31-October-October-2023	495,289
1-November-2023-31-October-October-2024	495,289
1-November-2024-31-October-October-2025	495,289
1-November-2025-31-October-October-2026	495,289
1-November-2026-31-October-October-2027	495,289
1-November-2027-31-October-October-2028	495,289
1-November-2028-31-October-October-2029	495,289
1-November-2029-31-October-October-2030	495,289
Total estimated ERs	4,982,890
Total number of crediting years	10
Average annual ERs	495,289

1.11 Description of the Project Activity

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.

A total of 66 thermal wells with a design depth of 2,300 meters were constructed, 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. In terms of terminal devices of heating configuration of users, floor radiation will be used as per Feasibility Study Report of the project. Technologies and measures employed by the project activity are shown in Figure 1-1 below.

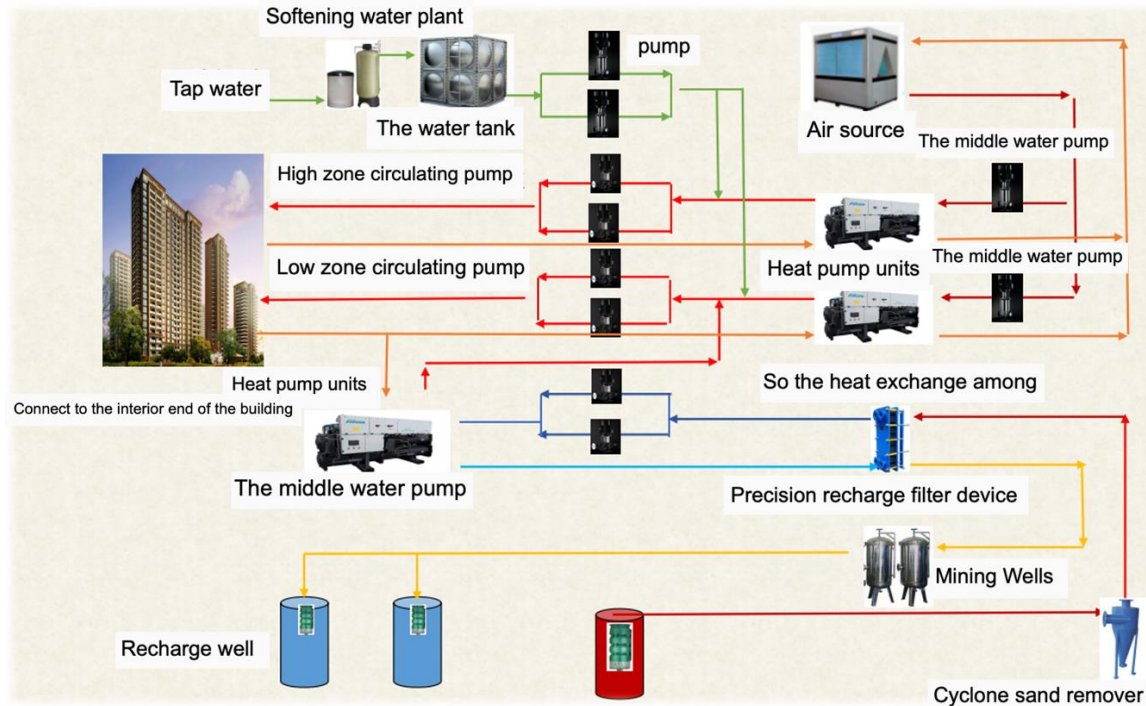


Figure 1-1 Technologies and Measures Employed by the Project Activity

A total of 44 heat substations in 10 sub-areas were constructed 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, tank, and water-softening facilities. All the geothermal wells, heat substations and related facilities were newly constructed. As per operation manual of the geothermal space heating system, the lifetime of the heat pump units, the water circulation and air duct system, and the underground pipeline system is 15-20 years, more than 25 years and 50 years separately. Therefore, the lifetime of the whole geothermal space heating system is more than 15 years.

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 343.55MW². 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 359.33MW³. The heating load of different sub-areas is calculated based on the heating area. The Main equipment and parameters of the 44 heat substations are shown in Table below.

Table 1-1 Main Equipment of Each Heat Substation

1#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q ⁴ =70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	9	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
2#LBC				

² According to the design area and heat load can be obtained the actual heat load is 6,871,047.47m²/7,989,600m²*399.48MW=343.55MW.

³ According to the design area and heat load can be obtained the actual heat load is 7,186,579.28m²/7,989,600m²*399.48MW=359.33MW.

⁴ Flow rate.

Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
3#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	6	Using variable frequency regulation system

Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
4#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
5#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	2	

Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
6#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	

Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
7#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water: 50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water: 24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
8#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange	Unit	1	

	temperature of supply water and return water:50/40 °C			
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
9#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	6	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	5	

Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	3	Supplemental heat source
10#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	5	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	3	Supplemental heat source
11#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange	Unit	3	

	temperature of supply water and return water:24/8 °C			
Circulating pumps	Q=250 m³/h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m³/h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	8	Supplemental heat source
12#LBC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m³/h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m³/h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m³/h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	4	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	2	Supplemental heat source
1#FJC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks

Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
2#FJC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system

Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
3#FJC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
4#FJC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	

Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	9	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	8	Supplemental heat source
5#FJC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	2	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	

Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
6#FJC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
1#DHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange	Unit	3	

	temperature of supply water and return water:50/40 °C			
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
2#DHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	

Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
3#DHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	6	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	5	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	3	Supplemental heat source
4#DHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange	Unit	1	

	temperature of supply water and return water:24/8 °C			
Circulating pumps	Q=235m ³ /h, 4Head=55 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	5	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	3	Supplemental heat source
5#DHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	8	Supplemental heat source
6#DHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks

Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=250 m ³ /h, Head=53 m	Unit	6	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	4	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	2	Supplemental heat source
1#ZHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	6	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system

Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
2#ZHC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
1#XCC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C;	Unit	3	

	Secondary heat exchange temperature of supply water and return water:50/40 °C			
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	8	Supplemental heat source
2#XCC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	4	

Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	2	Supplemental heat source
1#HDC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
2#HDC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	

Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
3#HDC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source

4#HDC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	9	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	8	Supplemental heat source
1#JYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange	Unit	3	

	temperature of supply water and return water:24/8 °C			
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
2#JYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
3#JYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks

Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	6	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	5	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	3	Supplemental heat source
4#JYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=235 m ³ /h, Head=55 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system

Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	5	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	3	Supplemental heat source
1#LTC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	1	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	1	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	9	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
2#LTC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	

Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
1#YZC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	6	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	

Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	6	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	4	Supplemental heat source
2#YZC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source
1#FYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	2	

Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	2	
Circulating pumps	Q=200 m ³ /h, Head=53 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	5	Supplemental heat source
2#FYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	7	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source

3#FYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange temperature of supply water and return water:24/8 °C	Unit	3	
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	9	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	10	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	8	Supplemental heat source
4#FYC				
Equipment Name	Models and Specifications	Unit	Quantity	Remarks
Deep-well pump	Q=70 m ³ /h, Head=235 m	Unit	6	Using variable frequency regulation system
Hydro-cyclones	Treatment capacity: 80 t/h	Unit	1	
Primary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 75/43 °C; Secondary heat exchange temperature of supply water and return water:50/40 °C	Unit	3	
Secondary plate heat exchanger	Primary heat exchange temperature of supply water and return water: 43/9 °C; Secondary heat exchange	Unit	3	

	temperature of supply water and return water:24/8 °C			
Circulating pumps	Q=250 m ³ /h, Head=58 m	Unit	8	Using variable frequency regulation system
Make-up pumps	Q=25 m ³ /h, Head=20 m	Unit	2	Using variable frequency regulation system
Tanks	Effective volume: 100 m ³	Unit	1	
Water-softening facilities	Treatment capacity: 75 t/h	Set	1	
Water source geothermal heat pumps	Model: WJS-H52F/XF-F	Unit	8	
Air source geothermal heat pumps	Model: WJK-G10B-7.2D	Unit	6	Supplemental heat source

Table 1-2 Main Parameters of the 44 Heat Substations

No.	Sub-area	Heat substation	Geothermal wells		Heat load (MW)	Heating area (thousand m ²)
			Number of production wells	Number of Re-injection wells		
1	Lv bo community	12	12	6	104.650	2,093.00
2	Fajina community	6	6	3	45.90	918.00
3	Dehong community	6	6	3	60.90	1,218.00
4	Zhongheng community	2	2	1	23.75	475.00
5	Zhongyang community	2	2	1	19.30	386.00
6	Hengda community	4	4	2	32.75	655.00
7	Jianye community	4	4	2	39.40	788.00
8	Langting community	2	2	1	23.68	473.60
9	Yuezhuang community	2	2	1	21.81	436.10
10	Fangyuan community	4	4	2	27.35	546.90

Total	44	44	22	399.48	Residential buildings 7,989.60
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All the building covered by the project were newly built buildings and there was no existing heating system prior to the project activity. In baseline scenario, heating supply in winter for the building areas will be provided by newly built coal-fired boilers in boiler house.

1.12 Project Location

The project is in Zhoukou City of Henan Province, China. The geographical coordinates are 33°03'-34°20'N, 114°05'-115°39'E. The detailed coordinates of the 66 geothermal Wells are provided in Table 1-3 below.

Table 1-3 Coordinates of 66 Geothermal Wells

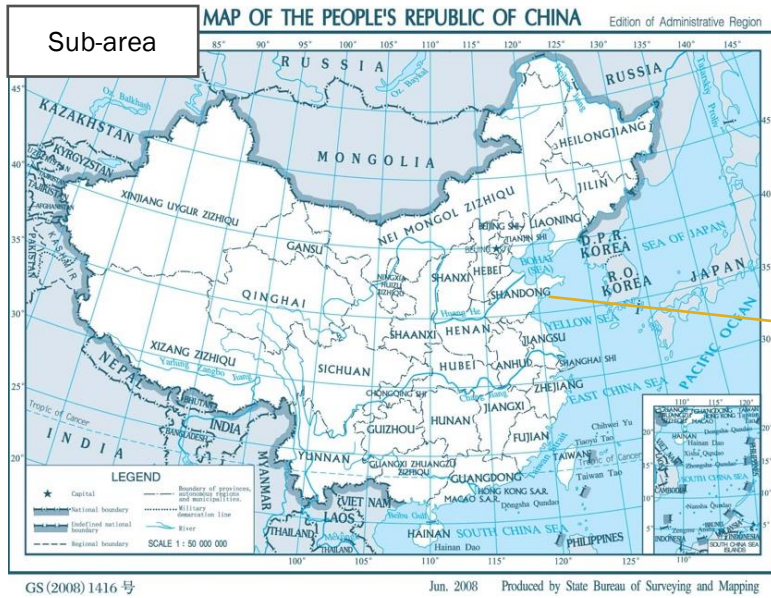
No.	Sub-areas	Heat Substations	Geothermal Wells	Coordinate
1	Lvbo community	1#LBC 2#LBC	1#LBC Production Well	33°52'33.5"N 115°29'37.1"E
			2#LBC Production Well	33°52'32.1"N 115°29'36.2"E
			1#LBC Injection Well	33°52'31.1"N 115°29'35.9"E
		3#LBC 4#LBC	3#LBC Production Well	33°52'33.8"N 115°29'38.6"E
			4#LBC Production Well	33°52'32.1"N 115°29'37.8"E
			2#LBC Injection Well	33°52'30.0"N 115°29'37.6"E
		5#LBC 6#LBC	5#LBC Production Well	33°52'33.4"N 115°29'41.2"E
			6#LBC Production Well	33°52'31.2"N 115°29'40.8"E
			3#LBC	33°52'29.0"N 115°29'40.9"E

			Injection Well	
		7#LBC 8#LBC	7#LBC Production Well	33°52'32.9"N 115°29'44.6"E
			8#LBC Production Well	33°52'31.2"N 115°29'43.9"E
			4#LBC Injection Well	33°52'29.2"N 115°29'43.5"E
		9#LBC 10#LBC	9#LBC Production Well	33°52'32.6"N 115°29'46.8"E
			10#LBC Production Well	33°52'30.5"N 115°29'46.6"E
			5#LBC Injection Well	33°52'28.8"N 115°29'46.3"E
		11#LBC 12#LBC	11#LBC Production Well	33°52'32.3"N 115°29'49.5"E
			12#LBC Production Well	33°52'30.7"N 115°29'49.2"E
			6#LBC Injection Well	33°52'32.5"N 115°29'51.1"E
2.	Fajina community	1#FJC 2#FJC	1#FJC Production Well	33°52'21.3"N 115°30'00.9"E
			2#FJC Production Well	33°52'20.1"N 115°29'60.0"E
			1#FJC Injection Well	33°52'18.9"N 115°30'00.3"E
		3#FJC 4#FJC	3#FJC Production Well	33°52'20.8"N 115°30'04.7"E
			4#FJC Production Well	33°52'19.2"N 115°30'04.5"E

			2#FJC Injection Well	33°52'17.8"N 115°30'04.2"E
		5#FJC 6#FJC	5#FJC Production Well	33°52'21.0"N 115°30'08.1"E
			6#FJC Production Well	33°52'19.2"N 115°30'07.4"E
			3#FJC Injection Well	33°52'20.1"N 115°30'08.5"E
3	Dehong community	1#DHC 2#DHC	1#DHC Production Well	33°52'44.0"N 115°29'13.7"E
			2#DHC Production Well	33°52'43.2"N 115°29'14.4"E
			1#DHC Injection Well	33°52'41.7"N 115°29'15.4"E
		3#DHC 4#DHC	3#DHC Production Well	33°52'42.4"N 115°29'12.0"E
			4#DHC Production Well	33°52'43.7"N 115°29'12.0"E
			2#DHC Injection Well	33°52'45.4"N 115°29'11.7"E
		5#DHC 6#DHC	5#DHC Production Well	33°52'41.9"N 115°29'09.6"E
			6#DHC Production Well	33°52'42.6"N 115°29'07.9"E
			3#DHC Injection Well	33°52'43.0"N 115°29'05.9"E
4	Zhongheng community	1#ZHC	1#ZHC Production Well	33°52'12.3"N 115°29'53.1"E
		2#ZHC	2#ZHC	33°52'09.5"N 115°29'53.0"E

			Production Well	
			1#ZHC Injection Well	33°52'06.4"N 115°29'55.5"E
5	Xincheng community	1#XCC 2#XCC	1#XCC Production Well	33°51'49.7"N 115°30'08.8"E
			2#XCC Production Well	33°51'47.9"N 115°30'08.0"E
			1#XCC Injection Well	33°51'46.0"N 115°30'05.3"E
6	Hengda community	1#HDC 2#HDC	1#HDC Production Well	34°04'32.9"N 114°50'26.6"E
			2#HDC Production Well	34°04'35.1"N 114°50'25.5"E
			1#HDC Injection Well	34°04'39.2"N 114°50'25.1"E
		3#HDC 4#HDC	3#HDC Production Well	34°04'35.4"N 114°50'31.6"E
			4#HDC Production Well	34°04'37.6"N 114°50'31.4"E
			2#HDC Injection Well	34°04'39.9"N 114°50'30.5"E
7	Jianye community	1#JYC 2#JYC	1#JYC Production Well	34°04'08.1"N 114°51'41.2"E
			2#JYC Production Well	34°04'07.0"N 114°51'41.6"E
			1#JYC Injection Well	34°04'08.5"N 114°51'41.3"E
		3#JYC 4#JYC	3#JYC Production Well	34°04'08.7"N 114°51'43.4"E
			4#JYC Production Well	34°04'07.9"N 114°51'43.3"E

			2#JYC Injection Well	34°04'06.8"N 114°51'43.2"E
8	Langting community	1#LTC 2#LTC	1#LTC Production Well	33°46'00.2"N 114°32'09.3"E
			2#LTC Production Well	33°46'00.2"N 114°32'11.4"E
			1#LTC Injection Well	33°45'58.6"N 114°32'08.1"E
9	Yuezhuang community	1#YZC 2#YZC	1#YZC Production Well	33°46'06.7"N 114°32'05.9"E
			2#YZC Production Well	33°46'05.4"N 114°32'05.9"E
			1#YZC Injection Well	33°46'04.2"N 114°32'09.9"E
10	Fangyuan community	1#FYC 2#FYC	1#FYC Production Well	33°45'47.2"N 114°31'45.1"E
			2#FYC Production Well	33°45'48.3"N 114°31'45.2"E
			1#FYC Injection Well	33°45'49.3"N 114°31'45.2"E
		3#FYC 4#FYC	3#FYC Production Well	33°45'46.4"N 114°31'48.3"E
			4#FYC Production Well	33°45'47.9"N 114°31'48.4"E
			2#FYC Injection Well	33°45'49.8"N 114°31'48.9"E



Henan Province

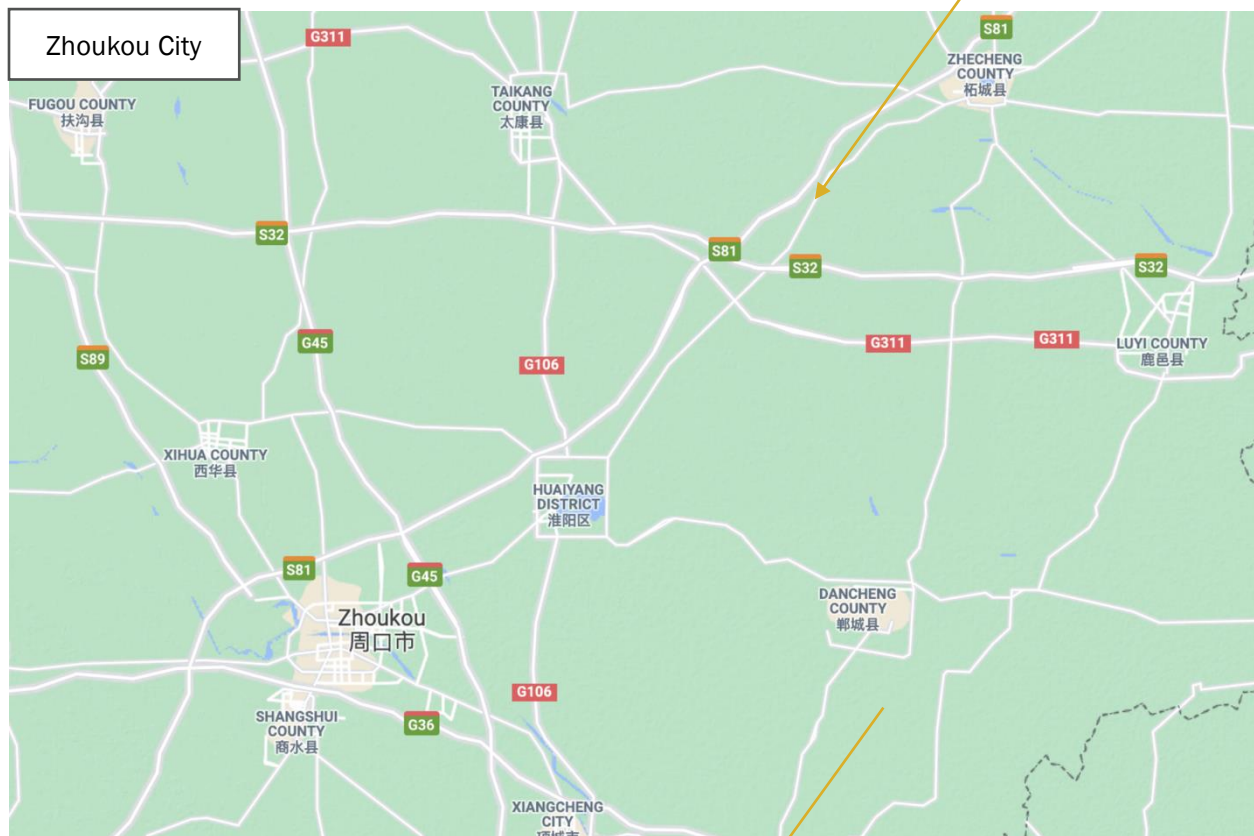
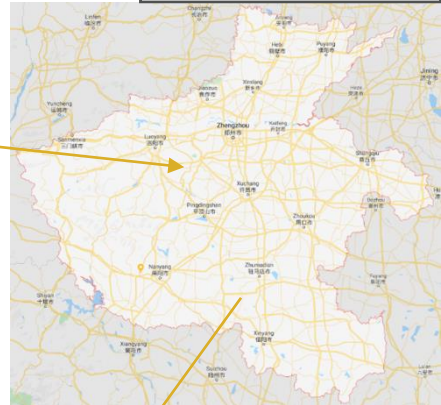




Figure 1-2 Location of the Project

1.13 Conditions Prior to Project Initiation

The project activity involves greenfield geothermal space heating system. There are no project activities at the project sites before the construction of the proposed project activities. The baseline scenario is the same as the conditions existing prior to the project initiation. Refer section 3.4 below for detailed baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project complies with all Chinese relevant laws and regulations. Mainly include:

1. Implementation Plan of Air Pollution Prevention and Control in Henan Province in 2018.⁵ Which 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.
2. Green Industry Guidance Directory (2019 version).⁶ Which demonstrates that the Chinese Government's commitment to the development of renewable energy as part of the overall energy development strategy, and encourages clean heating from renewable sources.
3. the Plan for Clean Heating in Winter in Northern China (2017-2021) (Development and Reform of Energy resources (2017) No. 2100) ⁷. It is pointed out in the Plan that at present, the proportion of clean heating in northern China is low, especially in some areas, where bulk burning coal is used in winter and air pollutant emissions are high, so it is urgent to promote clean heating. This will have a bearing on the winter warmth of the people in northern China and whether smog can be reduced. It is an important part of the revolution in energy production and consumption and the revolution in rural lifestyles.

The project activity is designed to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings in Zhoukou city over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area. Moreover, EIA approval and Water drawing permit from governmental authorities: Zhoukou Ecological Environment Bureau and Zhoukou Water Conservancy Bureau. The two approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, status, and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

The project has neither been registered nor seeking registration under any other GHG programs. The project is seeking registration only in VCS program.

⁵ <http://www.henan.gov.cn/2018/02-23/249520.html>

⁶ <http://www.henan.gov.cn/2018/02-23/249520.html>

⁷ <https://www.gov.cn/xinwen/2017-12/20/5248855/files/7ed7d7cda8984ae39a4e9620a4660c7f.pdf>

1.15.2 Projects Rejected by Other GHG Programs

1.16 The project activity is not participating in other environment credits, other GHG programs and has not been rejected by any other GHG Programs. Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

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. In addition, the project owner provided “Declaration of No Double Counting” and “Declaration of not involved in other GHG scheme”. 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 CO₂e/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”.

1.16.2 Other Forms of Environmental Credit

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

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

SDG 13 Climate Action

The project introduces a geothermal energy-based space heating system to provide heating for a series of new residential buildings in the winter of Zhoukou (off-grid solution for target users and/or applications). And replaced heating from isolated coal-fired boilers as a normal business scenario in the project area. And emissions credits would be reduced by using geothermal energy rather than burning fossil fuels. 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 an actual Emission reduction is 423,491 tCO₂e. For the monitoring period from 01-November-2020 to 31-March-2022, 7,186,579.28 m² of residential buildings with an actual Emission reduction is 443,846 tCO₂e. Besides, the project will provide an

opportunity for local residents to learn and raise awareness on climate change and mitigation measures on the stakeholder consultation fiscal meeting.

SDG 8 Decent Work and Economic Growth

Project activities provide employment opportunities for local people, regardless of gender or any other status, during project implementation and monitoring activities. Both men and women received equal pay for equal work. The project creates 30 jobs, including 15 male and 15 female.

SDG 7 Affordable and Clean Energy

The project introduces a geothermal energy-based space heating system to provide heating for a series of new residential buildings in the winter of Zhoukou (off-grid solution for target users and/or applications). And replaced heating from isolated coal-fired boilers as a normal business scenario in the project area. And emissions credits would be reduced by using geothermal energy rather than burning fossil fuels. 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, which the actual heating area is 6,871,047.47m². 89.9% from 01-November-2021 to 31-March-2022, which the actual heating area is 7,186,579.28 m².

1.17.2 Sustainable Development Contributions Activity Monitoring

Table: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	7.2.1 Renewable energy share in the total final energy consumption	Implemented activities to increase	During this monitoring period, 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, which the actual heating area is 6,871,047.47m ² . 89.9% from 01-November-2021 to 31-March-2022, which the actual heating area is 7,186,579.28 m ² .	From the operation start date of this project activity to the end of this monitoring period, the actual total heating area is 14,057,626.75 m ² .
2)	8.3	8.3.1 Proportion of informal employment in non - agriculture employment, by sex	Implemented activities to increase	During this monitoring period, 30 people including 15 females and 15 males were employed for operation, and maintenance of this project.	The project activity generates long-term working opportunities for 30 people during the construction period. From the operation start date of this project activity to the end of this monitoring period, 30 people were employed including 15 females and 15 males.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	For the monitoring period from 01/11/2020 to 31/03/2021, 6,871,047.47m ² of residential buildings with an actual Emission reduction is 423,491 tCO ₂ e. For the monitoring period from 01/11/2021 to 31/03/2022, 7,186,579.28 m ² of residential buildings with an actual Emission reduction is 443,846 tCO ₂ e.	From the operation start date of this project activity to the end of this monitoring period, the project has achieved GHG emission reductions of 867,337 tCO ₂ e.

1.18 Additional Information Relevant to the Project

Leakage Management

No leakage emissions have been identified for the project activity. Therefore, $LE_y=0$ tCO₂.

Refer to section 4.2 of the Joint-PD-MR for more details.

Commercially Sensitive Information

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

Further Information

NA.

2 SAFEGUARDS

2.1 No Net Harm

The EIA Report for the Project has been approved by Zhoukou Ecological environment Bureau on 26-May-2019, with approval No. “Environmental Assessment [2019] No.194”. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development (See section 2.3 below for detailed analysis) , and no net harm has been detected. Meanwhile, the implementation of the project will improve local socio-economic development through creating career opportunities and paying taxes.

2.2 Local Stakeholder Consultation

The Project owner collected comments by local stakeholders on the project activity. Survey questionnaires were distributed to local villagers and government officials by the Project owner in January 2020. For the local villagers, 37 printed questionnaires were distributed to the local villagers of the 10 communities randomly by the employees of the project owner in charge of each community. Only 8 questions included in the survey, and it can be completed within 10 minutes. Electronic questionnaires were sent to 3 government officials by email. All the completed questionnaires were collected and analyzed by the project owner. The survey questionnaire was designed to assess the project impacts on the local environment and social economic development. The structure of the survey respondents is listed in Table 2-1 below.

Table 2-1 Structure of stakeholders surveyed

Item	Distribution	Quantity	Percentage
Number of stakeholders surveyed	Male	24	60.00%
	Female	16	40.00%
Age	<25	10	25.00%
	25-45	18	45.00%
	45-55	10	25.00%
	>55	2	5.00%
Occupation	Worker	11	27.50%
	Peasant	18	45.00%
	Management personnel	4	10.00%
	Civil servant	3	7.50%
	Unspecified	4	10.00%

Forty questionnaires were distributed to local stakeholders, and all questionnaires have been recollected. Comments from these questionnaires are summarized in Table 2-2 below:

Table 2-2 Summary of stakeholders' comments

No.	Questions	Attitude or Opinion	Amount	Percentage
1	Do you know about the project activity?	Very much	32	80.00%
		Heard of	8	20.00%
		Nothing	0	0.00%
2	Do you think this project will improve the current heating situation?	Yes	31	77.50%
		No	0	0.00%
		Don't know	9	22.50%
3	Do you think the project will promote local economic development?	Yes	29	72.50%
		No	3	7.50%
		Don't know	8	20.00%
4		Yes	31	77.50%

	Do you think the project will improve the local employment situation?	No	0	0.00%
		Don't know	9	22.50%
5	What impact do you think will the project bring to your family?	Positive impact	23	57.50%
		No impact	17	42.50%
		Negative impact	0	0.00%
6	What is the most probable environmental impact do you think the project will cause after the construction finish? (Multiple choice)	None	32	80.00%
		Air pollution	0	0.00%
		Water pollution	0	0.00%
		Noise pollution	0	0.00%
		Harm to indigenous animals and plants	0	0.00%
		Don't know	8	20.00%
7	What do you think will be the project's impact on the local community? (Multiple choices)?	Promote economic development	19	47.50%
		Improve electricity supply condition	30	75.00%
		No great impact	5	12.50%
8	What is your attitude to the project activity?	Support	36	90.00%
		Against	0	0.00%
		Indifferent	4	10.00%

In general, local stakeholders are supportive of the project construction. 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. The survey shows that almost all the stakeholders are supportive to the project, believing that the project will provide more employment opportunities, help local economic development. Therefore, the implementation of the Project is regarded as beneficial by most of the local stakeholders.

Procedure followed to invite stakeholder comments

Public hearing for local stakeholders:

Invitation procedure

The stakeholder consultation was conducted by Wanjiang New Energy Group Co., Ltd. with assistance from Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. Stakeholder

groups were identified, and they were informed through oral and written means about the meeting. The invitation letter was sent by email to participants. This invitation email was done 2 weeks before the meeting date.

Place and date of the meeting

The stakeholder consultation was held from 9:00 a.m. to 11:30 a.m. on 25-January-2021 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

There were 40 participants who accepted the invitation, attended the meeting and returned the questionnaires on stakeholder evaluation form. The purpose of the evaluation form is to collect their impression of the meeting and comments on the projects.

Opening of the meeting

Xiangkang from Wanjiang New Energy Group Co., Ltd. introduced the project activity and its social and environmental impacts.

The project activity is designed to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings in Zhoukou City over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area. Emission reduction credits will be earned using geothermal energy instead of the combustion of fossil fuel for space heating.

Cheng Xiaoyu from Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd gave the opening address at the meeting. The feedback and comments will be taken into consideration during the implementation of the project.

Discuss any potential risks and positive impacts of the project

Afterwards, the meeting continued with the discussion of the Awareness training and project risk assessment activity. The Awareness training make participants aware of the contribution to the environment and the social, such as this project create jobs opportunities for locals, especially women's groups or other marginalized groups. During the project risk assessment, participants discussed the difficulties and risks that may be encountered in the process of project development.

Discuss the monitoring plan for environmental impacts

Regarding the monitoring plan, it mainly discusses the practicability and rationality of related parameter monitoring to ensure that it can be successfully registered and issued in VCS. During the stakeholder consultancy meeting, some stakeholders worried that the project would bring

noise, land occupying and pollution on employees and local residents' living. For these issues, the project owner will offer some measures: i.e., installation of soundproof devices and plating of green isolation belts are used for mitigating noise; the area the project built on only will not occupy life area of local residents. So, the effect of the noise from the plant is little to local residents; at the project site, waste recycling will be carried out reduce emit of waste. All attendances to the meeting were satisfied to the measures. The impacts of construction of the project are basically positive. All stakeholders were pleased with the development of the project.

Question and answer session about the project

After the description of the project, all participants have the opportunity to express their questions and comments. The representative of project owner provided answers to the questions and comments raised by the stakeholders. As per meeting minutes of the stakeholder consultation process, several representative questions and their replies were summarized as follows,

- Whether it is necessary to install additional equipment to use the heating generated by the project activity?

The heating was supplied by the heating pipeline, and there is no need to install additional equipment for the end-users.

- Whether the project will affect the groundwater?

The project only makes use of the renewable geothermal resources, and there is no negatively impact to the underground water.

- Whether the heat supplied by the project can meet the requirements of local government?

Design heating index of the project residential buildings is 50 W/m², which meets 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. Besides, the average indoor temperature during the 2020-2021 heating season is about 20 °C, which is higher than heating temperature required (18 °C) by *Central Heating Management Rules in Henan Province*⁸.

There were no other comments on project design and monitoring method. Furthermore, ownership of the issued carbon credits was also discussed during this session. All the geothermal heating equipment will be provided by Wanjiang New Energy Group Co., Ltd. It will offer a heating fee lower than the market price for the end users. All the end users who attended the meeting were notified that the project owner has the legal ownership of the carbon credits generated by the project activity.

Discussion of Continuous input & Grievance Mechanism

After discussions of the impacts and monitoring plan, the host then explained about the Continuous input & Grievance Mechanism which entails how the stakeholders can reach out to the project implementer during the project's crediting period in case of any questions, comments

⁸ <http://www.china-heating.com/news/2019/47598.html>

or suggestions. Also, the contact methods are provided to the attendees to see if the methods are appropriate and easy to access.

In a word, the impacts of construction of the project are basically positive. All stakeholders were pleased with the development of the project. The project would actually facilitate the development of the local economy and increase the income of local residents.

Communications with Local stakeholders are being carried out at periodic intervals. Key implementation schedules or changes of the project will be communicated to the local authority, who will inform the neighbourhood committee and the residents, the comments and suggestions from residents will be collected by the local authority meanwhile. And the local government agencies and competent authorities will conduct spot checks on the implementation of the project from time to time and give suggestions on the involved rectification problems. Besides, grievance books are kept in property management centre of each community. The continuous input & grievance mechanism were informed to the stakeholders during the local stakeholder consultation meeting held on 25-Janurary-2021. The end users of each community will also be notified by the property management centre about the continuous input & grievance mechanism of the project. 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. There were no negative comments received during this monitoring period. In line with VCS requirements all the processes have been implemented to receive comments from local stakeholders as well as communicate with them at periodic intervals.

2.3 Environmental Impact

The EIA report was approved by Zhoukou Ecological Environment Bureau on 26-May-2019. The environmental impacts of the project in construction period and in operation period are summarized as follows.

1. Construction Phase

1.1 Air pollution

During the construction period, closed construction, sprinkling dust suppression, speed limit and other measures can reduce dust pollution to the atmosphere; Construction machinery exhaust through the selection of low energy consumption, low pollution emissions of construction machinery and vehicles, strengthen the management and maintenance of machinery and vehicles; Welding dust is discharged after being treated by mobile dust purifier.

The above measures can effectively reduce the impact of waste gas on the surrounding environment during construction period and have little impact on the ambient air.

1.2 Wastewater

The construction personnel of the project do not live and sleep in the construction site, so the wastewater generated during the construction is mainly pipeline pressure test wastewater.

After laying the heating pipeline, the pressure of the pipeline will be flushed to test its tightness. The heating pipeline uses tap water as the pressure test medium, and the main pollutant in the pressure test wastewater of the pipeline is SS, which is relatively clean and discharged into the municipal government by relying on the residential sewage pipeline

Sewage pipe network, into the sewage treatment plant treatment.

1.3 Noise

During the construction of the project, the noise source is generated by the excavator. Through reasonable arrangement of construction time, reasonable arrangement of construction layout, the use of low-noise equipment and other measures, the impact on the surrounding sound environment can be effectively reduced. After the completion of construction, the mechanical noise will end.

1.4 Solid waste

The abandoned earth generated during the construction period should be piled up in the designated place, and those that can be recycled should be recycled and comprehensively utilized as far as possible, and those that cannot be utilized should be transported to the special construction waste dump site in time. The construction personnel's household garbage shall be uniformly cleared, transported, and disposed of by the sanitation department.

2. Operation Phase

1.1 Wastewater

The wastewater of the project is discharged from the soft water system and discharged from the heating circulation system. The wastewater enters the municipal sewage pipe network through the sewage pipe network of the heating community, and finally enters the sewage treatment plant of Zhoukou New District for centralized treatment. The impact of the project on the surface water environment is acceptable.

1.2 Noise

During the operation period, the noise 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. Low noise equipment is selected for heat source station. The noise of each factory boundary can meet the requirements of class 2 limit of Environmental Noise Emission Standard for Industrial Enterprise Factory boundary (GB12348-2008), and the sensitive points of sound environment meet the requirements of Class 2 standard of Sound Environment Quality Standard (GB3096-2008).

1.3 Solid waste

During the operation period, the waste filter element replaced by the filter device shall be recovered and disposed by the equipment manufacturer, and the waste ion exchange resin generated by the filter shall be temporarily stored in the temporary storage room of hazardous waste and shall be periodically disposed of by qualified units.

The Zhoukou Geothermal Based Space Heating System conforms to the national industrial policy; After taking the corresponding environmental protection measures, the pollutants generated during the construction period and operation period can be discharged up to the standard or reasonably placed, with little impact on the environment. Therefore, the project is feasible from the perspective of environmental protection.

2.4 Public Comments

Besides, 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-2021⁹.

2.5 AFOLU-Specific Safeguards

NA.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Approved baseline and monitoring methodology: AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating (Version 03.0).

Tool applied:

Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)¹⁰

Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)¹¹

Tool 07 Tool to calculate the emission factor for an electricity system (Version 07.0)¹²

Tool 24 Common practice (Version 03.1)¹³

3.2 Applicability of Methodology

Justification for the choice of the selected methodology is shown in the following table:

AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating (Version 03.0)	
Eligibility Criteria	Justification for the Project Activity

⁹ <https://registry.verra.org/app/projectDetail/VCS/2659>

¹⁰ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-02-v7.0.pdf>

¹¹ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-05-v3.0.pdf>

¹² <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v7.0.pdf>

¹³ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-24-v1.pdf>

The methodology is applicable for space heating in buildings by introducing 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.	The project activity is designed to introduce geothermal energy-based space heating system to realize heat supply to a series of new residential buildings in Zhoukou City over winter season. All the facilities related to the geothermal heating system were newly built, and the project activity didn't involve any capacity expansion through the addition of extra geothermal wells.
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;	The geographical extent of the project boundary includes the 66 geothermal wells, 44 heat substations, 10 sub-areas of residential buildings, and the primary networks and secondary network. No existing facilities were involved.
(b) Project will use geothermal resources for centralized space-heating system of residential areas, commercial areas and/or industrial areas;	As per Feasibility Study Report, the project activity is designed to introduce geothermal energy-based space heating system to realize heat supply to a total of 10 sub-areas in Zhoukou City. It can supply geothermal heat to 7,989.6 thousand m² of residential buildings.
(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;	As per Feasibility Study Report, the project involves installation of new geothermal based centralized space heating systems in new residential buildings of the project, which will replace the use of isolated coal-fired boilers in baseline scenario completely.
(d) The installed heat capacity may increase as a result of the project activity. But this increase is limited to 10 percent of the previous existing capacity; otherwise, a new baseline scenario has to be determined for the new capacity;	There is no existing capacity prior to implementation of the project. This condition is not applicable.
(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	As per Feasibility Study Report, only the residential were supplied by the fossil fuel heat-only boilers used in the baseline. No industrial processes were involved.

residential and/or commercial sector, but not for industrial processes;	
(f) The use of GHG emitting refrigerants is not permitted under this methodology.	As per Flow Chart of the Feasibility Study Report, the project is a closed circulating cycle and no GHG emitting refrigerants is used.
In addition, the applicability conditions included in the tools referred to below apply.	Justification for the choice of the selected tools is shown in the following tables.

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 project activity is designed to introduce geothermal energy-based space heating system to realize heat supply to a series of residential buildings in Zhoukou City. Alternative scenarios, barrier analysis, investment analysis and common practice analysis will be carried out based on Tool 02. Refer to section 4.1 of the Report for more details.

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	The project activity will use electricity from grid (the Project is connected to the Centre China Power Grid (CCPG), which falls under scenario A of Tool 05 (Version 03.0). Therefore, emissions related to electricity consumption need to be calculated. Electricity bill with the power grid company were provided as evidence.

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 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.	This methodological tool is applied for calculating for emission by electricity consumption in project activity. So, this criterion is not 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 CO ₂ emissions.	The project will install 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. Tool 05 is used for calculating project emissions of CO ₂ . This criterion is not applicable.

Tool 07 Tool to calculate the emission factor for an electricity system (Version 07.0)	
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been	In baseline scenario, heating supply in winter for the building areas were provided by coal-fired boilers in boiler house. No electricity will be used, this criterion is not applicable.

provided by the grid (e.g. demand-side energy efficiency projects).	
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.	The project activity uses electricity from Centre China Power Grid (CCPG) only. Electricity bill and contract with the power grid company were provided as evidence. Emission factor for the project electricity system will be calculated for grid power plants only as per Tool 07.
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project electricity system is located totally in Henan Province of China, which is not an Annex I country.
Under this tool, the value applied to the CO ₂ emission factor of biofuels is zero.	The project activity will use electricity from Centre China Power Grid (CCPG) only. As per requirements of this criterion, the value applied to the CO ₂ emission factor of biofuels were zero.

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.	The project applies the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" for the demonstration of additionality.

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.	It is consistent of Tool 24 (Version 03.1) and AM0072 (Version 03.0) on approaches for the conduction of the common practice test.
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3.3 Project Boundary

As per AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating (Version 03.0), the spatial extent of the project boundary includes:

(a) The site of geothermal heat extraction including, geothermal wells, re-injection wells, pumps, geothermal water storage tanks etc.

The project includes 44 production wells and 22 re-injection wells as shown in Figure 3-1.

(b) Centralized heating systems, including pipes, stations, sub-stations, and buildings that are or will be connected to the geothermal heating system.

The project includes 44 substations, residential in 10 sub-areas as shown in Figure 3-1.

(c) Decentralized heating equipment, including fossil fuel fired stoves etc.

The floor radiation system was installed in buildings connected to the substations. There is no decentralized heating equipment involved in the project boundary.

Figure 3-1 shows the project boundary in which the geothermal based space heating system is operated. Ground water extracted from geothermal production well j is pumped and transmitted, through primary heating network, to substation k where water at the downstream side of substation k will receive heat through heat exchangers and be subsequently supplied to end-users of construction type m through secondary heating network. Substation k (heat exchanger) is the primary point of measurement for monitoring parameters. The geothermal water returned from the exchanger will be re-injected into the re-injection well.

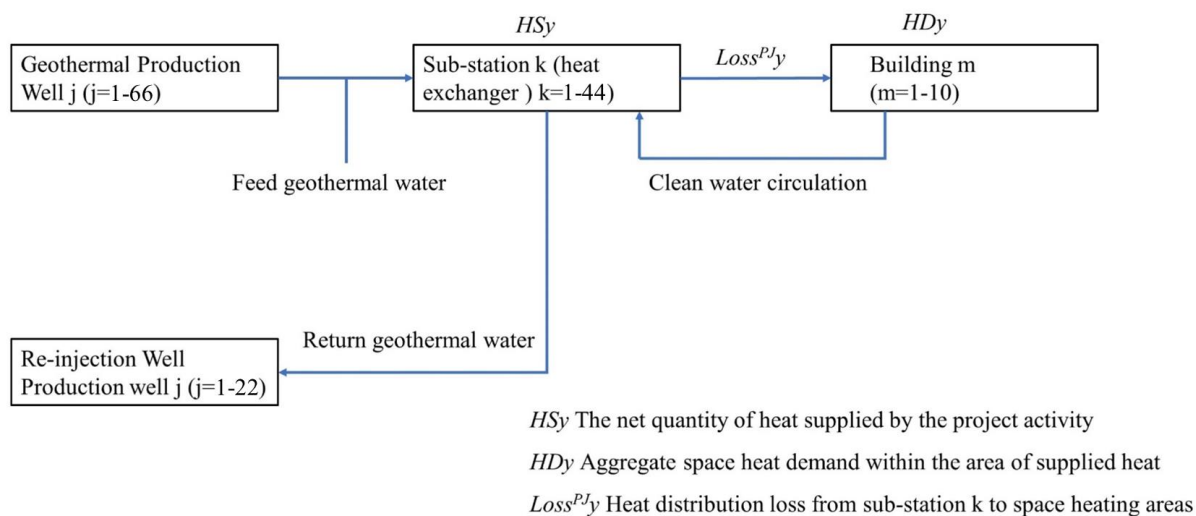


Figure 3-1 Project Boundary

The greenhouse gases included or excluded from the project boundary are summarized in Table 3-1 below.

Table 3-1 Emission Sources Included in or Excluded from the Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Fossil fuel used for space heating	CO ₂	Yes	Main emission source
		CH ₄	No	Minor source. Neglected for simplicity and conservativeness.
		N ₂ O	No	Minor source. Neglected for simplicity and conservativeness.
Project	Electricity used for geothermal extraction /operations	CO ₂	Yes	Significant emission source
		CH ₄	No	Minor source
		N ₂ O	No	Minor source
	Fuel used for geothermal extraction /operations	CO ₂	No	No fuel is used for geothermal extraction/operation.
		CH ₄	No	Minor source
		N ₂ O	No	Minor source

Source	Gas	Included?	Justification/Explanation
Fugitive emissions from geothermal resource extraction	CO ₂	No	No fugitive emissions will be considered by the project as the low-temperature geothermal system is designed to operate by extracting geothermal water at approximately 75°C.
	CH ₄	No	Minor source
	N ₂ O	No	Minor source

3.4 Baseline Scenario

As per section 5.2 of *AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating* (Version 03.0), the most plausible baseline scenario shall be determined with *Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality* (Version 07.0) by the application of the following steps:

Step 1 Identification of alternative scenarios

Step 1a: Define alternative scenarios to the proposed project activity

The identification of alternative baseline scenario should include all realistic and credible alternatives to the project activity that are consistent with current laws and regulations of the host country and that provide output or service (i.e., heat supply) with comparable quality as the proposed project activity. To identifying relevant alternative scenarios, provide an overview of other technologies or practices used for generation of heat that have been implemented prior to the start of the project activity or are currently underway in the relevant geographical area. The realistic and credible alternative(s) for the implementation of a new geothermal facility may include:

No.	Alternative scenarios	Pre-screening	Conclusion
1	(a) Implementation of the project activity without the benefits.	This is a realistic and credible alternative scenario.	Included
2	(b) Introduction of a new integrated district heating system(s) connected by a new primary network:		
	(i) Introduction of a district heating system;	Form the urban heating system "one city, one network" pattern, heating penetration rate of about 90%. ¹⁴ The location of the project is not in the central heating area. District heating is not provided in the project area.	Excluded

¹⁴ <https://www.henan.gov.cn/2020/11-16/1890415.html>

	(ii) The replacement of the heat-only boilers in the existing network(s) by new heat-only boilers.	All the residential buildings of the 10 sub-areas were newly constructed. There are no existing networks.	Excluded
3	Continued operation or rehabilitation of an existing [isolated] district heating network(s) or establishment of a new [isolated] district heating network(s). Such [isolated] district heating network(s) employ the following technologies:		
	(i) Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network:	Some areas of Zhoukou are still not covered by district heating system. It is normal practice in Zhoukou City for new buildings of the project area.	Included
	(ii) Natural gas fired boilers in boiler houses, supplying several buildings through a heat distribution network:	The laying of natural gas pipeline is relatively complicated, and the cost is high, once destroyed, it will cause great harm to the surrounding environment and people's life and property safety. The area where the project is located is temporarily not covered by natural gas pipe network. ¹⁵	Excluded
	(iii) Oil fired boilers in boiler houses, supplying several buildings through a heat distribution network:	The cost of using an oil-fired boiler is twice that of a gas fired boiler to produce the same amount of heat. In addition, the transportation and storage of oil is dangerous and more prone to accidents. It is not recommended in China ¹⁶ .	Excluded
	(iv) Decentralized cogeneration plants;	The centralized heat source does not cover the project area	Excluded
	(v) Renewable energy sources, such as biomass or solar thermal collectors, connected to a heat distribution network.	Due to the limit on biomass reserves and technique level, renewable energy sources, such as biomass energy, wind energy, and solar energy, are not stable for space heating. Renewable energy can only be used as supplementary energy sources in long term in Henan Province ¹⁷ .	Excluded
4	(d) Continued use or introduction of individual heat supply solutions:		
	(i) Coal fired boilers for individual buildings;	As per <i>Three-year Action Plan to Win the Blue Sky Defense War</i> ¹⁸ , coal fired boilers for individual buildings should be eliminated gradually. New coal fired	Excluded

¹⁵ http://www.bulletin.cas.cn/publish_article/2020/9/20200914.pdf

¹⁶ <http://rq.reenry.com/xinwenzixun/xingyedongtai/616.html>

¹⁷ <http://222.143.52.128/zcfg/1451.jhtml>

¹⁸ http://www.gov.cn/zhengce/content/2018-07/03/content_5303158.htm

		boilers built for individual buildings are forbidden by local government.	
	(ii) Coal fired stoves for individual apartments;	It's dangerous to use coal fired stoves inside the apartments due to carbon monoxide poisoning. Carbon monoxide poisoning incidents have occurred in many places ¹⁹ , it sounds the alarm on safety of home heating in winter.	Excluded
	(iii) Natural gas fired boilers for individual buildings;	As illustration of 3 (ii) above, sufficiently supply of natural gas can't be guaranteed in Henan Province and the current natural gas network cannot cover most of the rural area. Besides, some shortcomings cannot be neglected of the natural gas fired boilers, such as a short service life, a certain potential of safety hazard, a certain impact on air quality, and certain expenses for maintenance and equipment depreciation ²⁰	Excluded
	(iv) Oil fired boilers for individual buildings;	Oil-fired boilers generally use light oil and heavy oil as fuel, in which diesel oil is most used. The hourly fuel cost of a one-ton diesel boiler is about 382.8 RMB, which is nearly two times than that of natural gas fired boilers ²¹ .	Excluded
	(v) Oil fired stoves for individual apartments;	Oil fired stoves are mainly used in the industrial field. It is not yet completely mature for using in apartments ²² .	Excluded
	(vi) Electricity (e.g., off-peak storage heating);	Electricity-based heating technologies are more costly and thus not comparable with other alternatives in terms of cost-effectiveness. The operating costs of electricity boilers are about four times than that of coal-fired boilers ²³ .	Excluded
	(vii) Individual heating devises using renewable	Due to the low solar energy density, a larger collection area is required to meet the heating demands. Generally, there are	Excluded

¹⁹ http://www.xinhuanet.com/legal/2019-01/09/c_1210034051.htm

²⁰ [Guozhong Zheng, Wentao Bu. Review of Heating Methods for Rural Houses in China. Energies 11\(12\):3402. December 2018.](https://www.researchgate.net/publication/329410501)
<https://www.researchgate.net/publication/329410501> Review of Heating Methods for Rural Houses in China

²¹ <https://www.quolujiaage.cn/news/news1/512.html>

²² https://www.sohu.com/a/355884111_99999190

²³ <https://www.zzboiler.com/baike/explanation/3750.html>

	energy sources, e.g., solar thermal collectors;	air and water two kinds of heating media. The efficiency of the air heating solar system is low and the water heating solar system is easy to ruin by freezing. There is no stable individual space heating devices using solar thermal collectors ²⁴ .	
	(viii) 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
	(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

There is no existing geothermal based heat supply system, so it is not necessary to analysis the options for expansion of a geothermal heat supply system.

In summary, 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 laws and regulations

The above options are all considered to follow all mandatory applicable legal and regulatory requirements. The outcome of Step 1b is unchanged from Step 1a.

As per Planning of Clean Heating in Winter of Northern China (2017-2021)²⁵, 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 2018²⁶, 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.

²⁴ <https://www.ixueshu.com/h5/document/10a911bfed7419ce82f3a2eb1bb17fed318947a18e7f9386.html>

²⁵ <http://www.gov.cn/xinwen/2017-12/20/5248855/files/7ed7d7cda8984ae39a4e9620a4660c7f.pdf>

²⁶ <http://www.henan.gov.cn/2018/02-23/249520.html>

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.

Step 2: Barrier analysis

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

Without the project activity, heating supply to the project area is provided by isolated coal fired boilers. There are no barriers for alternative 3(i).

Wanjiang New Energy Group Co. Ltd. has about 30 key technicians on geothermal energy, which includes an academican of the Chinese Academy of Sciences. All the skilled technicians have ability to maintain and repair the related equipment. Furthermore, they can provide training for the employees hired the project on operation and maintenance of the whole geothermal space heating system. As per FSR of the project, it is rich in geothermal resources of Zhoukou City. The normal operation of the equipment can be guaranteed in the perspective of renewable energy supply. The project owner's geothermal heating projects have been implemented in 21 districts and countries in Henan Province. The geothermal heating technology used in the project is relatively mature. There are no technology barriers of the project scenario (alternative 1(a)).

Clean heating is promoted by the related policies of China. Geothermal energy is used by the project activity instead of coal, which will not only reduce the GHG emissions, but also be in line with the national policy orientation. The project uses geothermal resources in the middle and deep layers, which has the advantage of stability, continuity and high efficiency. Design heating index of the project residential buildings is 50 W/m², which meets 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. The average indoor temperature can be kept to around 20 °C, which can provide a comfortable living environment. According to the results of local stakeholder consultation, the geothermal space heating system is acceptable to the end-users. In summary, there are no acceptability barriers of the project scenario (alternative 1(a)).

The project owner is not included in the list of serious dishonest organization²⁷. Besides, cleaning heating supply with geothermal or other renewable energy is encouraged by the Chinese government. There are no financial barriers to apply for bank loans or other fundings of the project scenario (alternative 1(a)). Financial returns of the project activity are analyzed in Step 3. No technology barriers, acceptability barriers and financial barriers will prevent alternative 1(a) and 3(i) identified by Step 1 to occur.

Step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

Both of alternative 1(a) and 3(i) will not be prevented by any barriers.

Outcome of Step 2

There are still two alternative scenarios (1(a) and 3(i)) remaining. As per the applied methodology and Tool 02 (Version 07.0), Option 1: Step 3 investment analysis is chosen.

²⁷

<https://www.creditchina.gov.cn/xinyongxinxiqiangqing/xyDetail.html?searchState=1&entityType=1&keyword=%E4%B8%87%E6%B1%9F%E6%96%B0%E8%83%BD%E6%BA%90%E8%82%A1%E4%BB%BD%E6%9C%89%E9%99%90%E5%85%AC%E5%8F%B8&uuid=168aef709d7db1c0097c5916aad09595&tyshxydm=914112006807543230>

Step 3: Investment analysis

The comparison of economic attractiveness is carried out by applying Step 3 Investment analysis of Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0). The compared alternatives are: 1 (a) the proposed project activity undertaken without being registered as a VCS project; and 3 (i) coal fired boilers in the boiler houses, supplying several buildings through a small heat distribution network.

The levelized cost of heat (LCOH, RMB/GJ) is used as a financial indicator in the investment analysis for all alternatives. The formula applied to calculate the levelized cost of provided heat is the following²⁸:

$$LCOH = \frac{\text{Sum of costs over lifetime}}{\text{Sum of heat produced over lifetime}} = \frac{\sum_{t=1}^n \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^n \frac{H_t}{(1+r)^t}} \quad (1)$$

Where:

- $LCOH$ Levelized cost of heat (RMB/GJ)
- I_t Investment expenditures in the year t
- M_t Operation and maintenance cost in the year t
- F_t Fuel expenditures in the year t
- H_t Total heat supplied to the buildings in the year t
- r Discount rate

Inputs to the financial analysis

The parameters required in calculating $LCOH$ for the two remaining alternatives after step 2 are listed in Table 3-2 below.

Table 3-2 Key Inputs to Calculate $LCOH$

Item	Value	
	Proposed project	Alternative baseline
Investment expenditures (10,000 RMB)	68,698 ²⁹	19,974.00 ³⁰
O&M Cost (10,000 RMB/year)	6,156.00 ³¹	3,635.27 ²⁷
Fuel expenditure (10,000 RMB/year)	0 ³²	1,914.13 ²⁷

²⁸ https://en.wikipedia.org/wiki/Levelized_cost_of_energy

²⁹ The data is from the feasibility study report (Completed in March 2019)

³⁰ As per to the Research on Heating in Winter of Zhoukou City published Housing and Urban-Rural Development Bureau, the construction cost of a coal-fired boiler house in Zhoukou City is 25 RMB/m², the operating cost per unit of heating area is 4.56 RMB. so, the Investment expenditures can be calculated as: 798.96(10,000 m²) * 25 RMB/m²= 19,974.00 (10,000 RMB), so the O&M Cost can be calculated as: 798.96 (10,000 m²) * 4.55 RMB/m²=3,635.27 (10,000 RMB); Fuel expenditure for alternative baseline can be calculated as: 135 RMB/ton* 945.25 ton/day*150 day=1914.13 (10,000 RMB/year).

³¹ The data is from the feasibility study report (Completed in March 2019)

³² The data is from the feasibility study report (Completed in March 2019)

Residual value (10,000 RMB)	3,434.9 ³³	998.7 ³⁴
Annual heat supply (GJ)	5,177,260.80 ³⁵	5,177,260.80 ³²
Discount rate ³⁶	8%	8%
Project lifetime ³⁷	10 years	10 years

The levelized cost of provided heat for the proposed project and the plausible baseline scenarios are calculated respectively, and the results are in Table 3-3 below.

Table 3-3 Calculated Results of LCOH

Parameter	Proposed project (1 (a))	Alternative baseline (3 (i))
LCOH (RMB/GJ)	28.68	15.60

As indicated in Table 3-3, the levelized cost of alternative 3 (i) is the lowest. To further demonstrate that the financial attractiveness of these scenarios is robust to reasonable variations in the critical assumptions, a sensitivity analysis is performed.

Sensitivity analysis

A sensitivity analysis of +/- 10% on the following parameters was conducted:

- Investment expenditures.
- O&M costs; and
- Total heat supply.

Table 3-4 Sensitivity Analysis of LCOH on Investment Expenditures (Unit: RMB/GJ)

Item	-10%	-5%	0%	5%	10%	Critical point
Proposed project (1 (a))	27.00	27.84	28.68	29.52	30.36	-77.90%
Alternative baseline (3 (i))	15.11	15.36	15.60	15.84	16.09	

³³ The data is from the feasibility study report (Completed in March 2019)

³⁴ The data is from the feasibility study report, residual value can be calculated as: 19,974 (10,000 RMB) *5%=998.7 (10,000 RMB)

³⁵ The data is from the feasibility study report, Annual heat supply (GJ) can be calculated as: 3.6*(798.96 (10,000 m²)*50W/m²*3600h) *10⁻⁶=5,177,260.80 (GJ)

³⁶ Economic Evaluation Method and Parameter of Construction Projects version 03

³⁷ Manufacturer specifications of the geothermal space heating system

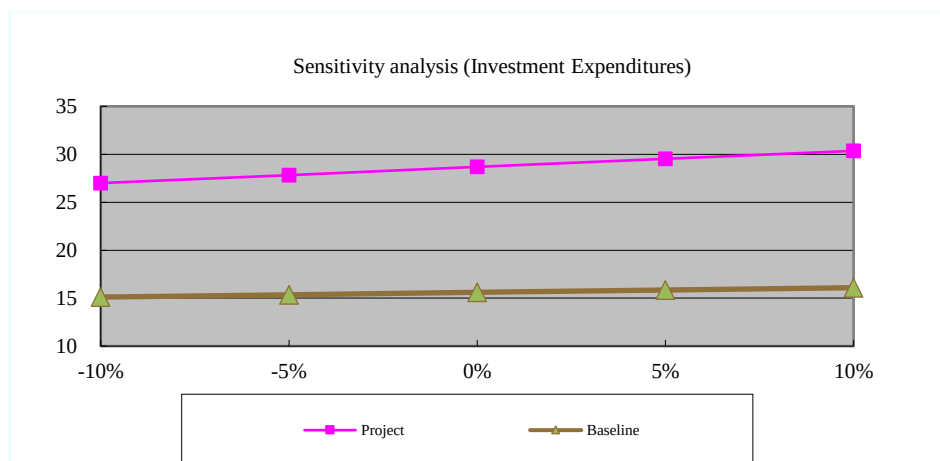
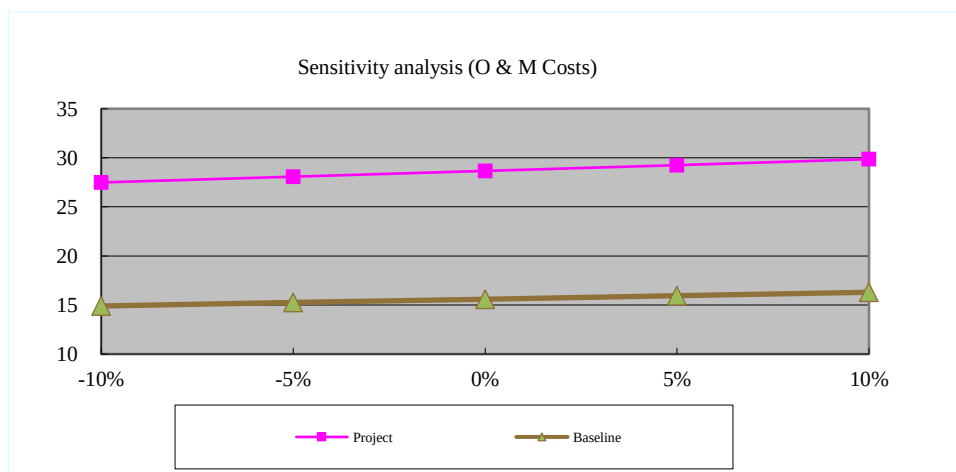


Figure 3-1 Sensitivity Analysis (Investment expenditures)

According to Table 3-3, scenario 3 (i) is the most economical attractive alternative. When the investment expenditure decreases 77.90%, the project becomes economical attractive. The price index of investment in fixed asset for Henan Province increased from 96.9 in 2015 to 101.1 in 2019 (increased 4.3%)³⁸. Therefore, it is not likely to implement the project activity with the investment expenditure reducing by 77.90%.

Table 3-5 Sensitivity Analysis of LCOH on O&M Costs (Unit: RMB/GJ)

Item	-10%	-5%	0%	5%	10%	Critical point
Proposed project (1 (a))	27.49	28.08	28.68	29.27	29.87	-110.00%
Alternative baseline (3 (i))	14.90	15.25	15.60	15.95	16.30	



³⁸ http://calendar.hexun.com/area/dqzb_410000_B1540000.shtml

Figure 3-2 Sensitivity Analysis (O&M Costs)

When the O&M expenditure decrease by 110.0%, the project activity becomes more financial attractive than the scenario 3 (i). The O&M costs mainly consist of salary for the employees, management fee etc. The average salary keeps increasing by about 9.8% annually during the past five years³⁹, it is not likely to decrease the O&M cost by 110.0%.

Table 3-6 Sensitivity Analysis of LCOH on Total Heat Supply (Unit: RMB/GJ)

Item	-10%	-5%	0%	5%	10%	Critical point
Proposed project (1 (a))	31.87	30.19	28.68	27.31	26.07	83.80%
Alternative baseline (3 (i))	16.92	16.23	15.60	15.03	14.52	

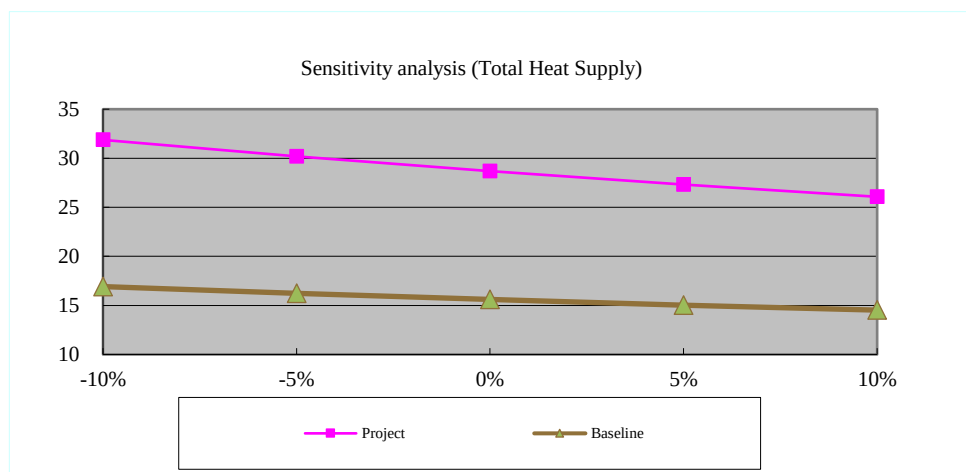


Figure 3-3 Sensitivity Analysis (Total Heat Supply)

When the total heat supply increased by 83.80%, the proposed project becomes financially attractive than alternative 3 (i). However, from the *Feasibility Study Report of the project*, the capacity load of the geothermal system is fixed, and the heating supply areas are also fixed. There is no possible for the project geothermal system to supply 87.50% more than its installed capacity. The increase in total heat supply by 83.80% is unrealistic.

The sensitivity analysis further confirms that construction of alternative 3 (i) is the most economically attractive option. Compared with the proposed project activity undertaken without being registered as a VCS project activity, construction of new coal fired boilers in boiler houses, supplying several buildings through a small heat distribution network is the lowest cost option and is selected as the most economically attractive alternative.

³⁹ <http://www.gszybw.com/gs/shuju/henan/9318.html>

According to the levelized cost of provided heat, alternative 3 (i) is the most economically attractive option. Furthermore, the sensitivity analysis is conclusive and confirms the result of the investment comparison analysis.

Therefore, the lowest levelized cost of provided heat (alternative 3 (i)) is considered as the baseline scenario.

3.5 Additionality

Additionality for the project activity is demonstrated using Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0). Step 1-3 were already done in section 3.4 of this Report for selection of alternative 1 (a) and 3 (i).

Common practice analysis

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

As above, power projects with the heating load between 199.74 MW-599.22 MW are included in the range of similar projects.

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

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

Henan Province is selected as the applicable geographical area for the common practice, and the reasons are detailed as follows:

- Due to the differences of economic development level, population size, industrial structure, fundamental infrastructure, strategic planning etc., the investment environment of each province in China varies widely. All of these factors can affect the final investment decision.
- The unique geological conditions in Henan Province results in the different natural resources, such as geothermal resource, compared to the other provinces in north China that must supply space heating service in wintertime.
- Finally, many key economic factors of power generation projects vary from province to province, including the tariff rates, the cost of labor and services, and the types of loan that can be obtained. These all vary between provinces.

In summary, the space heating projects within the same province are selected for the common practice analysis.

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

Geothermal based space heating system should be used.

(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.

Geothermal energy should be used in cascade levels. The heat exchanger medium can be water or air.

Besides, the following conditions should also be fulfilled:

- (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.

Based on above analysis. 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).

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} .

Through searching UNFCCC website⁴⁰、China CDM website⁴¹、China CER exchange info-platform⁴²、GS website⁴³、VCS⁴⁴、local DRC (Development and Reform Commission) of Henan province website⁴⁵, there are no similar projects, therefore $N_{all}=0$.

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

In summary, $N_{all}=N_{diff}=0$

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.

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

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

As per paragraph 18 of *Tool 24 Common practice* (Version 03.1), the proposed project activity is not a “common practice” within a sector in the applicable geographical area. As per paragraph

⁴⁰ <https://unfccc.int>

⁴¹ <http://www.cdmcenter.com>

⁴² <https://cdm.ccchina.org.cn/sdxm.aspx?clmId=163&page=5>

⁴³ <https://www.goldstandard.org/>

⁴⁴ <https://verra.org/>

⁴⁵ <http://fgw.henan.gov.cn>

40 of Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0), the project activity is additional.

3.6 Methodology Deviations

There is no methodology deviation for the project.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As per section 4.1 of this Report, the project reduces CO₂ emissions using geothermal heat to replace heat generated from the coal-fired isolated district heating system. As per 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.

For the proposed project, the baseline scenario is the establishment of new isolated district heating networks using isolated coal-fired boilers in boiler houses. Therefore, it falls into (a) of the above categories, and the baseline emissions BE_y in a year *y* are calculated as:

$$BE_y = \sum_i (HS_{i,y}^{BL}) \times EF_{CO_2,i} / \eta_{BL,i} \quad (2)$$

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 (tCO₂/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.
- $HS_{i,y}^{BL}$ = 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:

$$HS_y - Loss_y^{PJ} = \sum_i HS_{i,y}^{BL} - Loss_y^{BL} \quad (3)$$

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 ($HS_{i,y}^{BL}$)

$$HS_{i,y}^{BL} = w_i \times (HS_y - Loss_y^{PJ} + Loss_y^{BL}) \quad (4)$$

Where:

- $HS_{i,y}^{BL}$ = 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 this Report, 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 Zhoukou Housing and Urban-Rural Development Bureau, all the heating in winter of residential were supplied by coal fired boilers. 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).
- $Loss_y^{PJ}$ = 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).

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) $EF_{CO_2,i}$;
- (c) $Loss^{BL}_y$.

Ex post measurement parameters

- (a) HS_y ;
- (b) $Loss^{PJ}_y$.

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 following data can be used (from highest to lowest priority):

(a) Actual measurements of thermal efficiency and adjusted for conservativeness (project participants shall select (and justify) the appropriate conservativeness factor from the Table 3 below). Methods from recognized international standards shall be used to determine thermal efficiency, and uncertainty estimated (as directed in the standard). This uncertainty level shall be used to select the appropriate conservativeness factor from the table. For example, an uncertainty of 40 percent would mean that the project participant must multiply the baseline thermal efficiency by 1.12.

The boilers do not actually exist but would only exist in the assumed baseline scenario. This option is not applicable.

(b) A conservative thermal efficiency based on other boilers in the region, which are similar to that of the boiler on the project activity site (in terms of age, technology, capacity, etc.). This shall be justified using data and/or published reports. The uncertainty level in this case will be assumed to be greater than 100 percent unless based on assessment of the above data/information an independent expert justifies a lower level of uncertainty. The DOE is to check the credentials of the independent expert at the time of validation and verify that there is no conflict of interest.

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) The highest efficiency value provided by two or more manufacturers for units with similar specifications.

Three manufacturers of coal-fired boiler were checked, and the efficiencies of their products were from 79% to 85%⁴⁶. Thus, the highest efficiency value provided by the three manufacturers is 85%.

(d) Use the default values from Table 3-1 of AM0072 (Version 03.0)

As per Table 3-1 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.

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

As per Table 3-2 Data source for fossil fuel emission factors for each identified technology of AM0072 (Version 03.0), Data source (a) and (b) are unavailable. As discussed in section 4.1 of the Report, the boilers are not actually existing and there is no fuel supplier for the baseline coal-fired boilers. Data source (c) can only be used for liquid fuels. Therefore, 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.

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

Option 1 A conservative value of 0% of loss is used as historic information 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.

$$HS_y = \min\{H_{CAP}, HS_{y,estimated}\} \quad (5)$$

$HS_{y,estimated}$ 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.

$$HS_{y,estimated} = \sum_j (Q_{j,d,y} \times T_j \times CF) \quad (6)$$

Where:

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

⁴⁶ Zosen Boilers 79%. <https://www.zhongzhengquolu.cn/product/DZL-ran-mei-zheng-qi.html>, Fengcheng Energy Equipment Factory 80%. <https://www.nyglrq.com/CWNGreshuquolu/270.html>, Henan Hengxin Boiler Manufacturing Co., Ltd 85%. <http://hxglzz.com/3g/show.asp?m=1&d=3439>.

T_j = Number of hours per year heat utilization at well j.
 CF = Conversion factor from GWh to TJ (3.6).

$$Q_{j,d,y} = \frac{FR_{j,d,y} \times \Delta t_{j,d,y} \times 4.18}{3.6} \times 10^{-9} \quad (7)$$

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.

$$H_{CAP} = (\sum_m A_m \times HI_m \times T_j) \times CF + Loss_y^{PJ} - H_{ff} \quad (8)$$

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 (GW/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.

$$Loss_y^{PJ} = HS_y - HD_y \quad (9)$$

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.

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

Step 3: Calculate baseline emissions from heat produced

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

$$BE_y = \sum_i (HS_{i,y}^{BL} \times EF_{CO_2,i} / \eta_{BL,i}) \quad (11)$$

4.2 Project Emissions

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}).

$$PE_y = PE_{FE,y} + PE_{EC,y} + PE_{FF,y} \quad (12)$$

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 a low-temperature system. As per paragraph 84 of AM0072 (Version 03.0), fugitive emissions from low temperature geothermal system are 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 *Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation* (Version 03.0). Electricity consumption from each relevant source should be monitored and summed up to EC_y .

As per paragraph 16 of Tool 05 (Version 03.0), 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:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (13)$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (t CO ₂ /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 CO ₂ /MWh).

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y .

The electricity consumed by facilities of the geothermal system is sourced from local power grid connected to central China Power Grid (CCPG). 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). $EF_{EL,j,y} = EF_{grid,CM,y}$.

The tool determines the CO₂ emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the “combined margin” emission factor (CM) of the electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the “operating margin” (OM) and the “building margin” (BM). The operating margin is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed project activity. The build margin is the emission factor that refers to the group of power plants whose construction and future operation would be affected by the proposed project activity.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times \omega_{om} + EF_{grid,BM,y} \times \omega_{BM} \quad (14)$$

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 China⁴⁷, $EF_{grid,OM,y}$ of Central China Power Grid (CCPG) is 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 China⁴⁸, $EF_{grid,BM,y}$ of Central China Power Grid (CCPG) is 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 fixed 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 fixed crediting period.

Based on formula (14), $EF_{grid,CM,y}$ can be calculated as 0.8587 tCO₂/MWh *0.5+0.2854 tCO₂/MWh *0.5=0.5721 tCO₂/MWh.

⁴⁷ <http://www.mee.gov.cn/ywgz/ydqbhb/wsqtzk/202012/W020201229610353816665.pdf>

⁴⁸ <http://www.mee.gov.cn/ywgz/ydqbhb/wsqtzk/202012/W020201229610354442145.pdf>

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

No fossil fuel will be used to operate the geothermal facilities. Therefore, $PE_{FF,y}=0$ tCO₂.

4.3 Leakage

No leakage emissions have been identified for the project activity. Therefore, $LE_y=0$ tCO₂

4.4 Estimated Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (15)$$

Where:

ER_y	=	Emission reductions in year y (t CO ₂ e/yr).
BE_y	=	Baseline emissions in year y (t CO ₂ e/yr).
PE_y	=	Project emissions in year y (t CO ₂ /yr).
LE_y	=	Leakage emissions in year y (t CO ₂ /yr)

Baseline emissions

As per section 4.1 of the Report, Baseline emissions can be calculated as follows:

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

Where:

$EF_{CO_2,i}$	=	The CO ₂ emission factor per unit of energy of the fuel of technology i that would have been used in the baseline heating technology in (t CO ₂ /TJ). Where several fuel types are used in the boiler, use the fuel type with the lowest CO ₂ 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 t CO ₂ /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 3-1 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

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

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

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

Where:

w_i = Assign weights for heat generated by technology i . As per section 4.1 of this Report, 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 Zhoukou Housing and Urban-Rural Development Bureau, all the heating in winter of residential and commercial buildings were supplied by coal fired boilers. 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

$$HS_y = \min\{H_{CAP}, HS_{y,estimated}\}$$

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

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

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 Zhoukou Housing and Urban-Rural Development Bureau, 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).

Average temperature difference between inlet and outlet temperatures at the downstream of substation heat exchanger ($\Delta t_{j,d,y}$) and average flow rate at the downstream of heat exchanger ($FR_{j,d,y}$) are unavailable. For ex ante estimation, average temperature difference between inlet and outlet temperatures, and average flow rate at upstream of heat exchanger (water supply from the geothermal well j) will be used. As per *Feasibility Study Report* of the project, the average flow

rate of the geothermal well is 150 m³/h (150,000 kg/h)⁴⁹. The 44 production wells 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. Therefore, average temperature difference between inlet and outlet temperatures of the geothermal wells can be calculated as 75 °C-9 °C=66 °C. For ex ante estimation, $HS_{y,estimated}$ can be calculated as follows:

$$HS_{y,estimated} = (150,000 \text{ kg/h} \times 66^\circ\text{C} \times 4.18/3.6 \times 10^{-9} \times 3,600\text{h} \times 3.6 \times 44^\circ\text{C}) \text{ TJ} = 6,555 \text{ TJ}$$

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

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

Where:

- A_m = Net heating area for construction type m (m²). Heating area of residential buildings is 8,283 thousand m².
- HI_m = Heating index for construction type m (GW/m²). As per Feasibility Report of the project, HI_m is 50 W/m² 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 Zhoukou Housing and Urban-Rural Development Bureau, winter heating season of Zhoukou is usually from November 1 to March 31 of the next year (150 days). Therefore, T_j can be calculated as 150*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.

The results of HS_y can be summarized as the following table. Refer to the ER calculation sheet for more details. The results of HS_y can be summarized as the following table. Refer to the ER calculation sheet for more details.

Sub-area	A_m (m ²)	$Loss_y^{PJ}$ (TJ)	H_{CAP} (TJ)	$HS_{y,estimated}$ (TJ)	HS_y (TJ)
	Residential				
Lv bo community	2,093,000.00	135.63	1,491.89	1,787.70	1,491.89
Fajina community	918,000.00	59.49	654.35	893.85	654.35
Dehong community	1,218,000.00	78.93	868.19	893.85	868.19
Zhongheng community	475,000.00	30.78	338.58	297.95	297.95
Zhongyang community	386,000.00	25.01	275.14	297.95	275.14
Hengda community	655,000.00	42.44	466.88	595.90	466.88
Jianye community	788,000.00	51.06	561.69	595.90	561.69
Langting community	473,600.00	30.69	337.58	297.95	297.95

⁴⁹ The density of water is 1,000 kg/m³.

Yuezhuang community	436,100.00	28.26	310.85	297.95	297.95
Fangyuan community	546,900.00	35.44	389.83	595.90	389.83
Total	7,989,600	518	5,695	6,555	5,601.82

Calculate baseline emissions from heat produced

Baseline emissions can be summarized as the following table. Refer to the ER calculation sheet for more details.

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

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

Where:

$PE_{FE,y}$ = Project emissions from fugitive emissions resulting from non-condensable gases from the geothermal vents during the year y (tCO₂). The geothermal system of the proposed project is designed to operate by extracting geothermal water at approximately 75°C, which is considered to be a low-temperature system. As per paragraph 84 of AM0072 (Version 03.0), fugitive emissions from low temperature geothermal systems is considered negligible. Therefore, $PE_{FE,y} = 0$ tCO₂.

$PE_{FF,y}$ = Project emissions from fossil fuel consumed as a direct result of the operations of the project activity. No fossil fuel will be used to operate the geothermal facilities. Therefore, $PE_{FF,y} = 0$ tCO₂.

So here is obtained: $PE_y = PE_{EC,y}$.

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

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

Where:

$EF_{EL,j,y}$ = Emission factor for electricity generation for source j in year y (t CO₂/MWh). $EF_{EL,j,y} = EF_{grid,CM,y} = 0.5721$ tCO₂/MWh.

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y . The electricity consumed by facilities of the geothermal system is sourced from local power grid connected to central China Power Grid (CCPG). 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 $TDL_{j,y}$.

Estimated quantity of electricity consumed by the project electricity consumption source j in year y ($EC_{PJ,j,y}$)

As per *Feasibility Study Report* of the project, estimate of annual electricity consumption per m² of heating space for residential buildings is 4.9 kWh/m². For ex ante estimation, $EC_{PJ,j,y}$ can be calculated as (79,89,600 m²*4.9 kWh/m²)/1,000=39,149.04MWh. The actual values will be monitored.

Project emissions can be summarized as the following table. Refer to the ER calculation sheet for more details.

Year	1	2	3	4	5	6	7	8	9	10
$EC_{PJ,j,y}$ (kWh)	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040	39,14 9,040
$EC_{PJ,j,y}$ (MWh)	39,14 9	39,14 9	39,14 9	39,14 9	39,14 9	39,14 9	39,14 9	39,14 9	39,14 9	39,14 9
$EF_{EL,j,y}$ (tCO ₂ /MWh)	0.572 1	0.572 1	0.572 1	0.572 1	0.572 1	0.572 1	0.572 1	0.572 1	0.572 1	0.572 1
(1+TD $L_{j,y}$)	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)	26,87 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

Leakage

As described in section 4.3, the leakage is not considered.

Emission reductions

$$ER_y = BE_y - PE_y - LE_y = (522,166 - 26,877) \text{ tCO}_2\text{e/yr} = 495,289 \text{ tCO}_2\text{e/yr (average)}$$

Summary of ex ante estimates of each SDG Impact

Year	Estimated baseline emissions or removals (tCO _{2e})	Estimated project emissions or removals (tCO _{2e})	Estimated leakage emissions (tCO _{2e})	Estimated net GHG emission reductions or removals (tCO _{2e})
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1 -November-2020-31-October-2021	522,166	26,877	0	495,289
1 -November-2021-31-October-2022	522,166	26,877	0	495,289
1 -November-2022-31-October-2023	522,166	26,877	0	495,289
1 -November-2023-31-October-2024	522,166	26,877	0	495,289
1 -November-2024-31-October-2025	522,166	26,877	0	495,289
1 -November-2025-31-October-2026	522,166	26,877	0	495,289
1 -November-2026-31-October-2027	522,166	26,877	0	495,289
1 -November-2027-31-October-2028	522,166	26,877	0	495,289
1 -November-2028-31-October-2029	522,166	26,877	0	495,289
1 -November-2029-31-October-2030	522,166	26,877	0	495,289
Total	5,221,660	268,770	0	4,952,890

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{CO_2,i}$
Data unit	tCO ₂ /TJ
Description	The CO ₂ emission factor per unit of energy of the fuel of technology <i>i</i> that would have been used in the baseline heating technology.

Source of data	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 is used as per Table 5 of the applied methodology AM0072 (Version 03.0).
Value applied:	87.3
Justification of choice of data or description of measurement methods and procedures applied	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 tCO ₂ /TJ.
Purpose of Data	To calculate baseline emissions
Comments	Where several fuel types are used in the boiler, use the fuel type with the lowest CO ₂ emission factor. 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. Coking coal and brown coal briquettes have the same CO ₂ emission factor. Coking coal is usually used for heating in coal boiler, which was also validated by space heating experts at the project site for the first monitoring period.

Data / Parameter	$\eta_{BL,i}$
Data unit	Dimensionless
Description	Net thermal efficiency of the boiler technology i using fossil fuel that would have been used in the absence of the project activity.
Source of data	Follow the guidance given in the applied methodology AM0072 (Version 03.0).
Value applied:	85
Justification of choice of data or description of measurement methods and procedures applied	The highest efficiency of coal-fired boilers provided by Zosen Boilers (79%), Fengcheng Energy Equipment Factory (80%) and Henan Hengxin Boiler Manufacturing Co., Ltd (85%). As per Table 3-1 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.
Purpose of Data	To calculate baseline emissions
Comments	N/A

Data / Parameter	$Loss^{BL}_{i,y}$
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Data unit	TJ/yr
Description	The net distribution losses of the heat supply system, in the absence of project activity, during the year y .
Source of data	Section 5.4.6.3 of AM0072 (Version 03.0).
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied	The historic 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).
Purpose of Data	To calculate baseline emissions
Comments	N/A

Data / Parameter	<i>Subscript i</i>
Data unit	
Description	Type of technology used in the baseline scenario.
Source of data	<i>Feasibility Study Report</i> of the proposed project
Value applied:	Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network.
Justification of choice of data or description of measurement methods and procedures applied	As per section 5.2 of AM0072 <i>Fossil Fuel Displacement by Geothermal Resources for Space Heating</i> (Version 03.0), the most plausible baseline scenario shall be determined through the use of <i>Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality</i> (Version 07.0). Heat supply system using coal-fired boilers is identified as the baseline scenario of the proposed project activity. Refer to section 3.4 of the Report for more details.
Purpose of Data	To calculate baseline emissions
Comments	Data shall be stored in an excel sheet/database

Data / Parameter	<i>Subscript j</i>
Data unit	
Description	Geothermal well number.
Source of data	<i>Feasibility Study Report</i> of the proposed project
Value applied:	Geothermal wells number $j = 1$ to 66.
Justification of choice of data or description of measurement methods and procedures applied	There are a total of 66 geothermal wells including 44 production wells and 22 re-injection wells in the boundary of the proposed project activity as per <i>Feasibility Study Report</i> , which can be identified through unique identification code.
Purpose of Data	To calculate baseline emissions
Comments	Distinct geothermal well with distinct properties of temperature, pressure, and flow volume.

Data / Parameter	<i>Subscript m</i>
Data unit	

Description	Space heating construction type
Source of data	<i>Feasibility Study Report</i> of the proposed project
Value applied:	Residential
Justification of choice of data or description of measurement methods and procedures applied	Identified by local urban planners under a short to medium term development plan for the area.
Purpose of Data	To calculate baseline emissions
Comments	Areas designated for space heating under the categories of residential, commercial and industrial space heat

Data / Parameter	<i>Subscript k</i>
Data unit	
Description	Sub-station number
Source of data	<i>Feasibility Study Report</i> of the proposed project
Value applied:	Sub-station number $k=1$ to 44
Justification of choice of data or description of measurement methods and procedures applied	There is a total of 44 sub-stations in the boundary of the proposed project activity, which can be identified through unique identification code and GPS coordinates.
Purpose of Data	To calculate baseline emissions
Comments	Includes a heat exchanger as part of the sub-station.

Data / Parameter	$Loss^{PJ}_y$
Data unit	TJ/yr
Description	Net distribution loss of the geothermal heat supply system during the year y .
Source of data	Calculated based on design heat losses from heat network manufacturer per the methodology.
Value applied:	Refer to ER calculation sheet for more details.
Justification of choice of data or description of measurement methods and procedures applied	$Loss^{PJ}_y = \sum_m 10\% \times A_m \times HI_m \times T_j \times CF \times 10^{-9}$ Where: A_m=Net heating area for construction type m HI_m=Heating index for construction type m T_j=Hours per hear heat utilization in well j CF=Conversion factor from GWh to TJ (3.6).
Purpose of Data	To calculate baseline emissions
Comments	N/A

Data / Parameter	w_i
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Data unit	-
Description	Heat generation ratio for baseline heating technology i
Source of data	Paragraph 51(a)(ii) option 2 Assign weights based on available historical records of AM0072 (Version 03.0).
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	As per section 4.1 of this Report, 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 would be used. According to <i>Research on Heating in Winter of Zhoukou City</i> published by Zhoukou Housing and Urban-Rural Development Bureau, all the heating in winter of residential and commercial buildings were supplied by coal fired boilers. 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.
Purpose of Data	To calculate baseline emissions
Comments	N/A

Data / Parameter	H_{ff}
Data unit	TJ
Description	Heat supplied by fossil fuel boiler; in case a boiler is used to meet the heat demand of network.
Source of data	On site metering of heat (e.g., flow of steam/hot water multiplied by enthalpy) at the outlet of the boiler.
Value applied:	There are no fossil fuel boilers used to meet the heat demand of the project heating network. Therefore, $H_{ff}=0$ TJ.
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	To calculate baseline emissions
Comments	Yearly average data to be used

5.2 Data and Parameters Monitored

Data / Parameter	$\Delta t_{j,d,y}$
Data unit	°C
Description	Average temperature difference between inlet and outlet temperatures at the downstream of each heat exchanger in year y .
Source of data	Ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger.
Description of measurement methods and procedures applied	Outlet temperature minus inlet temperature at the downstream of each heat exchanger j . All the temperature data were measured by the

ultrasonic calorimeters installed at downstream inlet and outlet points of each heat exchanger.

Inlet and outlet temperatures at the downstream of each heat exchanger are monitored by the ultrasonic calorimeters. There are 44 production wells and 22 re-injection wells. There are totally 44 sets of heat exchange system. 88 ultrasonic calorimeters are needed to monitor the inlet and outlet temperatures of all the heat exchange system. Refer to Figure 5-2 of the Joint-PD-MR for more details on installation and configuration of the ultrasonic calorimeters. Serial No. of the ultrasonic calorimeters are RJ00000158, RJ00000159, RJ00000160, RJ00000161, RJ00000162, RJ00000163, RJ00000164, RJ00000165, RJ00000166, RJ00000167, RJ00000168, RJ00000169, RJ00000170, RJ00000171, RJ00000172, RJ00000173, RJ00000174, RJ00000175, RJ00000176, RJ00000177, RJ00000178, RJ00000179, RJ00000180, RJ00000181, RJ00000182, RJ00000183, RJ00000184, RJ00000185, RJ00000186, RJ00000187, RJ00000188, RJ00000189, RJ00000190, RJ00000191, RJ00000192, RJ00000193, RJ00000194, RJ00000195, RJ00000196, RJ00000197, RJ00000198, RJ00000199, RJ00000200, RJ00000201, RJ00000246, RJ00000247, RJ00000248, RJ00000249, RJ00000250, RJ00000251, RJ00000252, RJ00000253, RJ00000254, RJ00000255, RJ00000256, RJ00000257, RJ00000258, RJ00000259, RJ00000260, RJ00000261, RJ00000262, RJ00000263, RJ00000264, RJ00000265, RJ00000266, RJ00000267, RJ00000268, RJ00000269, RJ00000270, RJ00000271, RJ00000272, RJ00000273, RJ00000274, RJ00000275, RJ00000276, RJ00000277, RJ00000278, RJ00000279, RJ00000280, RJ00000281, RJ00000282, RJ00000283, RJ00000284, RJ00000285, RJ00000286, RJ00000287, RJ00000288 and RJ00000289 separately.

The ultrasonic calorimeters can monitor the inlet and outlet temperature of each heat exchange system continuously and record the temperature data per hour. All the hourly temperature data were exported by the VCS monitoring team to form the monthly record at the beginning of the next month. 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. Finally, the operation

	record of the geothermal heating system during the related heating season were summarized by all the monthly record.																				
Frequency of monitoring/recording	Measured Hourly/Recording Monthly																				
Value applied:	Average temperature difference between inlet and outlet temperatures at the downstream of substation heat exchanger is unavailable. For ex ante estimation, average temperature difference between inlet and outlet temperatures was used. As per Feasibility Study Report of the project, the 44 production wells will supply the feed geothermal water at temperature of 75 °C to 44 heat substations through primary heating network. The 44 re-injection wells will receive the return water at temperature of 9 °C after secondary heat exchange. Therefore, average temperature difference between inlet and outlet temperatures of the geothermal wells can be calculated as 75 °C-9 °C=66 °C.																				
Monitoring equipment	Ultrasonic calorimeters																				
QA/QC procedures applied	Ultrasonic calorimeters have been checked regularly for potentially performance-reducing anomalies by the VCS monitoring team. The temperature measurement range of the ultrasonic calorimeters are 4 °C to 95 °C with an accuracy of 0.01 °C. The ultrasonic calorimeters are calibrated based on JJG 225-2001 Verification Regulation of Heat Meters. All the 88 ultrasonic calorimeters were calibrated before the operation period of the geothermal heating system. Calibration of the 88 ultrasonic calorimeters is shown as the following table. If the ultrasonic calorimeters can be used normally, recalibration is not required. The validity is 5 years. <table><tr><th>NO.</th><th>Serial No.</th><th>Purpose</th><th>Calibration Date</th><th>Term of Validity</th></tr><tr><td>1</td><td>RJ00000158</td><td>To monitor supply water temperature of 1# heat exchange system</td><td>06-October-2020</td><td>05-October-2025</td></tr><tr><td>2</td><td>RJ00000159</td><td>To monitor supply water temperature of 2# heat exchange system</td><td>06-October-2020</td><td>05-October-2025</td></tr><tr><td>3</td><td>RJ00000160</td><td>To monitor supply water temperature of 3# heat</td><td>06-October-2020</td><td>05-October-2025</td></tr></table>	NO.	Serial No.	Purpose	Calibration Date	Term of Validity	1	RJ00000158	To monitor supply water temperature of 1# heat exchange system	06-October-2020	05-October-2025	2	RJ00000159	To monitor supply water temperature of 2# heat exchange system	06-October-2020	05-October-2025	3	RJ00000160	To monitor supply water temperature of 3# heat	06-October-2020	05-October-2025
NO.	Serial No.	Purpose	Calibration Date	Term of Validity																	
1	RJ00000158	To monitor supply water temperature of 1# heat exchange system	06-October-2020	05-October-2025																	
2	RJ00000159	To monitor supply water temperature of 2# heat exchange system	06-October-2020	05-October-2025																	
3	RJ00000160	To monitor supply water temperature of 3# heat	06-October-2020	05-October-2025																	

		exchange system		
	4	RJ00000161	To monitor supply water temperature of 4# heat exchange system	06-October-2020 05-October-2025
	5	RJ00000162	To monitor supply water temperature of 5# heat exchange system	06-October-2020 05-October-2025
	6	RJ00000163	To monitor supply water temperature of 6# heat exchange system	06-October-2020 05-October-2025
	7	RJ00000164	To monitor supply water temperature of 7# heat exchange system	06-October-2020 05-October-2025
	8	RJ00000165	To monitor supply water temperature of 8# heat exchange system	06-October-2020 05-October-2025
	9	RJ00000166	To monitor supply water temperature of 9# heat exchange system	06-October-2020 05-October-2025
	10	RJ00000167	To monitor supply water temperature of 10# heat exchange system	06-October-2020 05-October-2025
	11	RJ00000168	To monitor supply	06-October-2020 05-October-2025

		water temperature of 11# heat exchange system		
	12	RJ00000169	To monitor supply water temperature of 12# heat exchange system	06-October-2020 05-October-2025
	13	RJ00000170	To monitor supply water temperature of 13# heat exchange system	06-October-2020 05-October-2025
	14	RJ00000171	To monitor supply water temperature of 14# heat exchange system	06-October-2020 05-October-2025
	15	RJ00000172	To monitor supply water temperature of 15# heat exchange system	06-October-2020 05-October-2025
	16	RJ00000173	To monitor supply water temperature of 16# heat exchange system	06-October-2020 05-October-2025
	17	RJ00000174	To monitor supply water temperature of 17# heat exchange system	06-October-2020 05-October-2025
	18	RJ00000175	To monitor supply water temperature of 18# heat	06-October-2020 05-October-2025

		exchange system		
	19	RJ00000176	To monitor supply water temperature of 19# heat exchange system	06-October-2020 05-October-2025
	20	RJ00000177	To monitor supply water temperature of 20# heat exchange system	06-October-2020 05-October-2025
	21	RJ00000178	To monitor supply water temperature of 21# heat exchange system	06-October-2020 05-October-2025
	22	RJ00000179	To monitor supply water temperature of 22# heat exchange system	06-October-2020 05-October-2025
	23	RJ00000180	To monitor supply water temperature of 23# heat exchange system	07-October-2020 06-October-2025
	24	RJ00000181	To monitor supply water temperature of 24# heat exchange system	07-October-2020 06-October-2025
	25	RJ00000182	To monitor supply water temperature of 25# heat exchange system	07-October-2020 06-October-2025
	26	RJ00000183	To monitor supply	07-October-2020 06-October-2025

		water temperature of 26# heat exchange system		
	27	RJ00000184	To monitor supply water temperature of 27# heat exchange system	07-October-2020 06-October-2025
	28	RJ00000185	To monitor supply water temperature of 28# heat exchange system	07-October-2020 06-October-2025
	29	RJ00000186	To monitor supply water temperature of 29# heat exchange system	07-October-2020 06-October-2025
	30	RJ00000187	To monitor supply water temperature of 30# heat exchange system	07-October-2020 06-October-2025
	31	RJ00000188	To monitor supply water temperature of 31# heat exchange system	07-October-2020 06-October-2025
	32	RJ00000189	To monitor supply water temperature of 32# heat exchange system	07-October-2020 06-October-2025
	33	RJ00000190	To monitor supply water temperature of 33# heat	07-October-2020 06-October-2025

		exchange system		
	34	RJ00000191	To monitor supply water temperature of 34# heat exchange system	07-October-2020 06-October-2025
	35	RJ00000192	To monitor supply water temperature of 35# heat exchange system	07-October-2020 06-October-2025
	36	RJ00000193	To monitor supply water temperature of 36# heat exchange system	07-October-2020 06-October-2025
	37	RJ00000194	To monitor supply water temperature of 37# heat exchange system	07-October-2020 06-October-2025
	38	RJ00000195	To monitor supply water temperature of 38# heat exchange system	07-October-2020 06-October-2025
	39	RJ00000196	To monitor supply water temperature of 39# heat exchange system	07-October-2020 06-October-2025
	40	RJ00000197	To monitor supply water temperature of 40# heat exchange system	07-October-2020 06-October-2025
	41	RJ00000198	To monitor supply	07-October-2020 06-October-2025

		water temperature of 41# heat exchange system		
	42	RJ00000199	To monitor supply water temperature of 42# heat exchange system	07-October-2020 06-October-2025
	43	RJ00000200	To monitor supply water temperature of 43# heat exchange system	07-October-2020 06-October-2025
	44	RJ00000201	To monitor supply water temperature of 44# heat exchange system	07-October-2020 06-October-2025
	45	RJ00000246	To monitor return water temperature of 1# heat exchange system	08-October-2020 07-October-2025
	46	RJ00000247	To monitor return water temperature of 2# heat exchange system	08-October-2020 07-October-2025
	47	RJ00000248	To monitor return water temperature of 3# heat exchange system	08-October-2020 07-October-2025
	48	RJ00000249	To monitor return water temperature of 4# heat exchange system	08-October-2020 07-October-2025
	49	RJ00000250	To monitor return water temperature	08-October-2020 07-October-2025

		of 5# heat exchange system		
	50	RJ00000251	To monitor return water temperature of 6# heat exchange system	08-October-2020 07-October-2025
	51	RJ00000252	To monitor return water temperature of 7# heat exchange system	08-October-2020 07-October-2025
	52	RJ00000253	To monitor return water temperature of 8# heat exchange system	08-October-2020 07-October-2025
	53	RJ00000254	To monitor return water temperature of 9# heat exchange system	08-October-2020 07-October-2025
	54	RJ00000255	To monitor return water temperature of 10# heat exchange system	08-October-2020 07-October-2025
	55	RJ00000256	To monitor return water temperature of 11# heat exchange system	08-October-2020 07-October-2025
	56	RJ00000257	To monitor return water temperature of 12# heat exchange system	08-October-2020 07-October-2025
	57	RJ00000258	To monitor return water temperature of 13# heat exchange system	08-October-2020 07-October-2025
	58	RJ00000259	To monitor return water	08-October-2020 07-October-2025

		temperature of 14# heat exchange system		
	59	RJ00000260	To monitor return water temperature of 15# heat exchange system	08-October-2020 07-October-2025
	60	RJ00000261	To monitor return water temperature of 16# heat exchange system	08-October-2020 07-October-2025
	61	RJ00000262	To monitor return water temperature of 17# heat exchange system	08-October-2020 07-October-2025
	62	RJ00000263	To monitor return water temperature of 18# heat exchange system	08-October-2020 07-October-2025
	63	RJ00000264	To monitor return water temperature of 19# heat exchange system	08-October-2020 07-October-2025
	64	RJ00000265	To monitor return water temperature of 20# heat exchange system	08-October-2020 07-October-2025
	65	RJ00000266	To monitor return water temperature of 21# heat exchange system	08-October-2020 07-October-2025
	66	RJ00000267	To monitor return water temperature of 22# heat exchange system	08-October-2020 07-October-2025

	67	RJ00000268	To monitor return water temperature of 23# heat exchange system	09-October-2020	08-October-2025
	68	RJ00000269	To monitor return water temperature of 24# heat exchange system	09-October-2020	08-October-2025
	69	RJ00000270	To monitor return water temperature of 25# heat exchange system	09-October-2020	08-October-2025
	70	RJ00000271	To monitor return water temperature of 26# heat exchange system	09-October-2020	08-October-2025
	71	RJ00000272	To monitor return water temperature of 27# heat exchange system	09-October-2020	08-October-2025
	72	RJ00000273	To monitor return water temperature of 28# heat exchange system	09-October-2020	08-October-2025
	73	RJ00000274	To monitor return water temperature of 29# heat exchange system	09-October-2020	08-October-2025
	74	RJ00000275	To monitor return water temperature of 30# heat exchange system	09-October-2020	08-October-2025
	75	RJ00000276	To monitor return water temperature of 31# heat	09-October-2020	08-October-2025

		exchange system		
	76	RJ00000277	To monitor return water temperature of 32# heat exchange system	09-October-2020 08-October-2025
	77	RJ00000278	To monitor return water temperature of 33# heat exchange system	09-October-2020 08-October-2025
	78	RJ00000279	To monitor return water temperature of 34# heat exchange system	09-October-2020 08-October-2025
	79	RJ00000280	To monitor return water temperature of 35# heat exchange system	09-October-2020 08-October-2025
	80	RJ00000281	To monitor return water temperature of 36# heat exchange system	09-October-2020 08-October-2025
	81	RJ00000282	To monitor return water temperature of 37# heat exchange system	09-October-2020 08-October-2025
	82	RJ00000283	To monitor return water temperature of 38# heat exchange system	09-October-2020 08-October-2025
	83	RJ00000284	To monitor return water temperature of 39# heat exchange system	09-October-2020 08-October-2025
	84	RJ00000285	To monitor return water temperature	09-October-2020 08-October-2025

		of 40# heat exchange system		
	85	RJ00000286	To monitor return water temperature of 41# heat exchange system	09-October-2020 08-October-2025
	86	RJ00000287	To monitor return water temperature of 42# heat exchange system	09-October-2020 08-October-2025
	87	RJ00000288	To monitor return water temperature of 43# heat exchange system	09-October-2020 08-October-2025
	88	RJ00000289	To monitor return water temperature of 44# heat exchange system	09-October-2020 08-October-2025
There were no missing data or damaged data during the 1st monitoring period. The average temperature change of the 44 heat exchange system of the 2020-2021 heating season (11.63°C), 2021-2022 heating season (11.65°C) were cross checked by the design temperature difference of the end-user (10-15 °C). As per feedback from the space heating experts at the project site, average temperature change of the 44 heat exchange system of the Zhoukou geothermal heating system is about 11°C.				
Purpose of data		To calculate baseline emissions		
Calculation method		-		
Comments		The heat exchanger should handle the heat supplied by geothermal well only and not by any other source. The temperature readings should be taken at immediate inlet and outlet point of heat exchanger.		

Data / Parameter	$FR_{j,d,y}$
Data unit	kg/h
Description	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 .
Source of data	Ultrasonic calorimeters

Description of measurement methods and procedures applied	Average flow rate at the downstream of each heat exchanger are monitored by the 44 ultrasonic calorimeters. Refer to Figure 5-2 of the Joint-PD-MR for more details on installation and configuration of the ultrasonic calorimeters. Serial No. of the ultrasonic calorimeters are RJ00000246, RJ00000247, RJ00000248, RJ00000249, RJ00000250, RJ00000251, RJ00000252, RJ00000253, RJ00000254, RJ00000255, RJ00000256, RJ00000257, RJ00000258, RJ00000259, RJ00000260, RJ00000261, RJ00000262, RJ00000263, RJ00000264, RJ00000265, RJ00000266, RJ00000267, RJ00000268, RJ00000269, RJ00000270, RJ00000271, RJ00000272, RJ00000273, RJ00000274, RJ00000275, RJ00000276, RJ00000277, RJ00000278, RJ00000279, RJ00000280, RJ00000281, RJ00000282, RJ00000283, RJ00000284, RJ00000285, RJ00000286, RJ00000287, RJ00000288 and RJ00000289 separately. The ultrasonic calorimeters can monitor the volume flow rate of each heat exchange system continuously and record it per hour. All the hourly volume flow rate data were exported by the VCS monitoring team to form the monthly record at the beginning of the next month. The average daily volume flow rate was calculated based on the 24-hourly data. The average monthly volume flow rate was calculated based on all the daily data of this month. Finally, the operation record of the geothermal heating system during the related heating season were summarized by all the monthly record. Density of the water is 1,000 kg/m³. Mass flow can be calculated as volume flow rate times density of water.
Frequency of monitoring/recording	Measured Hourly/Recording Monthly
Value applied:	Average flow rate at the downstream of heat exchanger is unavailable. For ex ante estimation, average flow rate at upstream of heat exchanger (water supply from the geothermal well j) was used. As per <i>Feasibility Study Report</i> of the project, the average flow rate of the geothermal well is 150 m ³ /h (150,000 kg/h)
Monitoring equipment	Ultrasonic calorimeters
QA/QC procedures applied	Ultrasonic calorimeters have been checked regularly for potentially performance-reducing anomalies by the VCS monitoring team. The highest measurement flow rate range of the ultrasonic calorimeters are 1,000 m ³ /h with an accuracy of 0.01 m ³ /h.

The ultrasonic calorimeters are calibrated based on JJG 225-2001 Verification Regulation of Heat Meters. All the 44 ultrasonic calorimeters were calibrated before the operation period of the geothermal heating system. Calibration of the 44 ultrasonic calorimeters is shown as the following table. If the ultrasonic calorimeters can be used normally, recalibration is not required. The validity is 5 years.

NO.	Serial No.	Purpose	Calibration Date	Term of Validity
1	RJ00000246	To monitor flow rate of 1# heat exchange system	08-October-2020	07-October-2025
2	RJ00000247	To monitor flow rate of 2# heat exchange system	08-October-2020	07-October-2025
3	RJ00000248	To monitor flow rate of 3# heat exchange system	08-October-2020	07-October-2025
4	RJ00000249	To monitor flow rate of 4# heat exchange system	08-October-2020	07-October-2025
5	RJ00000250	To monitor flow rate of 5# heat exchange system	08-October-2020	07-October-2025
6	RJ00000251	To monitor flow rate of 6# heat exchange system	08-October-2020	07-October-2025
7	RJ00000252	To monitor flow rate of 7# heat exchange system	08-October-2020	07-October-2025
8	RJ00000253	To monitor flow rate of 8# heat exchange system	08-October-2020	07-October-2025
9	RJ00000254	To monitor flow rate of 9# heat	08-October-2020	07-October-2025

		exchange system		
	10	RJ00000255	To monitor flow rate of 10# heat exchange system	08-October-2020 07-October-2025
	11	RJ00000256	To monitor flow rate of 11# heat exchange system	08-October-2020 07-October-2025
	12	RJ00000257	To monitor flow rate of 12# heat exchange system	08-October-2020 07-October-2025
	13	RJ00000258	To monitor flow rate of 13# heat exchange system	08-October-2020 07-October-2025
	14	RJ00000259	To monitor flow rate of 14# heat exchange system	08-October-2020 07-October-2025
	15	RJ00000260	To monitor flow rate of 15# heat exchange system	08-October-2020 07-October-2025
	16	RJ00000261	To monitor flow rate of 16# heat exchange system	08-October-2020 07-October-2025
	17	RJ00000262	To monitor flow rate of 17# heat exchange system	08-October-2020 07-October-2025
	18	RJ00000263	To monitor flow rate of 18# heat exchange system	08-October-2020 07-October-2025
	19	RJ00000264	To monitor flow rate of 19# heat exchange system	08-October-2020 07-October-2025

	20	RJ00000265	To monitor flow rate of 20# heat exchange system	08-October-2020	07-October-2025
	21	RJ00000266	To monitor flow rate of 21# heat exchange system	08-October-2020	07-October-2025
	22	RJ00000267	To monitor flow rate of 22# heat exchange system	08-October-2020	07-October-2025
	23	RJ00000268	To monitor flow rate of 23# heat exchange system	09-October-2020	08-October-2025
	24	RJ00000269	To monitor flow rate of 24# heat exchange system	09-October-2020	08-October-2025
	25	RJ00000270	To monitor flow rate of 25# heat exchange system	09-October-2020	08-October-2025
	26	RJ00000271	To monitor flow rate of 26# heat exchange system	09-October-2020	08-October-2025
	27	RJ00000272	To monitor flow rate of 27# heat exchange system	09-October-2020	08-October-2025
	28	RJ00000273	To monitor flow rate of 28# heat exchange system	09-October-2020	08-October-2025
	29	RJ00000274	To monitor flow rate of 29# heat exchange system	09-October-2020	08-October-2025
	30	RJ00000275	To monitor flow rate of 30# heat	09-October-2020	08-October-2025

		exchange system		
	31	RJ00000276	To monitor flow rate of 31# heat exchange system	09-October-2020 08-October-2025
	32	RJ00000277	To monitor flow rate of 32# heat exchange system	09-October-2020 08-October-2025
	33	RJ00000278	To monitor flow rate of 33# heat exchange system	09-October-2020 08-October-2025
	34	RJ00000279	To monitor flow rate of 34# heat exchange system	09-October-2020 08-October-2025
	35	RJ00000280	To monitor flow rate of 35# heat exchange system	09-October-2020 08-October-2025
	36	RJ00000281	To monitor flow rate of 36# heat exchange system	09-October-2020 08-October-2025
	37	RJ00000282	To monitor flow rate of 37# heat exchange system	09-October-2020 08-October-2025
	38	RJ00000283	To monitor flow rate of 38# heat exchange system	09-October-2020 08-October-2025
	39	RJ00000284	To monitor flow rate of 39# heat exchange system	09-October-2020 08-October-2025
	40	RJ00000285	To monitor flow rate of 40# heat exchange system	09-October-2020 08-October-2025

	41	RJ00000286	To monitor flow rate of 41# heat exchange system	09-October-2020	08-October-2025
	42	RJ00000287	To monitor flow rate of 42# heat exchange system	09-October-2020	08-October-2025
	43	RJ00000288	To monitor flow rate of 43# heat exchange system	09-October-2020	08-October-2025
	44	RJ00000289	To monitor flow rate of 44# heat exchange system	09-October-2020	08-October-2025
There were no missing data or damaged data during the 1st monitoring period. The average volume flow rate of the 44 heat exchange system of the 2020-2021 heating season (673.38 m³/h), 2021-2022 heating season (675.84 m³/h) were cross checked by the rated flow of the circulating pumps, refer to Table 1-1 of the for more details. The average volume flow rate of the 44 heat exchange system of the 2020-2021 heating season were lower than the least rated flow of the circulating pumps (1,400 m³/h).					
Purpose of data		To calculate baseline emissions			
Calculation method		-			
Comments		The heat exchanger should handle the heat supplied by geothermal well only and not by any other source.			

Data / Parameter	T_j
Data unit	Hours
Description	Hours per hear heat utilization in well j .
Source of data	Operation record of the geothermal based space heating system.
Description of measurement methods and procedures applied	As per <i>Research on Heating in Winter of Zhoukou City</i> published by Zhoukou Housing and Urban-Rural Development Bureau, winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year, last day not included ⁵⁰ (150 days).

⁵⁰ As per *Research on Heating in Winter of Zhoukou City* published by Zhoukou Housing and Urban-Rural Development Bureau, the cut-off time of winter heating usually to be 24:00 of the 30th-March of each year. The last day of March usually to be the settlement day. But the actual number of heating hours may vary from year to year, which is determined by the winter climate of the year.

Frequency of monitoring/recording	Monthly
Value applied:	The actual number of heating hours are sourced from operation record of the geothermal based space heating system. Monthly operation time of the 44-heat exchange system were 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 were summarized by all the monthly record. 3,624h (151 days*24h) during 2020-2021 heating season. 3,624h (151 days*24h) during 2021-2022 heating season.
Monitoring equipment	-
QA/QC procedures applied	Time given for heating services provided will be measured. The measured data shall be cross-checked against <i>Research on Heating in Winter of Zhoukou City</i> published by Zhoukou Housing and Urban-Rural Development Bureau.
Purpose of data	To calculate baseline emissions
Comments	NA.

Data / Parameter	HI_m
Data unit	W/m ²
Description	Heating index for construction type m .
Source of data	The conservative standard index for construction type m as provided by Feasibility Report of the project
Description of measurement methods and procedures applied	-
Frequency of monitoring/recording	-
Value applied:	Estimates and actual project feasibility study data are the same. 50 W/m ² for residential buildings.
Monitoring equipment	-
QA/QC procedures applied	As per feedback from the space heating experts at the project site, heating index of the Zhoukou geothermal heating system is 50 W/m ² for residential buildings, which are comply with 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.
Purpose of data	To calculate baseline emissions
Comments	N/A

Data / Parameter	$EC_{PJ,y}$ (EC_y)
Data unit	MWh
Description	Electricity consumption for the year y in operating the geothermal heating system.

Source of data	Record of the Electricity Meters
Description of measurement methods and procedures applied	Electricity consumptions of the geothermal heating system are monitored by the electricity meters installed at each heat substation. Totally 44 electricity meters are needed. Refer to Figure 5.2 of the Joint-PD-MR for more details on installation and configuration of the electricity meters. Serial No. of the electricity meters are 110238121130, 110238121131, 110238121132, 110238121133, 110238121134, 110238121135, 110238121136, 110238121137, 110238121138, 110238121139, 110238121140, 110238121141, 110238121311, 110238121312, 110238121313, 110238121314, 110238121315, 110238121316, 110238121317, 110238121318, 110238121319, 110238121320, 110238121321, 110238121322, 110238121323, 110238121324, 110238121325, 110238121326, 110238121327, 110238121328, 110238121329, 110238121330, 110238121331, 110238121332, 110238121333, 110238121334, 110238121335, 110238121336, 110238121337, 110238121338, 110238121339, 110238121340, 110238121341, 110238121342 separately. Before test run of the whole geothermal space heating system, base number of all the 44 electricity meters were recorded by the VCS monitoring team under the supervision of the representative of each sub-area . At the end of each heating month, the VCS monitoring team recorded readings of the 44 electricity meters, which can calculate the electricity consumption of this month by minus last month's base number of meters. The operation record of the geothermal heating system during the related heating season were summarized by all the monthly record. Electricity consumption of the geothermal space heating system are only part of the power consumption in public area of each sub-area. All the electricity costs during the heating season were settled by the community property service company of each sub-area and local power grid company, which includes the electricity consumption of the geothermal heating system. Electricity settlement agreement was signed between the project owner and the community property service company of each sub-area. At the end of each winter heating season, the project owner prepares electricity bill to the related community property service company for confirmation, which contains name of the community property service company, period of the electricity consumption, related electricity consumption (test run period included), information of the electricity meters (location, serial number, accuracy, highest range and stop number of this heating season) and the related charges. The project owner would pay the bill and payment receipt

	would be provided by the related community property service company.																																																																											
Frequency of monitoring/recording	Hourly																																																																											
Value applied:	39,149.04MWh ((79,89,600m ² *4.9kWh/m ²)/1,000). For ex ante estimation, the data is from <i>Feasibility Study Report</i> of the project. The actual electricity consumption will be monitored.																																																																											
Monitoring equipment	Electricity meters. Calibration of the electricity meters will be done according to national standard by qualified organizations. Readings will be verified using electricity bill of the geothermal heating system. The accuracy of the electricity meters is 0.5s.																																																																											
QA/QC procedures applied	The electricity meters are calibrated based on JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy. All the 44 electricity meters were calibrated before the operation period of the geothermal heating system. Calibration of the 44electricity meters is shown as the following table. If the electricity meters can be used normally, recalibration is not required. The validity is 5 years. <table><tr><th>NO.</th><th>Serial No.</th><th>Location</th><th>Calibration Date</th><th>Term of Validity</th></tr><tr><td>1</td><td>110238121130</td><td>1#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>2</td><td>110238121131</td><td>2#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>3</td><td>110238121132</td><td>3#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>4</td><td>110238121133</td><td>4#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>5</td><td>110238121134</td><td>5#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>6</td><td>110238121135</td><td>6#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>7</td><td>110238121136</td><td>7#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>8</td><td>110238121137</td><td>8#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>9</td><td>110238121138</td><td>9#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>10</td><td>110238121139</td><td>10#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>11</td><td>110238121140</td><td>11#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>12</td><td>110238121141</td><td>12#LBC heat substation</td><td>08-October-2020</td><td>07-October-2025</td></tr><tr><td>13</td><td>110238121311</td><td>1#FJC heat substation</td><td>09-October-2020</td><td>08-October-2025</td></tr><tr><td>14</td><td>110238121312</td><td>2#FJC heat substation</td><td>09-October-2020</td><td>08-October-2025</td></tr></table>	NO.	Serial No.	Location	Calibration Date	Term of Validity	1	110238121130	1#LBC heat substation	08-October-2020	07-October-2025	2	110238121131	2#LBC heat substation	08-October-2020	07-October-2025	3	110238121132	3#LBC heat substation	08-October-2020	07-October-2025	4	110238121133	4#LBC heat substation	08-October-2020	07-October-2025	5	110238121134	5#LBC heat substation	08-October-2020	07-October-2025	6	110238121135	6#LBC heat substation	08-October-2020	07-October-2025	7	110238121136	7#LBC heat substation	08-October-2020	07-October-2025	8	110238121137	8#LBC heat substation	08-October-2020	07-October-2025	9	110238121138	9#LBC heat substation	08-October-2020	07-October-2025	10	110238121139	10#LBC heat substation	08-October-2020	07-October-2025	11	110238121140	11#LBC heat substation	08-October-2020	07-October-2025	12	110238121141	12#LBC heat substation	08-October-2020	07-October-2025	13	110238121311	1#FJC heat substation	09-October-2020	08-October-2025	14	110238121312	2#FJC heat substation	09-October-2020	08-October-2025
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15	11023812131 3	3#FJC heat substation	09-October- 2020	08-October- 2025
16	11023812131 4	4#FJC heat substation	09-October- 2020	08-October- 2025
17	11023812131 5	5#FJC heat substation	09-October- 2020	08-October- 2025
18	11023812131 6	6#FJC heat substation	09-October- 2020	08-October- 2025
19	11023812131 7	1#DHC heat substation	09-October- 2020	08-October- 2025
20	11023812131 8	2#DHC heat substation	09-October- 2020	08-October- 2025
21	11023812131 9	3#DHC heat substation	09-October- 2020	08-October- 2025
22	11023812132 0	4#DHC heat substation	09-October- 2020	08-October- 2025
23	11023812132 1	5#DHC heat substation	09-October- 2020	08-October- 2025
24	11023812132 2	6#DHC heat substation	09-October- 2020	08-October- 2025
25	11023812132 3	1#ZHC heat substation	10-October- 2020	09-October- 2025
26	11023812132 4	2#ZHC heat substation	10-October- 2020	09-October- 2025
27	11023812132 5	1#XCC heat substation	10-October- 2020	09-October- 2025
28	11023812132 6	2#XCC heat substation	10-October- 2020	09-October- 2025
29	11023812132 7	1#HDC heat substation	10-October- 2020	09-October- 2025
30	11023812132 8	2#HDC heat substation	10-October- 2020	09-October- 2025
31	11023812132 9	3#HDC heat substation	10-October- 2020	09-October- 2025
32	11023812133 0	4#HDC heat substation	10-October- 2020	09-October- 2025
33	11023812133 1	1#JYC heat substation	11-October- 2020	10-October- 2025
34	11023812133 2	2#JYC heat substation	11-October- 2020	10-October- 2025
35	11023812133 3	3#JYC heat substation	11-October- 2020	10-October- 2025
36	11023812133 4	4#JYC heat substation	11-October- 2020	10-October- 2025
37	11023812133 5	1#LTC heat substation	11-October- 2020	10-October- 2025
38	11023812133 6	2#LTC heat substation	11-October- 2020	10-October- 2025
39	11023812133 7	1#YZC heat substation	11-October- 2020	10-October- 2025
40	11023812133 8	2#YZC heat substation	11-October- 2020	10-October- 2025

	41	110238121339	1#FYC heat substation	11-October-2020	10-October-2025
	42	110238121340	2#FYC heat substation	11-October-2020	10-October-2025
	43	110238121341	3#FYC heat substation	11-October-2020	10-October-2025
	44	110238121342	4#FYC heat substation	11-October-2020	10-October-2025
There were no missing data or damaged data during the 1st monitoring period. All the electricity consumption data was cross checked with the electricity bill confirmed by each community property service company and payment receipt of the geothermal heating system.					
Purpose of data		To calculate project emissions			
Comments		N/A			

Data / Parameter	$EF_{EL,j,y}$ ($EF_{grid,CM,y}$)
Data unit	tCO ₂ /MWh
Description	Combined margin emission factor for the grid in year y.
Source of data	Zhoukou city is in Henan province, which belongs to Central China Regional Power Grid (CCPG). The data of CCPG's <i>Baseline emission factors of China's regional power grid for emission reduction projects in 2019</i> published by Ministry of Ecology and Environment of the People's Republic of China⁵¹, which calculated $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ based on <i>Tool 07</i> (Version 07.0). $EF_{grid,CM,y}$ can be calculated as $EF_{grid,CM,y} = EF_{grid,OM,y} \times \omega_{OM} + EF_{grid,BM,y} \times \omega_{BM}$. As per paragraph 86(b) of <i>Tool 07</i> (Version 07.0), $\omega_{OM}=0.5$ and $\omega_{BM}=0.5$ are used for the fixed crediting period. It's the monitoring period of the project which belongs to the first crediting period. Therefore, $\omega_{OM}=0.5$ and $\omega_{BM}=0.5$ were used for the fixed monitoring period.
Description of measurement methods and procedures applied	Zhoukou city is in Henan province, which belongs to Central China Regional Power Grid (CCPG). The data of CCPG's $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ were taken from <i>Baseline emission factors of China's regional power grid for emission reduction projects in 2019</i>, 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.
Frequency of monitoring/recording	Once each monitoring period

⁵¹ <http://www.mee.gov.cn/ywgz/xdqhbh/wsqtz/202012/W020201229610353340851.pdf>

Value applied:	The data were the same before and after the project began. 0.5721 (0.8587 tCO ₂ e/MWh*0.5+0.2854 tCO ₂ e/MWh*0.5)
Monitoring equipment	-
QA/QC procedures applied	The latest version of <i>Baseline emission factors of China's regional power grid for emission reduction projects</i> published by Ministry of Ecology and Environment of the People's Republic of China were used for the 1 st monitoring period. It calculated $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ based on the latest version of <i>Tool 07</i> (Version 07.0).
Purpose of data	To calculate project emissions
Comments	N/A

Data / Parameter	$TDL_{j,y}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y .
Source of data	In case of scenario B and scenario C, case C.II, assume $TDL_{j,y}=0$ as a simplification. In case of other scenarios (scenario A and scenario C, cases C.I and C.III), choose one of the following options: 1. Use annual average value based on the most recent data available within the host country. 2. Use as default values of 20% for: (a) project or leakage electricity consumption sources; (b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies. 3. Use as default values of 3% for: (a) baseline electricity consumption sources. (b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.
Description of measurement methods and procedures applied	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 $TDL_{j,y}$.
Frequency of monitoring/recording	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
Value applied:	20%
Monitoring equipment	-
QA/QC procedures applied	-

Purpose of data	To calculate project emissions
Comments	For (a): $TDL_{j,y}$ should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g., commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.

Data / Parameter	A_m
Data unit	m ²
Description	Net heating area for construction type m .
Source of data	For ex ante estimation, the data is from <i>Feasibility Study Report</i> of the project. Actual measurements are available from heating supply contracts.
Description of measurement methods and procedures applied	Yearly measurement.
Frequency of monitoring/recording	Yearly
Value applied:	7,989.6 thousand m ² for residential buildings.
Monitoring equipment	-
QA/QC procedures applied	The data was cross-checked with Certificate of Enterprise Investment Project in Henan Province issued by Zhoukou Development and Reform Commission. The net heating area sourced from the heating supply contract 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	To calculate baseline emissions
Comments	N/A

5.3 Monitoring Plan

The monitoring plan presented in this Joint-PD-MR assures that real, measurable, long term GHG emission reductions can be monitored, recorded, and reported. It is a crucial procedure to identify the final VCUs of the project. This monitoring plan will be implemented by the project owner during the project operation. The details of the monitoring plan are specified 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).

Monitoring framework

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). Figure 5-1 below outlines the organization structure of the monitoring system for the related three parameters. The project owner will be responsible for the whole monitoring work. The VCS monitoring team will be responsible for the monitoring of all the parameters to be monitored. All the data will be reviewed by the project developer and VVB.

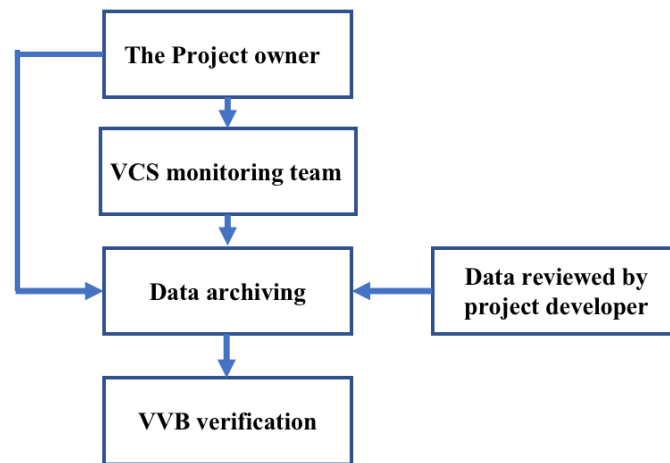


Figure 5-1 Organization Structure of the Monitoring Team

Principle of Monitoring

All heat supplied to end-users shall be measured at each substation k as part of the monitoring plan. For each isolated district heating network connected to a heat exchange station (k), the quantity of heat supplied should be measured continuously.

Meters shall be installed in a manner that ensures that only the quantity of heat supplied for space heating purposes and supplied by geothermal well j is metered. Besides, the meters shall be installed in a manner that ensures that metering of flow conditions at the heat exchanger be satisfied.

If point of heat measurement is changed or added during the crediting period, this should be documented transparently in the monitoring reports, and the procedure for post registration changes shall be followed.

Monitoring equipment and installation

Inlet and outlet temperatures at the downstream of each heat exchanger are monitored by the ultrasonic calorimeters. There are 44 production wells and 22 re-injection wells. There are totally 44 sets of heat exchange system. 88 ultrasonic calorimeters are needed to monitor the inlet and outlet temperatures of all the heat exchange system. The temperature measurement range of the ultrasonic calorimeters are 4 °C to 95 °C with an accuracy of 0.01 °C.

Average flow rate at the downstream of each heat exchanger are monitored by the 44 ultrasonic calorimeters for outlet temperature. The highest measurement flow rate range of the ultrasonic calorimeters are 1,000 m³/h with an accuracy of 0.01 m³/h.

Electricity consumptions of the geothermal heating system are monitored by the electricity meters installed at each heat substation. 44 electricity meters are needed. The highest measurement range of the electricity meters are 999999.99 kWh with an accuracy of 0.01 kWh.

Installation and configuration of monitoring equipment are shown as Figure 5-2. All the monitoring equipment can measure continuously and installed in a manner that only the heat supplied by the geothermal heating system and the electricity consumed by it are measured.

In order to ensure measurements with a low degree of uncertainty, all the data monitoring equipment were calibrated by appropriately qualified third party according to appropriate national standard. The ultrasonic calorimeters are calibrated based on *JJG 225-2001 Verification Regulation of Heat Meters*⁵² and the electricity meters are calibrated based on *JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy*⁵³. All the monitoring equipment were calibrated before the operation period of the geothermal heating system. If the monitoring equipment can be used normally, recalibration is not required. The validity of them are 5 years.

The point of heat measurement was not changed or added during the 1st monitoring period.

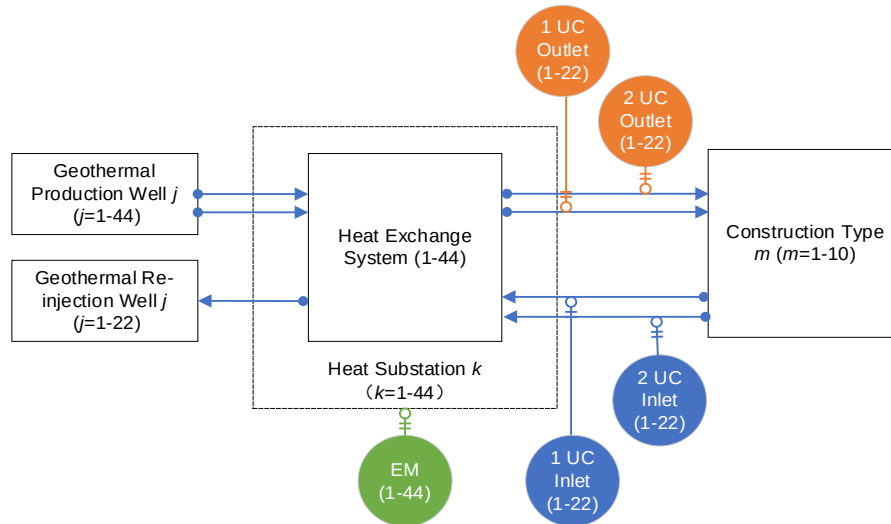


Figure 5-2 Installation and Configuration of Meters

EM (1-44): 44 electricity meters installed at 44 heat substations to monitor the electricity consumptions of the geothermal heating system.

1UC Outlet (1-22): The first 22 ultrasonic calorimeters installed at downstream of each heat exchange system to monitor the supply water temperature and the average flow rate from the geothermal heating system.

2UC Outlet (1-22): The second 22 ultrasonic calorimeters installed at downstream of each heat exchange system to monitor the supply water temperature and the average flow rate from the end users.

⁵² <https://www.wdfwx.net/doc60326801.htm>

⁵³ <https://www.wdfwx.net/doc91019332.htm>

1UC Inlet (1-22): The first 22 ultrasonic calorimeters installed at downstream of each heat exchange system to monitor the return water temperature from the end users.

2UC Inlet (1-22): The second 22 ultrasonic calorimeters installed at downstream of each heat exchange system to monitor the return water temperature from the end users.

Quality control and quality assurance procedures

A quality management system will be established, which ensures the quality and accuracy of the measured data.

Training

For all members involved in the project, necessary trainings will be provided by the project owner. Besides, the project owner should ensure that only skilled employees are allowed to undertake the monitoring work. The training contents should be regard to the general and technical aspects of the project to the extent appropriate, as well as basic understandings of VCS Standard and climate change.

Data management

All data collected as part of monitoring plan should be saved with at least 1 backup copy until the end of the crediting period. After the crediting period ends, the data should be archived electronically on hard disks and be kept at least 2 years after the end of the last crediting period.

Corrective actions

The whole VCS monitoring team will follow recognized standard data evaluation methods to guarantee that the data is reliable and accurate. The quality control and quality assurance procedures include the handling and correction of nonconformities in the implementation of the project or the monitoring plan. In case such nonconformities are observed:

- An analysis of the nonconformity and its causes will be carried out immediately by the project owner, with the help of external experts if necessary.

- A corrective action plan should then be developed to eliminate the non-conformity and its causes to prevent its recurrence.

- Corrective actions are implemented and reported back to the VCS monitoring team.

- Relative information will be included in the monitoring report and reported to VVB during the verification.

- 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 (84,867.02 MWh/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.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$\Delta t_{j,d,y}$							
Data unit	°C							
Description	Average temperature difference between inlet and outlet temperatures at the downstream of each heat exchanger in year y.							
Value applied:	01-November-2020 to 31-March-2021							
	Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21
		1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-injection Well	10.24	11.72	11.54	11.70	11.74
			2#LBC Production Well and 1#LBC Re-injection Well	11.51	12.53	11.52	11.51	12.60
		3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re-injection Well	11.50	11.52	11.50	11.48	11.50
			4#LBC Production Well and 2#LBC Re-injection Well	10.73	11.50	11.51	11.48	11.48
		5#LBC 6#LBC	5#LBC Production Well and 3#LBC Re-injection Well	10.77	11.72	11.52	11.76	11.76
			6#LBC Production Well and 3#LBC Re-injection Well	10.74	12.52	11.49	12.54	12.46
		7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re-injection Well	11.49	11.98	11.50	12.04	11.97

			8#LBC Production Well and 4#LBC Re- injection Well	10.77	11.54	11.50	11.50	11.51
		9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re- injection Well	10.74	12.50	11.51	11.54	12.51
			10#LBC Production Well and 5#LBC Re- injection Well	11.49	12.26	11.53	11.55	12.28
		11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re- injection Well	10.77	12.26	11.49	12.31	12.22
			12#LBC Production Well and 6#LBC Re- injection Well	11.55	11.51	11.53	11.50	11.52
	Fajina community	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re- injection Well	10.25	12.20	11.50	12.29	12.27
			2#FJC Production Well and 1#FJC Re- injection Well	11.47	12.55	11.50	11.54	12.39
		3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re- injection Well	10.25	12.43	11.52	12.50	12.40
			4#FJC Production Well and 2#FJC Re- injection Well	10.75	12.21	11.50	11.46	12.28
		5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re- injection Well	11.50	11.50	11.50	11.50	11.51
			6#FJC Production Well and 3#FJC Re- injection Well	10.75	11.99	11.48	12.01	12.00
	Dehong community	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	10.77	12.02	11.51	11.98	12.04

			2#DHC Production Well and 1#DHC Injection Well	12.03	12.00	11.46	11.99	11.98
		3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	11.99	11.98	11.52	11.95	12.03
			4#DHC Production Well and 2#DHC Injection Well	11.48	11.48	11.48	11.49	11.50
		5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	11.51	11.50	11.51	11.48	11.47
			6#DHC Production Well and 3#DHC Injection Well	11.49	11.51	11.54	11.54	11.49
	Zhongheng community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	10.75	12.48	11.51	11.51	12.52
			2#ZHC Production Well and 1#ZHC Injection Well	11.46	12.50	11.46	11.51	12.54
	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	11.49	11.49	11.48	11.52	11.50
			2#XCC Production Well and 1#XCC Injection Well	10.25	11.51	11.49	11.43	11.49
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	11.52	11.49	11.50	11.50	11.51
			2#HDC Production	11.00	12.58	11.50	10.99	12.48

		Well and 1#HDC Injection Well					
		3#HDC Production Well and 2#HDC Injection Well	11.51	11.51	11.49	11.51	11.52
		4#HDC Production Well and 2#HDC Injection Well	11.01	12.45	11.50	11.00	12.48
	Jianye community	1#JYC Production Well and 1#JYC Injection Well	10.24	12.53	11.48	12.46	12.50
		2#JYC Production Well and 1#JYC Injection Well	11.49	11.51	11.48	11.56	11.49
		3#JYC Production Well and 2#JYC Injection Well	10.27	12.48	11.53	12.51	12.51
		4#JYC Production Well and 2#JYC Injection Well	11.50	11.49	11.50	11.49	11.49
	Langting community	1#LTC Production Well and 1#LTC Injection Well	11.05	11.54	11.51	11.49	11.53
		2#LTC Production Well and 1#LTC Injection Well	11.50	11.52	11.49	11.51	11.51
	Yuezhuang community	1#YZC Production Well and 1#YZC Injection Well	10.99	12.49	11.53	11.02	12.53
		2#YZC Production Well and 1#YZC	11.00	12.46	11.49	11.03	12.46

		Injection Well					
Fangyuan community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	11.00	12.54	11.48	10.99	12.55
		2#FYC Production Well and 1#FYC Injection Well	11.50	11.50	11.52	11.48	11.49
	3#FYC 4#FYC	3#FYC Production Well and 2#FYC Injection Well	11.51	11.47	11.53	11.51	11.53
		4#FYC Production Well and 2#FYC Injection Well	11.49	11.47	11.48	11.49	11.51

01-November-2021 to 31-March-2022

Sub-areas	Heat Substations	Geothermal Wells	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22
Lvbo community	1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-injection Well	10.97	11.75	11.77	11.75	11.49
		2#LBC Production Well and 1#LBC Re-injection Well	11.02	12.48	12.52	12.52	11.02
	3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re-injection Well	11.44	11.50	11.48	11.48	11.47
		4#LBC Production Well and 2#LBC Re-injection Well	11.20	11.49	11.48	11.48	11.54
	5#LBC 6#LBC	5#LBC Production Well and 3#LBC Re-injection Well	11.51	11.66	11.75	11.72	11.54
		6#LBC Production Well and	11.01	12.49	12.46	12.45	10.98

			3#LBC Re-injection Well					
		7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re-injection Well	10.97	12.02	12.05	12.02	11.54
			8#LBC Production Well and 4#LBC Re-injection Well	11.49	11.49	11.49	11.49	10.98
		9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re-injection Well	10.99	12.45	12.43	12.54	10.99
			10#LBC Production Well and 5#LBC Re-injection Well	11.50	12.21	12.34	12.20	11.52
		11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re-injection Well	11.00	12.24	12.19	12.21	11.50
			12#LBC Production Well and 6#LBC Re-injection Well	11.01	11.52	11.47	11.50	11.01
	Fajina community	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re-injection Well	11.52	12.26	12.27	12.20	11.03
			2#FJC Production Well and 1#FJC Re-injection Well	10.97	12.54	12.48	12.42	11.00
		3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re-injection Well	11.51	12.47	12.50	12.53	11.02
			4#FJC Production Well and 2#FJC Re-injection Well	11.47	12.35	12.29	12.29	11.01
		5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re-injection Well	11.00	11.47	11.48	11.50	11.51
			6#FJC Production Well and 3#FJC Re-injection Well	10.98	11.98	12.00	12.04	11.50

	Dehong community	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	11.48	12.01	12.01	12.04	10.98
			2#DHC Production Well and 1#DHC Injection Well	10.99	12.03	11.99	11.95	10.98
		3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	10.96	12.02	12.03	12.00	11.53
			4#DHC Production Well and 2#DHC Injection Well	11.48	11.54	11.52	11.45	11.49
		5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	11.46	11.50	11.49	11.50	11.02
			6#DHC Production Well and 3#DHC Injection Well	10.99	11.48	11.48	11.48	11.00
	Zhongheng community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	11.53	12.46	12.43	12.55	10.99
			2#ZHC Production Well and 1#ZHC Injection Well	11.49	12.57	12.47	12.43	11.03
	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	11.00	11.47	11.46	11.50	11.48
			2#XCC Production Well and 1#XCC Injection Well	11.50	11.46	11.49	11.52	10.94
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	11.52	11.55	11.45	11.49	11.04
			2#HDC Production Well and 1#HDC Injection Well	10.99	12.47	12.52	12.52	11.00
		3#HDC 4#HDC	3#HDC Production	11.52	11.47	11.54	11.48	11.48

		Well and 2#HDC Injection Well					
		4#HDC Production Well and 2#HDC Injection Well	11.00	12.45	12.54	12.52	11.04
	Jianye community	1#JYC Production Well and 1#JYC Injection Well	11.04	12.49	12.53	12.50	11.51
		2#JYC Production Well and 1#JYC Injection Well	11.51	11.51	11.52	11.48	11.50
		3#JYC Production Well and 2#JYC Injection Well	11.05	12.46	12.50	12.43	11.04
		4#JYC Production Well and 2#JYC Injection Well	11.49	11.54	11.49	11.53	11.01
	Langting community	1#LTC Production Well and 1#LTC Injection Well	11.53	11.48	11.46	11.50	10.98
		2#LTC Production Well and 1#LTC Injection Well	10.99	11.50	11.54	11.52	11.52
	Yuezhuang community	1#YZC Production Well and 1#YZC Injection Well	11.04	12.46	12.46	12.54	11.53
		2#YZC Production Well and 1#YZC Injection Well	11.00	12.57	12.48	12.60	11.07
	Fangyuan community	1#FYC Production Well and 1#FYC Injection Well	11.00	12.51	12.42	12.37	10.96
		2#FYC Production Well and 1#FYC Injection Well	10.97	11.56	11.49	11.53	11.01
		3#FYC Production Well and 4#FYC	10.97	11.45	11.51	11.49	10.97

		2#FYC Injection Well					
		4#FYC Production Well and 2#FYC Injection Well	10.96	11.49	11.48	11.46	11.53
Comments	The heat exchanger should handle the heat supplied by geothermal well only and not by any other source. The temperature readings should be taken at immediate inlet and outlet point of heat exchanger.						

Data / Parameter	$FR_{j,d,y}$							
Data unit	kg/h							
Description	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.							
Value applied:	01-November-2020 to 31-March-2021							
	Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21
	Lvbo community	1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-injection Well	609,60 4.01	675,54 4.10	690,58 0.66	675,84 2.35	674,755 .75
			2#LBC Production Well and 1#LBC Re-injection Well	610,19 5.50	695,15 9.01	689,78 1.55	693,97 8.97	694,903 .95
		3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re-injection Well	610,53 6.81	695,39 5.27	689,64 5.05	695,98 3.94	695,424 .25
			4#LBC Production Well and 2#LBC Re-injection Well	609,64 7.58	675,71 2.85	690,41 8.74	674,73 4.17	675,842 .59
		5#LBC 6#LBC	5#LBC Production Well and 3#LBC Re-injection Well	610,38 0.92	695,49 1.48	690,39 3.21	696,46 2.69	695,701 .09

			6#LBC Production Well and 3#LBC Re-injection Well	611,08 4.50	674,79 8.90	690,82 4.26	676,16 0.19	675,606 .20
		7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re-injection Well	611,28 5.28	696,22 3.52	690,66 4.56	674,09 5.80	696,768 .75
			8#LBC Production Well and 4#LBC Re-injection Well	611,03 3.51	676,74 9.18	690,34 3.12	676,15 0.21	674,848 .47
		9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re-injection Well	621,00 4.32	696,75 1.09	690,47 9.09	674,59 8.76	695,807 .82
			10#LBC Production Well and 5#LBC Re-injection Well	610,47 7.56	675,32 5.09	690,21 0.83	675,03 8.33	675,215 .05
		11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re-injection Well	611,10 5.61	709,52 7.97	689,80 6.51	675,61 8.38	710,144 .10
			12#LBC Production Well and 6#LBC Re-injection Well	620,73 2.71	696,27 4.18	689,53 8.06	695,47 4.88	695,230 .99
	Fajina commu nity	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re-injection Well	621,95 8.79	709,24 6.91	689,03 9.02	674,72 4.11	711,492 .20
			2#FJC Production Well and 1#FJC Re-injection Well	610,18 6.97	695,15 7.77	689,93 4.35	693,96 5.04	696,529 .38
		3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re-injection Well	610,85 9.60	695,76 2.93	690,05 9.56	695,86 3.27	694,349 .35
			4#FJC Production	610,55 8.42	694,63 2.07	689,83 3.20	695,30 8.60	695,140 .30

		Well and 2#FJC Re-injection Well					
		5#FJC Production Well and 3#FJC Re-injection Well	611,47 4.50	710,70 5.94	690,01 2.11	675,43 7.35	710,633 .12
		6#FJC Production Well and 3#FJC Re-injection Well	609,16 2.54	694,04 5.85	689,76 5.04	694,92 2.66	694,400 .16
	Dehong community	1#DHC Production Well and 1#DHC Injection Well	590,67 6.85	665,17 2.81	690,27 6.94	665,05 4.20	667,342 .02
		2#DHC Production Well and 1#DHC Injection Well	590,34 0.36	665,30 7.24	690,33 0.98	664,47 8.84	666,161 .81
		3#DHC Production Well and 2#DHC Injection Well	611,49 2.17	694,70 7.92	689,74 1.90	675,47 1.44	695,436 .21
		4#DHC Production Well and 2#DHC Injection Well	612,27 3.67	696,27 9.03	689,51 6.91	696,01 6.07	696,124 .56
		5#DHC Production Well and 3#DHC Injection Well	590,42 3.68	695,48 3.55	689,20 2.85	676,61 2.22	695,227 .03
		6#DHC Production Well and 3#DHC Injection Well	621,32 7.76	696,58 0.71	689,35 8.66	675,44 9.03	696,781 .02
	Zhongheng community	1#ZHC Production Well and 1#ZHC Injection Well	622,12 6.88	672,94 4.44	690,34 9.99	676,58 4.67	674,306 .98
		2#ZHC Production Well and 1#ZHC	620,98 4.94	666,03 0.01	690,07 7.80	665,71 7.92	664,641 .21

		Injection Well					
Xinchen community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	621,995.97	694,756.40	689,202.57	694,393.02	694,327.35
		2#XCC Production Well and 1#XCC Injection Well	609,952.01	694,775.09	690,550.90	694,987.13	695,715.42
Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	610,236.13	695,992.50	689,715.52	694,553.90	695,499.70
		2#HDC Production Well and 1#HDC Injection Well	610,346.58	695,387.84	690,204.27	675,008.76	695,106.32
	3#HDC 4#HDC	3#HDC Production Well and 2#HDC Injection Well	611,186.58	695,100.85	690,182.47	676,434.26	695,881.91
		4#HDC Production Well and 2#HDC Injection Well	610,112.01	678,539.15	689,759.34	680,035.63	681,249.97
Jianye community	1#JYC 2#JYC	1#JYC Production Well and 1#JYC Injection Well	610,874.42	681,798.20	690,258.05	679,741.31	681,368.74
		2#JYC Production Well and 1#JYC Injection Well	610,674.33	696,541.45	690,726.68	694,740.49	696,174.69
	3#JYC 4#JYC	3#JYC Production Well and 2#JYC Injection Well	610,291.29	696,445.73	690,299.85	696,147.46	696,384.10
		4#JYC Production Well and 2#JYC Injection Well	675,890.65	710,213.45	691,264.60	675,229.39	711,324.56

Langting community	1#LTC 2#LTC	1#LTC Production Well and 1#LTC Injection Well	609,71 4.50	695,05 1.76	690,02 2.23	675,81 3.11	695,072 .89
		2#LTC Production Well and 1#LTC Injection Well	609,26 2.13	711,39 2.19	690,66 9.13	676,53 8.69	711,545 .17
Yuezhua ng community	1#YZC 2#YZC	1#YZC Production Well and 1#YZC Injection Well	609,62 0.04	695,86 0.70	689,93 9.05	675,66 1.31	696,175 .28
		2#YZC Production Well and 1#YZC Injection Well	611,20 7.85	695,45 2.69	690,16 9.45	694,60 0.54	694,442 .20
Fangyua n community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	611,57 9.42	694,69 1.41	690,43 3.36	694,38 6.86	695,293 .13
		2#FYC Production Well and 1#FYC Injection Well	611,83 8.15	675,21 1.01	690,18 0.79	676,54 5.43	675,255 .65
	3#FYC 4#FYC	3#FYC Production Well and 2#FYC Injection Well	610,95 4.18	675,56 0.38	689,34 1.42	674,72 5.21	677,328 .55
		4#FYC Production Well and 2#FYC Injection Well	610,54 3.82	696,62 6.92	690,25 3.48	695,95 4.60	695,783 .94

01-November-2021 to 31-March-2022

Sub-areas	Heat Substations	Geothermal Wells	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22
Lvbo community	1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-injection Well	647,17 7.60	676,75 9.22	674,96 9.58	676,43 0.52	675,286 .06

			2#LBC Production Well and 1#LBC Re- injection Well	647,97 9.31	695,81 1.20	696,60 8.06	693,95 1.85	656,468 .20
		3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re- injection Well	648,93 1.50	694,33 4.22	694,90 4.18	695,22 5.24	644,475 .30
			4#LBC Production Well and 2#LBC Re- injection Well	658,76 1.63	673,79 6.26	674,94 4.42	675,79 0.07	645,729 .23
		5#LBC 6#LBC	5#LBC Production Well and 3#LBC Re- injection Well	647,31 8.88	695,40 8.15	695,36 3.78	695,50 8.82	645,623 .59
			6#LBC Production Well and 3#LBC Re- injection Well	646,39 0.64	675,16 0.08	674,93 7.31	674,95 5.03	675,386 .10
		7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re- injection Well	645,96 4.79	695,21 3.40	694,80 2.88	696,03 9.23	655,309 .73
			8#LBC Production Well and 4#LBC Re- injection Well	646,55 3.35	674,97 8.86	676,54 8.74	675,96 2.49	675,170 .22
		9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re- injection Well	647,95 7.78	696,34 9.76	696,17 2.70	696,32 4.45	664,920 .16
			10#LBC Production Well and 5#LBC Re- injection Well	675,35 8.29	674,97 0.27	675,42 1.53	675,37 8.41	676,897 .85
		11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re- injection Well	647,38 2.38	710,81 8.62	710,09 6.63	711,42 1.07	675,764 .68
			12#LBC Production	647,65 8.01	695,46 6.08	695,88 4.81	694,91 0.18	657,399 .29

			Well and 6#LBC Re-injection Well					
	Fajina community	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re-injection Well	647,29 0.93	712,06 0.05	711,96 2.47	709,81 2.81	665,236 .83
			2#FJC Production Well and 1#FJC Re-injection Well	647,34 0.03	694,92 4.70	695,68 8.71	696,50 2.75	656,289 .93
		3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re-injection Well	647,68 2.86	695,15 6.17	696,13 4.33	694,02 2.44	696,608 .86
			4#FJC Production Well and 2#FJC Re-injection Well	647,09 8.07	695,90 8.56	694,55 1.90	696,19 1.26	655,484 .62
		5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re-injection Well	645,67 1.96	710,65 9.91	710,84 6.53	711,06 3.41	665,284 .02
			6#FJC Production Well and 3#FJC Re-injection Well	646,88 1.51	695,48 5.15	695,79 8.28	695,11 8.94	665,307 .84
	Dehong community	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	645,83 3.88	665,77 7.11	665,48 0.87	666,15 0.34	664,699 .65
			2#DHC Production Well and 1#DHC Injection Well	645,89 1.46	665,46 6.72	665,48 1.30	665,39 4.66	666,509 .81
		3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	646,15 4.89	694,77 4.50	694,85 0.35	696,94 3.10	645,314 .50
			4#DHC Production Well and 2#DHC	647,50 4.35	694,18 2.57	695,95 2.06	695,88 7.19	646,074 .93

			Injection Well					
		5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	646,533.04	693,858.51	696,491.92	695,868.13	644,834.99
			6#DHC Production Well and 3#DHC Injection Well	647,179.65	694,681.67	695,707.16	695,786.01	645,946.64
	Zhongheng community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	646,815.97	675,515.51	674,739.09	674,991.09	644,764.26
			2#ZHC Production Well and 1#ZHC Injection Well	646,525.25	665,798.68	665,172.61	663,930.24	665,546.21
	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	695,772.74	695,221.92	695,611.67	695,157.25	645,825.32
			2#XCC Production Well and 1#XCC Injection Well	647,921.85	696,232.11	695,502.26	696,422.40	654,476.20
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	646,897.11	695,981.18	696,055.63	695,264.78	654,113.04
			2#HDC Production Well and 1#HDC Injection Well	677,234.99	694,977.11	694,654.23	694,946.47	655,336.18
		3#HDC 4#HDC	3#HDC Production Well and 2#HDC Injection Well	658,436.10	694,376.77	696,509.33	696,502.19	644,817.70
			4#HDC Production Well and 2#HDC Injection Well	647,082.83	681,817.55	682,561.98	680,314.72	645,371.36

	Jianye community	1#JYC 2#JYC	1#JYC Production Well and 1#JYC Injection Well	646,64 2.33	679,65 4.74	682,04 5.03	679,74 8.13	645,397 .55
			2#JYC Production Well and 1#JYC Injection Well	647,41 1.75	694,99 5.78	695,41 0.89	697,47 7.71	645,617 .92
		3#JYC 4#JYC	3#JYC Production Well and 2#JYC Injection Well	646,29 3.03	695,88 9.23	696,36 5.08	695,51 7.35	645,110 .55
			4#JYC Production Well and 2#JYC Injection Well	647,02 7.94	712,39 7.58	711,35 1.20	710,46 8.72	643,906 .99
	Langting community	1#LTC 2#LTC	1#LTC Production Well and 1#LTC Injection Well	645,96 6.49	695,62 7.33	695,92 7.70	695,02 9.64	656,333 .78
			2#LTC Production Well and 1#LTC Injection Well	647,22 9.31	711,90 7.46	708,90 3.17	711,57 1.00	645,171 .12
	Yuezhua ng community	1#YZC 2#YZC	1#YZC Production Well and 1#YZC Injection Well	646,42 2.08	694,96 2.14	695,80 0.40	695,47 3.66	644,045 .27
			2#YZC Production Well and 1#YZC Injection Well	647,24 0.31	695,30 9.31	694,46 2.61	695,83 6.35	644,855 .44
	Fangyua n community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	646,37 9.18	695,09 2.03	695,45 5.42	695,54 2.72	676,094 .23
			2#FYC Production Well and 1#FYC Injection Well	647,62 0.35	676,40 8.58	674,64 3.47	675,48 4.52	645,419 .31
		3#FYC 4#FYC	3#FYC Production	677,60 6.89	674,39 7.80	676,08 7.39	676,42 2.07	644,008 .91

		Well and 2#FYC Injection Well					
		4#FYC Production Well and 2#FYC Injection Well	647,32 2.92	694,41 9.44	695,69 2.22	696,35 9.18	645,357 .18
Comments	The heat exchanger should handle the heat supplied by geothermal well only and not by any other source.						

Data / Parameter	T_j							
Data unit	Hours							
Description	Hours per hear heat utilization in well j .							
Value applied:	01-November-2020 to 31-March-2021							
	Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21
Lvbo community	1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-injection Well	720	744	744	672	744	
		2#LBC Production Well and 1#LBC Re-injection Well	720	744	744	672	744	
	3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re-injection Well	720	744	744	672	744	
		4#LBC Production Well and 2#LBC Re-injection Well	720	744	744	672	744	
	5#LBC 6#LBC	5#LBC Production	720	744	744	672	744	

			Well and 3#LBC Re-injection Well					
			6#LBC Production Well and 3#LBC Re-injection Well	720	744	744	672	744
		7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re-injection Well	720	744	744	672	744
			8#LBC Production Well and 4#LBC Re-injection Well	720	744	744	672	744
		9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re-injection Well	720	744	744	672	744
			10#LBC Production Well and 5#LBC Re-injection Well	720	744	744	672	744
		11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re-injection Well	720	744	744	672	744
			12#LBC Production Well and 6#LBC Re-injection Well	720	744	744	672	744
	Fajina community	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re-injection Well	720	744	744	672	744
			2#FJC Production Well and 1#FJC Re-injection Well	720	744	744	672	744
		3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re-	720	744	744	672	744

			injection Well					
			4#FJC Production Well and 2#FJC Re-injection Well	720	744	744	672	744
		5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re-injection Well	720	744	744	672	744
			6#FJC Production Well and 3#FJC Re-injection Well	720	744	744	672	744
	Dehong community	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	720	744	744	672	744
			2#DHC Production Well and 1#DHC Injection Well	720	744	744	672	744
		3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	720	744	744	672	744
			4#DHC Production Well and 2#DHC Injection Well	720	744	744	672	744
		5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	720	744	744	672	744
			6#DHC Production Well and 3#DHC Injection Well	720	744	744	672	744
	Zhonghen community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	720	744	744	672	744

			2#ZHC Production Well and 1#ZHC Injection Well	720	744	744	672	744
	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	720	744	744	672	744
			2#XCC Production Well and 1#XCC Injection Well	720	744	744	672	744
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	720	744	744	672	744
			2#HDC Production Well and 1#HDC Injection Well	720	744	744	672	744
		3#HDC 4#HDC	3#HDC Production Well and 2#HDC Injection Well	720	744	744	672	744
			4#HDC Production Well and 2#HDC Injection Well	720	744	744	672	744
	Jianye community	1#JYC 2#JYC	1#JYC Production Well and 1#JYC Injection Well	720	744	744	672	744
			2#JYC Production Well and 1#JYC Injection Well	720	744	744	672	744
		3#JYC 4#JYC	3#JYC Production Well and 2#JYC Injection Well	720	744	744	672	744
			4#JYC Production	720	744	744	672	744

			Well and 2#JYC Injection Well					
Langting community	1#LTC 2#LTC	1#LTC Production Well and 1#LTC Injection Well	720	744	744	672	744	
		2#LTC Production Well and 1#LTC Injection Well	720	744	744	672	744	
Yuezhuang community	1#YZC 2#YZC	1#YZC Production Well and 1#YZC Injection Well	720	744	744	672	744	
		2#YZC Production Well and 1#YZC Injection Well	720	744	744	672	744	
Fangyuan community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	720	744	744	672	744	
		2#FYC Production Well and 1#FYC Injection Well	720	744	744	672	744	
	3#FYC 4#FYC	3#FYC Production Well and 2#FYC Injection Well	720	744	744	672	744	
		4#FYC Production Well and 2#FYC Injection Well	720	744	744	672	744	
01-November-2021 to 31-March-2022								
Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	
Lvbo community	1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-	720	744	744	672	744	

			injection Well					
			2#LBC Production Well and 1#LBC Re-injection Well	720	744	744	672	744
		3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re-injection Well	720	744	744	672	744
			4#LBC Production Well and 2#LBC Re-injection Well	720	744	744	672	744
		5#LBC 6#LBC	5#LBC Production Well and 3#LBC Re-injection Well	720	744	744	672	744
			6#LBC Production Well and 3#LBC Re-injection Well	720	744	744	672	744
		7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re-injection Well	720	744	744	672	744
			8#LBC Production Well and 4#LBC Re-injection Well	720	744	744	672	744
		9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re-injection Well	720	744	744	672	744
			10#LBC Production Well and 5#LBC Re-injection Well	720	744	744	672	744
		11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re-injection Well	720	744	744	672	744

			12#LBC Production Well and 6#LBC Re- injection Well	720	744	744	672	744
	Fajina communit y	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re- injection Well	720	744	744	672	744
			2#FJC Production Well and 1#FJC Re- injection Well	720	744	744	672	744
		3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re- injection Well	720	744	744	672	744
			4#FJC Production Well and 2#FJC Re- injection Well	720	744	744	672	744
		5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re- injection Well	720	744	744	672	744
			6#FJC Production Well and 3#FJC Re- injection Well	720	744	744	672	744
	Dehong communit y	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	720	744	744	672	744
			2#DHC Production Well and 1#DHC Injection Well	720	744	744	672	744
		3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	720	744	744	672	744
			4#DHC Production	720	744	744	672	744

			Well and 2#DHC Injection Well					
		5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	720	744	744	672	744
			6#DHC Production Well and 3#DHC Injection Well	720	744	744	672	744
	Zhongheng community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	720	744	744	672	744
			2#ZHC Production Well and 1#ZHC Injection Well	720	744	744	672	744
	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	720	744	744	672	744
			2#XCC Production Well and 1#XCC Injection Well	720	744	744	672	744
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	720	744	744	672	744
			2#HDC Production Well and 1#HDC Injection Well	720	744	744	672	744
		3#HDC 4#HDC	3#HDC Production Well and 2#HDC Injection Well	720	744	744	672	744
			4#HDC Production Well and 2#HDC Injection Well	720	744	744	672	744

			Injection Well					
	Jianye community	1#JYC 2#JYC	1#JYC Production Well and 1#JYC Injection Well	720	744	744	672	744
			2#JYC Production Well and 1#JYC Injection Well	720	744	744	672	744
		3#JYC 4#JYC	3#JYC Production Well and 2#JYC Injection Well	720	744	744	672	744
			4#JYC Production Well and 2#JYC Injection Well	720	744	744	672	744
	Langting community	1#LTC 2#LTC	1#LTC Production Well and 1#LTC Injection Well	720	744	744	672	744
			2#LTC Production Well and 1#LTC Injection Well	720	744	744	672	744
	Yuezhuang community	1#YZC 2#YZC	1#YZC Production Well and 1#YZC Injection Well	720	744	744	672	744
			2#YZC Production Well and 1#YZC Injection Well	720	744	744	672	744
	Fangyuan community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	720	744	744	672	744
2#FYC Production Well and 1#FYC Injection Well			720	744	744	672	744	

		3#FYC 4#FYC	3#FYC Production Well and 2#FYC Injection Well	720	744	744	672	744
			4#FYC Production Well and 2#FYC Injection Well	720	744	744	672	744
Comments	N/A.							

Data / Parameter	HI_m
Data unit	W/m ²
Description	Heating index for construction type m .
Value applied:	50 W/m ² for residential buildings.
Comments	N/A

Data / Parameter	$EC_{PJ,j,y} (EC_y)$														
Data unit	MWh														
Description	Electricity consumption for the year y in operating the geothermal heating system.														
Value applied:	<table> <tr> <td>1-November-2020-30-November-2020</td><td>8,085.02</td></tr> <tr> <td>1-December-2020-31-December-2020</td><td>8,563.62</td></tr> <tr> <td>1-January-2021-31-January-2021</td><td>8,612.29</td></tr> <tr> <td>1-February-2021-28-February-2021</td><td>8,814.54</td></tr> <tr> <td>1-March-2021-31-March-2021</td><td>7,913.73</td></tr> <tr> <td>1-November-2020-31-December-2020</td><td>16,648.64</td></tr> <tr> <td>1-January-2021-31-March-2021</td><td>25,340.56</td></tr> </table>	1-November-2020-30-November-2020	8,085.02	1-December-2020-31-December-2020	8,563.62	1-January-2021-31-January-2021	8,612.29	1-February-2021-28-February-2021	8,814.54	1-March-2021-31-March-2021	7,913.73	1-November-2020-31-December-2020	16,648.64	1-January-2021-31-March-2021	25,340.56
1-November-2020-30-November-2020	8,085.02														
1-December-2020-31-December-2020	8,563.62														
1-January-2021-31-January-2021	8,612.29														
1-February-2021-28-February-2021	8,814.54														
1-March-2021-31-March-2021	7,913.73														
1-November-2020-31-December-2020	16,648.64														
1-January-2021-31-March-2021	25,340.56														

	1-November-2020-31-March-2021	41,989.20
	1-April-2021-31-October-2021	0.00 ⁵⁴
	1-November-2021-30-November-2021	8,248.69
	1-December-2021-31-December-2021	8,772.92
	1-January-2022-31-January-2022	8,729.70
	1-February-2022-28-February-2022	8,993.57
	1-March-2022-31-March-2022	8,171.34
	1-April-2021-31-December-2021	17,021.62
	1-January-2022-31-March-2022	25,894.61
	1-April-2021-31-March-2022	42,916.23
	Total	84,905,429.49
Comments	N/A	

Data / Parameter	$EF_{EL,j,y} (EF_{grid,CM,y})$
Data unit	tCO ₂ /MWh
Description	Combined margin emission factor for the grid in year y .
Value applied:	0.5721 (0.8587 tCO ₂ e/MWh *0.5+0.2854 tCO ₂ e/MWh *0.5)
Comments	N/A

Data / Parameter	$TDL_{j,y}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y .

⁵⁴ Winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year. So, the electricity consumption in operating the geothermal heating system from 1-April-2021 to 31-October-2021 is 0.

Value applied:	20%
Comments	For (a): $TDL_{j,y}$ should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g., commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.

Data / Parameter	A_m			
Data unit	m ²			
Description	Net heating area for construction type m .			
Value applied:	01-November-2020 to 31-March-2021			
	Sub-areas	Heat Substations	Geothermal Wells	Residential
Lvbo community		1#LBC	1#LBC Production Well and 1#LBC Re-injection Well	289,997.25
		2#LBC	2#LBC Production Well and 1#LBC Re-injection Well	
		3#LBC	3#LBC Production Well and 2#LBC Re-injection Well	495,000.23
		4#LBC	4#LBC Production Well and 2#LBC Re-injection Well	
		5#LBC	5#LBC Production Well and 3#LBC Re-injection Well	384,250.25
		6#LBC	6#LBC Production Well and 3#LBC Re-injection Well	
		7#LBC	7#LBC Production Well and 4#LBC Re-injection Well	256,680.88
		8#LBC	8#LBC Production Well and 4#LBC Re-injection Well	
		9#LBC	9#LBC Production Well and 5#LBC Re-injection Well	172,000.16
		10#LBC	10#LBC Production Well and 5#LBC Re-injection Well	
		11#LBC	11#LBC Production Well and 6#LBC Re-injection Well	202,053.35
		12#LBC	12#LBC Production Well and 6#LBC Re-injection Well	
Fajina community		1#FJC	1#FJC Production Well and 1#FJC Re-injection Well	289,233.20
		2#FJC	2#FJC Production Well and 1#FJC Re-injection Well	
		3#FJC	3#FJC Production Well and 2#FJC Re-injection Well	214,911.25

			4#FJC Production Well and 2#FJC Re-injection Well		
		5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re-injection Well	248,615.55	
			6#FJC Production Well and 3#FJC Re-injection Well		
	Dehong community	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	350,677.88	
			2#DHC Production Well and 1#DHC Injection Well		
		3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	329,548.60	
			4#DHC Production Well and 2#DHC Injection Well		
		5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	355,073.52	
			6#DHC Production Well and 3#DHC Injection Well		
		Zhongheng community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	427,500.00
				2#ZHC Production Well and 1#ZHC Injection Well	
	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	347,400.15	
			2#XCC Production Well and 1#XCC Injection Well		
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	276,395.20	
			2#HDC Production Well and 1#HDC Injection Well		
		3#HDC 4#HDC	3#HDC Production Well and 2#HDC Injection Well	286,904.80	
			4#HDC Production Well and 2#HDC Injection Well		
	Jianye community	1#JYC 2#JYC	1#JYC Production Well and 1#JYC Injection Well	339,656.31	
			2#JYC Production Well and 1#JYC Injection Well		
		3#JYC 4#JYC	3#JYC Production Well and 2#JYC Injection Well	353,783.69	
			4#JYC Production Well and 2#JYC Injection Well		
	Langting community	1#LTC 2#LTC	1#LTC Production Well and 1#LTC Injection Well	399,408.08	
			2#LTC Production Well and 1#LTC Injection Well		
	Yuezhuang community	1#YZC 2#YZC	1#YZC Production Well and 1#YZC Injection Well	370,685.12	
2#YZC Production Well and 1#YZC Injection Well					
Fangyuan community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	218,608.80		
		2#FYC Production Well and 1#FYC Injection Well			
	3#FYC 4#FYC	3#FYC Production Well and 2#FYC Injection Well	262,663.20		
		4#FYC Production Well and 2#FYC Injection Well			
Total				6,871,047.47	

01-November-2021 to 31-March-2022

Sub-areas	Heat Substations	Geothermal Wells	Residential
Lvbo community	1#LBC 2#LBC	1#LBC Production Well and 1#LBC Re-injection Well	300,585.52
		2#LBC Production Well and 1#LBC Re-injection Well	
	3#LBC 4#LBC	3#LBC Production Well and 2#LBC Re-injection Well	507,375.24
		4#LBC Production Well and 2#LBC Re-injection Well	
	5#LBC 6#LBC	5#LBC Production Well and 3#LBC Re-injection Well	400,603.23
		6#LBC Production Well and 3#LBC Re-injection Well	
	7#LBC 8#LBC	7#LBC Production Well and 4#LBC Re-injection Well	268,261.37
		8#LBC Production Well and 4#LBC Re-injection Well	
	9#LBC 10#LBC	9#LBC Production Well and 5#LBC Re-injection Well	178,640.17
		10#LBC Production Well and 5#LBC Re-injection Well	
	11#LBC 12#LBC	11#LBC Production Well and 6#LBC Re-injection Well	225,840.08
		12#LBC Production Well and 6#LBC Re-injection Well	
Fajina community	1#FJC 2#FJC	1#FJC Production Well and 1#FJC Re-injection Well	301,542.43
		2#FJC Production Well and 1#FJC Re-injection Well	
	3#FJC 4#FJC	3#FJC Production Well and 2#FJC Re-injection Well	230,229.92
		4#FJC Production Well and 2#FJC Re-injection Well	
	5#FJC 6#FJC	5#FJC Production Well and 3#FJC Re-injection Well	293,377.45
		6#FJC Production Well and 3#FJC Re-injection Well	
Dehong community	1#DHC 2#DHC	1#DHC Production Well and 1#DHC Injection Well	366,376.83
		2#DHC Production Well and 1#DHC Injection Well	
	3#DHC 4#DHC	3#DHC Production Well and 2#DHC Injection Well	347,712.09
		4#DHC Production Well and 2#DHC Injection Well	
	5#DHC 6#DHC	5#DHC Production Well and 3#DHC Injection Well	380,717.68
		6#DHC Production Well and 3#DHC Injection Well	
Zhongheng community	1#ZHC 2#ZHC	1#ZHC Production Well and 1#ZHC Injection Well	439,181.69
		2#ZHC Production Well and 1#ZHC Injection Well	

	Xincheng community	1#XCC 2#XCC	1#XCC Production Well and 1#XCC Injection Well	359,720.74	
			2#XCC Production Well and 1#XCC Injection Well		
	Hengda community	1#HDC 2#HDC	1#HDC Production Well and 1#HDC Injection Well	284,944.17	
			2#HDC Production Well and 1#HDC Injection Well		
		3#HDC 4#HDC	3#HDC Production Well and 2#HDC Injection Well	297,256.51	
			4#HDC Production Well and 2#HDC Injection Well		
	Jianye community	1#JYC 2#JYC	1#JYC Production Well and 1#JYC Injection Well	344,237.72	
			2#JYC Production Well and 1#JYC Injection Well		
		3#JYC 4#JYC	3#JYC Production Well and 2#JYC Injection Well	356,180.80	
			4#JYC Production Well and 2#JYC Injection Well		
	Langting community	1#LTC 2#LTC	1#LTC Production Well and 1#LTC Injection Well	425,689.20	
			2#LTC Production Well and 1#LTC Injection Well		
	Yuezhuang community	1#YZC 2#YZC	1#YZC Production Well and 1#YZC Injection Well	391,991.10	
			2#YZC Production Well and 1#YZC Injection Well		
	Fangyuan community	1#FYC 2#FYC	1#FYC Production Well and 1#FYC Injection Well	221,303.28	
			2#FYC Production Well and 1#FYC Injection Well		
		3#FYC 4#FYC	3#FYC Production Well and 2#FYC Injection Well	264,812.06	
			4#FYC Production Well and 2#FYC Injection Well		
	Total				7,186,579.28
	Comments	N/A			

6.2 Baseline Emissions

The baseline emissions in year y (BE_y) can be calculated as follows,

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

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. 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 Zosen Boilers (79%), Fengcheng Energy Equipment Factory (80%) and Henan Hengxin Boiler Manufacturing Co., Ltd (85%). As per Table 3-1 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.

$HS_{i,y}^{BL}$ = 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).

$HS_{i,y}^{BL}$ can be calculated as follows,

$$HS_{i,y}^{BL} = w_i \times (HS_y - Loss^{PJ}_y + Loss^{BL}_y)$$

Where:

$HS_{i,y}^{BL}$ = 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 this Report, 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 Zhoukou City Housing and Urban-Rural Development Bureau, all the heating in winter of residential and commercial buildings were supplied by coal fired boilers. 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). Option 1 A conservative value of 0% of loss is used as historic information is not available.

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.

$$HS_y = \min\{H_{CAP}, HS_{y,estimated}\} \quad (5)$$

$HS_{y,estimated}$ 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.

$$HS_{y,estimated} = \sum_j (Q_{j,d,y} \times T_j \times CF) \quad (6)$$

Where:

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

$$Q_{j,d,y} = \frac{FR_{j,d,y} \times \Delta t_{j,d,y} \times 4.18}{3.6} \times 10^{-9} \quad (7)$$

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) ($^{\circ}\text{C}$).

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.

$$H_{CAP} = (\sum_m A_m \times HI_m \times T_j) \times CF + Loss_y^{PJ} - H_{ff} \quad (8)$$

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 (m^2).
HI_m	=	Heating index for construction type m (GW/m^2). As per Feasibility Report of the project, HI_m is $50 \text{ W}/\text{m}^2$ for residential buildings.
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.

Based on the results of monitored parameters, heat supplied by the geothermal based heating system (each heat exchangers) is summarized as Table 6-1. Please refer to the ER calculation sheet for more details.

Table 6-1 Calculation results of baseline emissions

Date	H_{CAP} (TJ)	$HS_{y,estimated}$ (TJ)	HS_y (TJ)	$Loss^{PL}_y$ (TJ)	$HS^{BL}_{I,y}$ (TJ)	$EF_{CO_2,I}$ (t CO ₂ /TJ)	$\eta_{BL,I}$ (%)	BE_y (tCO _{2e} /yr)
	A	B	C=min(A,B)	D	E=C-D	F	G	H=E*F/G
1-November-2020-30-November-2020	979.54	901.48	901.48	89.05	812.43	87.30	0.85	83,441
1-December-2020-31-December-2020	1,012.19	1,129.76	1,012.19	92.02	920.17			94,506
1-January-2021-31-January-2021	1,012.19	1,086.16	1,012.19	92.02	920.17			94,506
1-February-2021-28-February-2021	914.23	981.95	914.23	83.11	831.12			85,361
1-March-2021-31-March-2021	1,012.19	1,130.29	1,012.19	92.02	920.17			94,506
1-April-2021-31-October-2021 ⁵⁵	0	0	0	0	0			0
1-November-2021-30-November-2021	1024.52	997.62	997.62	93.14	904.48			92,895
1-December-2021-31-December-2021	1058.67	1129.56	1,058.67	96.24	962.43			98,846
1-January-2022-31-January-2022	1058.67	1129.64	1,058.67	96.24	962.43			98,846
1-February-2022-28-February-2022	956.22	1020.27	956.22	86.93	869.29			89,281
1-March-2022-31-March-2022	1058.67	1006.06	1,006.06	96.24	909.82			93,443

⁵⁵ Winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year. So, data from 1-April-2021 to 31-October-2021 is 0.

1-November-2020-31-December-2020	1,991.72	2,031.23	1,913.67	181.07	1,732.60			177,947
1-January-2021-31-December-2021	5,021.80	5,325.58	4,994.90	456.53	4,538.37			466,114
1-January-2022-31-March-2022	3,073.56	3,155.98	3,020.95	279.41	2,741.54			281,570
Total of the 1 st monitoring period	10,087.08	10,512.79	9,929.51	917.01	9,012.51			925,631

Baseline emissions was 177,947 tCO₂e from 01-November-2020 to 31-December-2020, 466,114 tCO₂e from 01-January-2021 to 31-December-2021, and 281,570 tCO₂e from 01-January-2022 to 31-March-2022. Total baseline emissions of the 1st monitoring period (01-November-2020-31-March-2022) was 925,631tCO₂e.

6.3 Project Emissions

As per the signed heating contract, heating areas (2020-2021 heating season) are summarized as the the following table.

Sub-areas	Heat Substations	1-November-2020-30-March-2021	1-November-2021-30-March-2022
		A_m (m ²)	A_m (m ²)
Lvbo community	1#LBC 2#LBC	289,997.25	300,585.52
	3#LBC 4#LBC	495,000.23	507,375.24
	5#LBC 6#LBC	384,250.25	400,603.23
	7#LBC 8#LBC	256,680.88	268,261.37
	9#LBC 10#LBC	172,000.16	178,640.17
	11#LBC 12#LBC	202,053.35	225,840.08
Fajina community	1#FJC 2#FJC	289,233.20	301,542.43
	3#FJC 4#FJC	214,911.25	230,229.92
	5#FJC 6#FJC	248,615.55	293,377.45
Dehong community	1#DHC 2#DHC	350,677.88	366,376.83
	3#DHC 4#DHC	329,548.60	347,712.09

	5#DHC 6#DHC	355,073.52	380,717.68
Zhongheng community	1#ZHC 2#ZHC	427,500.00	439,181.69
Xincheng community	1#XCC 2#XCC	347,400.15	359,720.74
Hengda community	1#HDC 2#HDC	276,395.20	284,944.17
	3#HDC 4#HDC	286,904.80	297,256.51
Jianye community	1#JYC 2#JYC	339,656.31	344,237.72
	3#JYC 4#JYC	353,783.69	356,180.80
Langting community	1#LTC 2#LTC	399,408.08	425,689.20
Yuezhuang community	1#YZC 2#YZC	370,685.12	391,991.10
Fangyuan community	1#FYC 2#FYC	218,608.80	221,303.28
	3#FYC 4#FYC	262,663.20	264,812.06
Total		6,871,047.47	7,186,579.28

For the 1st monitoring period from 01-November-2020 to 31-March-2022,

From 01-November-2020 to 31-March-2021, 6,871,047.47m² of residential buildings can access to geothermal energy-based space heating system in winter season.

From 01-April-2021 to 31-March-2022, 7,186,579.28 m² of residential buildings can access to geothermal energy-based space heating system in winter season.

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}).

$$PE_y = PE_{FE,y} + PE_{EC,y} + PE_{FF,y} \quad (12)$$

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 a low-temperature system. As per paragraph 84 of AM0072 (Version 03.0), fugitive emissions from low temperature geothermal system are 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 *Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation* (Version 03.0). Electricity consumption from each relevant source should be monitored and summed up to EC_y .

As per paragraph 16 of Tool 05 (Version 03.0), 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:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (13)$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (t CO ₂ /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 CO ₂ /MWh).
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source j in year y.

The electricity consumed by facilities of the geothermal system is sourced from local power grid connected to central China Power Grid (CCPG). 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 $TDL_{j,y}$.

Calculation results of project emissions during the year y (PE_y) are summarized as Table 6-2,

Table 6-2 Calculation results of project emissions

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)
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1-November-2020-30-November-2020	8,085,019.41	8,085.02	0.5721	1.2	5,551
1-December-2020-31-December-2020	8,563,619.95	8,563.62	0.5721	1.2	5,880
1-January-2021-31-January-2021	8,612,291.88	8,612.29	0.5721	1.2	5,913
1-February-2021-28-February-2021	8,814,543.72	8,814.54	0.5721	1.2	6,052
1-March-2021-31-March-2021	7,913,728.04	7,913.73	0.5721	1.2	5,433
1-April-2021-31-October-2021 ⁵⁶	0	0	0.5721	1.2	0
1-November-2021-30-November-2021	8,248,691.05	8,248.69	0.5721	1.2	5,663
1-December-2021-31-December-2021	8,772,924.35	8,772.92	0.5721	1.2	6,023
1-January-2022-31-January-2022	8,729,699.29	8,729.70	0.5721	1.2	5,994
1-February-2022-28-February-2022	8,993,572.71	8,993.57	0.5721	1.2	6,175
1-March-2022-31-March-2022	8,171,339.09	8,171.34	0.5721	1.2	5,610
1-November-2020-31-December-2020	16,648,639.36	16,648.64	0.5721	1.2	11,431
1-January-2021-31-December-2021	42,362,179.04	42,362.18	0.5721	1.2	29,084
1-January-2022-31-March-2022	25,894,611.09	25,894.61	0.5721	1.2	17,779

⁵⁶ Winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year. So, data from 1-April-2021 to 31-October-2021 is 0.

Total of the 1st monitoring period	84,905,429.49	84,905.43	0.5721	1.2	58,294
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No fossil fuel was used to operate the geothermal facilities. Therefore, $PE_{FF,y}=0$ tCO₂.

Therefore, for the 1st monitoring period, $PE_y=PE_{EC,y}$.

In summary, project emissions were 11,431 tCO₂e from 01-November-2020 to 31-December-2020, 29,084 tCO₂e from 01-January-2021 to 31-December-2021, and 17,779 tCO₂e from 01-January-2022 to 31-March-2022. Total project emissions of the 1st monitoring period (01-November-2020-31-March-2022) was 58,294 tCO₂e.

6.4 Leakage

No leakage emissions have been identified for the project activity. Therefore, $LE_y=0$ tCO₂.

6.5 Net GHG Emission Reductions and Removals

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)
1-November-2020-30-November-2020	83,441	5,551	0	77,890
1-December-2020-31-December-2020	94,506	5,880	0	88,626
1-January-2021-31-January-2021	94,506	5,913	0	88,593
1-February-2021-28-February-2021	85,361	6,052	0	79,309
1-March-2021-31-March-2021	94,506	5,433	0	89,073
1-April-2021-31-October-2021 ⁵⁷	0	0	0	0

⁵⁷ Winter heating season of Zhoukou City is usually from November 1 to March 31 of the next year. So, data from 1-April-2021 to 31-October-2021 is 0.

1-November-2021-30-November-2021	92,895	5,663	0	87,232
1-December-2021-31-December-2021	98,846	6,023	0	92,823
1-January-2022-31-January-2022	98,846	5,994	0	92,852
1-February-2022-28-February-2022	89,281	6,175	0	83,106
1-March-2022-31-March-2022	93,443	5,610	0	87,833
1-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
Total of the 1st monitoring period	925,631	58,294	0	867,337

Comparison of actual emission reduction and the estimation in the Joint-PD-MR.

Year	Estimated ER (tCO ₂)	Emission reduction achieved (tCO ₂)	Difference
01-November-2020 – 31-March-2022	990,578	867,337	-12.44%

The estimated outcomes for the 1st monitoring period (01-November-2020– 31-March-2022) is 867,337 tCO₂e. 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 1st monitoring period was 867,337 tCO₂e. 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.