

TEMPLATE

MONITORING REPORT

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VERSION v. 1.1

RELATED SUPPORT – TEMPLATE GUIDE Monitoring Report v. 1.1

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KEY PROJECT INFORMATION

Key Project Information

GS ID (s) of Project (s)	GS11167
Title of the project (s) covered by monitoring report	Taishan Geothermal Central Heating System
Version number of the PDD/VPA-DD (s) applicable to this monitoring report	04
Version number of the monitoring report	02
Completion date of the monitoring report	28/09/2021
Date of project design certification	31/10/2021 (estimated)
Date of Last Annual Report	N/A
Monitoring period number	01
Duration of this monitoring period	The 1 st monitoring period from 01/11/2020 to 31/03/2021 (first and last days included)
Project Representative	The official focal point and project developer: Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. The project owner: Zhengzhou Onar Heating Co., Ltd
Host Country	People's Republic of China
Activity Requirements applied	☒ Community Services Activities ☐ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Methodology (ies) applied and version number	AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating (Version 03.0)
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A

Table 1 - Sustainable Development Contributions Achieved

Sustainable Development Goals Targeted	SDG Impact	Amount Achieved	Units/ Products
13 Climate Action	GHG emission reductions	140,256	tCO ₂ e
8 Decent Work and Economic Growth	Number of males and females employed by the project	10 jobs created including 5 males and 5 females	Number
	Average monthly salary	3,500	RMB/person
7 Affordable and Clean Energy	Net heating area for construction type m (A_m)	2,441,983.15 m ² for residential buildings and	m ²
		94,516.36 m ² for commercial buildings	

Table 2 – Product Vintages

SDG 7 Affordable and Clean Energy		Amount Achieved
Start Dates	End Dates	Net heating area for construction type m (A_m)
01/11/2020	31/12/2020	2,441,983.15 m ² for residential buildings and 94,516.36 m ² for commercial buildings
01/01/2021	31/03/2021	2,441,983.15 m ² for residential buildings and 94,516.36 m ² for commercial buildings

SDG 8 Decent Work and Economic Growth		Amount Achieved	
Start Dates	End Dates	Number of jobs created	Average monthly salary
01/11/2020	31/12/2020	10 jobs created including 5 males and 5 females	3,500 RMB/person
01/01/2021	31/03/2021	10 jobs created including 5 males and 5 females	3,500 RMB/person

SDG 13 Climate Action		Amount Achieved
Start Dates	End Dates	GHG emission reductions (tCO ₂ e)
01/11/2020	31/12/2020	57,669

01/01/2021	31/03/2021	82,587
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SECTION A. DESCRIPTION OF PROJECT

A.1. General description of project

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The project activity is designed to introduce geothermal energy based space heating system to realize heat supply to a series of new residential buildings and commercial buildings in Taishan village over winter season, which will displace heat supply from isolated coal-fired boilers as a business-as-usual scenario in the project area.

Taishan Village is in Longhu Town, Xinzheng City of Henan Province. In December 2019, it was selected as the National Rural Governance Demonstration Village. The project involves the construction and operation of geothermal production wells, reinjection wells, heat substations and heat supply pipelines.

The project owner is Zhengzhou Onar Heating Co., Ltd and it has put into operation in November 2020 (winter season). It can supply geothermal heat to 2,480.907 thousand m² of residential buildings and 94.516 thousand m² of commercial buildings with a total heating load of 116.84MW. All the buildings covered by the project were newly built 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.

Emission reduction credits will be earned by the use of geothermal energy instead of the combustion of fossil fuel for space heating. The annual average CO₂ emission reductions are estimated as 143,987 tCO₂e. Total emission reductions achieved in the first monitoring period (01/11/2020 to 31/03/2021 (first and last days included)) is 140,256 tCO₂e.

A.2. Location of project

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The project is in Taishan Village, Longhu Town, Xinzheng City of Henan Province. The geographical coordinates are Longitude east 113°37'23.8" to 113°38'33.1" and Latitude North 34°34'42.8" to 34°35'17.0". The detailed coordinates of the 6 heat substations are provided in Table 3 below.

Table 3 Coordinates of the 6 Heat Substations

No.	Sub-areas	Heat Substations	Geothermal Wells	Coordinate
1	No.4 Village Group	1# TS4G	1# TS4G Production Well	34°34'57.2"N 113°37'41.4"E

			1# TS4G Re-injection Well	
			2# TS4G Production Well	
			2# TS4G Re-injection Well	
		2# TS4G	3# TS4G Production Well	34°35'00.1"N 113°38'10.4"E
			3# TS4G Re-injection Well	
			4# TS4G Production Well	
			4# TS4G Re-injection Well	
2	Zhengrongfu	3# TSZR	5# TSZR Production Well	34°34'59.1"N 113°38'33.1"E
			5# TSZR Re-injection Well	
			6# TSZR Production Well	
			6# TSZR Re-injection Well	
3	Taishan Villa	4# TSTS	7# TSTS Production Well	34°35'16.7"N 113°38'22.4"E
			7# TSTS Re-injection Well	
		5# TSTS	8# TSTS Production Well	34°35'17.0"N 113°38'08.8"E
			8# TSTS Re-injection Well	
			9# TSTS Production Well	
			9# TSTS Re-injection Well	
4	Wangdong Community	6# TSWD	10# TSWD Production Well	34°34'42.8"N 113°37'23.8"E
			10# TSWD Re-injection Well	
			11# TSWD Production Well	
			11# TSWD Re-injection Well	

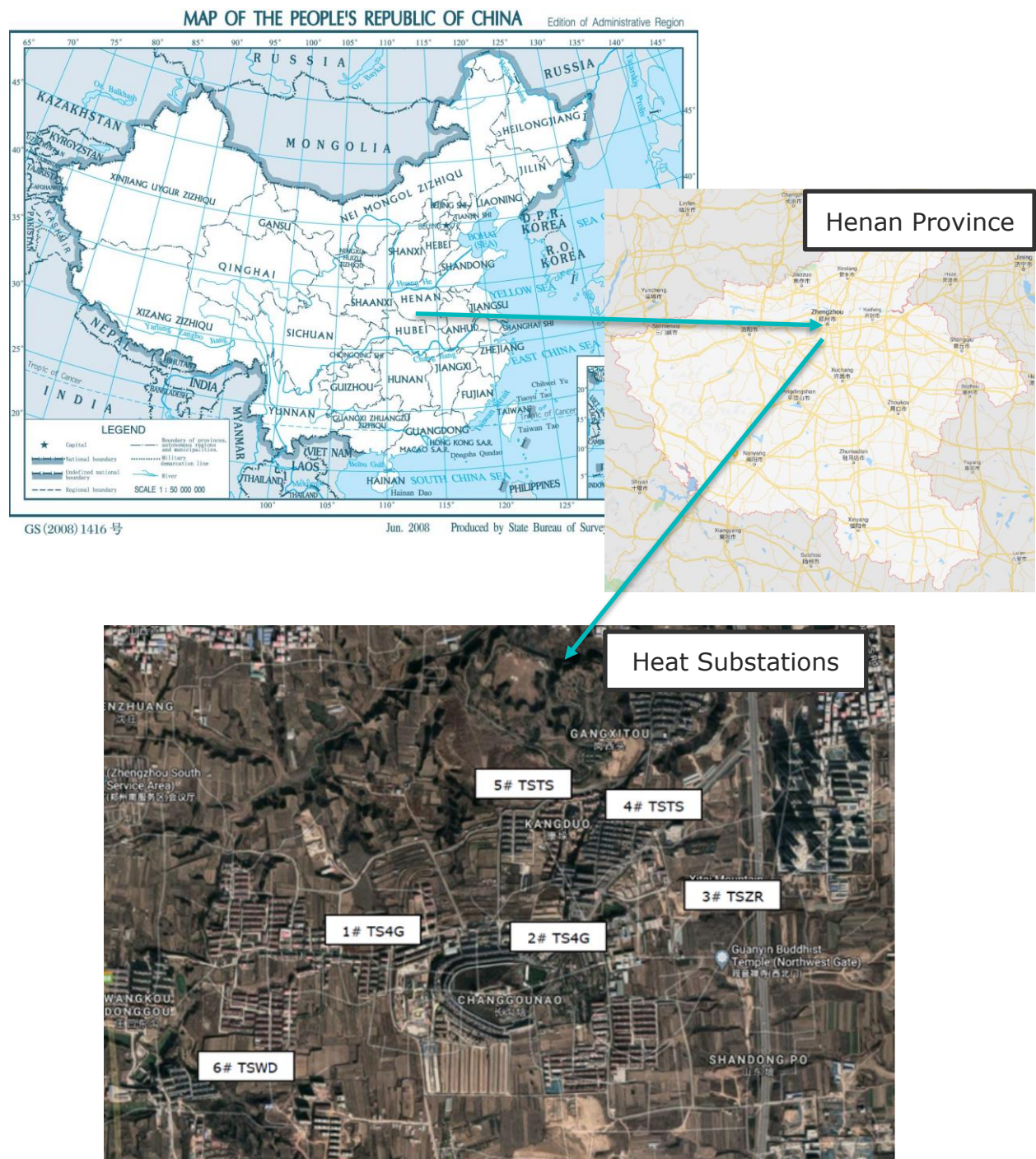


Figure 1 Location of the Project

A.3. Reference of applied methodology

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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)¹

Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)²

Tool 07 Tool to calculate the emission factor for an electricity system (Version 07.0)³

Tool 24 Common practice (Version 03.1)⁴

A.4. Crediting period of project

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Start date of crediting period: 01/11/2020.

Total length of crediting period: 01/11/2020 to 31/10/2025 (first and last days included) for the first crediting period (two renewal cycles and in total 15 years). The first monitoring period is from 01/11/2020 to 31/03/2021 (first and last days included), which belong to the first crediting period.

Expected lifetime of the project: 15 years⁵.

SECTION B. IMPLEMENTATION OF PROJECT

B.1. Description of implemented project

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The geothermal based space heating system was constructed from 15/05/2020 to 24/10/2020. The 22 geothermal (including 11 production wells and 11 reinjection wells) wells were connected to 6 Heat Substations in 4 Sub-areas to realize heat supply to the end-users in Taishan village over 2020-2021 heating season. The main actions made for implementation of the project are generalized in the following table.

Table 4 Milestone for implementation of the project

Time	Main actions
05/03/2020	Completion of feasibility study of the project
07/01/2020	Got water abstraction permits issued by Water Resources Bureau of Henan Province
18/02/2020	Approval by local Environmental Protection Bureau
14/04/2020	Approval by local Development and Reform Commission
15/05/2020	Start date of the project, the date on signing the geothermal well drilling contract
25/05/2020	Training for the GS monitoring team
09/10/2020	The first heating supply contract signed with end-user

¹ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf>

² <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf>

³ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>

⁴ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf>

⁵ As per manufacturer specifications of the geothermal space heating system, the lifetime of the equipment is more than 15 years.

24/10/2020-31/10/2020	Test run period of the whole system
01/11/2020	Start date of fully operation of the geothermal heating system, and the start date of 2020-2021 winter heating season of Taishan village
31/03/2021	End date of 2020-2021 winter heating season
22/04/2021	Submission for preliminary review
10/05/2021	Local stakeholder consulting physical meeting

The utilization hours of the geothermal heating system were 3,600 hours during this monitoring period (01/11/2020-31/03/2021). It provided geothermal heat to 2,480.907 thousand m² of residential buildings and 94.516 thousand m² of commercial buildings with a total heating load of 116.84MW. There are no deviations or delays compared to information in approved Project Design Document (PDD).

B.1.1. Forward Action Requests

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B.2. Post-Design Certification changes

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B.2.1. Temporary deviations from the approved Monitoring & Reporting Plan, methodology or standardized baseline

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None.

B.2.2. Corrections

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None.

B.2.3. Changes to start date of crediting period

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None.

B.2.4. Permanent changes from the Design Certified monitoring plan, applied methodology or applied standardized baseline

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None.

B.2.5. Changes to project design of approved project

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None.

SECTION C. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

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Parameters to be monitored

According to section B.7.1 of the PDD, there are 10 SDG parameters to be monitored,

SDG 7/SDG 13

a) Net heating area for construction type m , A_m

SDG 8

b) Number of males and females employed by the project

c) Average monthly salary

SDG 13

d) Heating index for construction type m , HI_m

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

f) Combined margin emission factor for the grid in year y , $EF_{EL,j,y}$ ($EF_{grid,CM,y}$)

g) Hours per hear heat utilization in well j , T_j

h) Average temperature difference between inlet and outlet temperatures at the downstream of substation heat exchanger in year y , $\Delta t_{j,d,y}$

i) 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 , $FR_{j,d,y}$

j) Electricity consumption for the year y in operating the geothermal heating system, $EC_{PJ,j,y}$ (EC_y)

For the parameters of SDG 7 and SDG 13, net heating areas for construction type m (A_m) were determined based on heating supply contracts and cross-checked by the business investment project approval.

For the parameters of SDG 8, number of males and females employed by the project and average monthly salary were determined based on record keeping book. 10 jobs for local people were created and the average monthly salary were 3,500 RMB/person in the 1st monitoring period.

For the parameters of SDG 13

Heating index for construction type m (HI_m) was sourced from the conservative standard index as provided by the standards institute of China (*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). There were no updated version of the related national and local standards.

Average technical transmission and distribution losses for providing electricity to source j in year y ($TDL_{j,y}$) was determined using the latest version of *Tool 05* (Version 03.0).

Combined margin emission factor for the grid in year y ($EF_{EL,j,y}$ ($EF_{grid,CM,y}$)) was calculated using the procedures in the latest version of *Tool 07* (Version 07.0). It was determined as per 2019 *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 China⁶. Taishan village is in Henan province, which belongs to Central China Regional Power Grid. $EF_{grid,OM\ Simple,y}$ and $EF_{grid,BM,y}$ were 0.8587 tCO₂/MWh and 0.2854 tCO₂/MWh separately in 2019. $EF_{EL,j,y}$ ($EF_{grid,CM,y}$) can be calculated as 0.8587 tCO₂/MWh*0.5+0.2854 tCO₂/MWh*0.5=0.5721 tCO₂/MWh.

Hours per hear heat utilization in well j (T_j) was sourced from statistical data of the geothermal space heating system. The 2020-2021 winter heating season of Taishan village was from 01/11/2020 to 31/03/2021 (150 days). The whole geothermal based space heating system was put into test run from 24/10/2020 to 31/10/2020. The use time during the test run was ignored for conservative principles.

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

Figure 2 below outlines the organization structure of the monitoring system for the related three parameters. The project owner was responsible for the whole monitoring work. The GS monitoring team was responsible for the monitoring of all the parameters to be monitored. All the data were reviewed by the project developer and VVB.

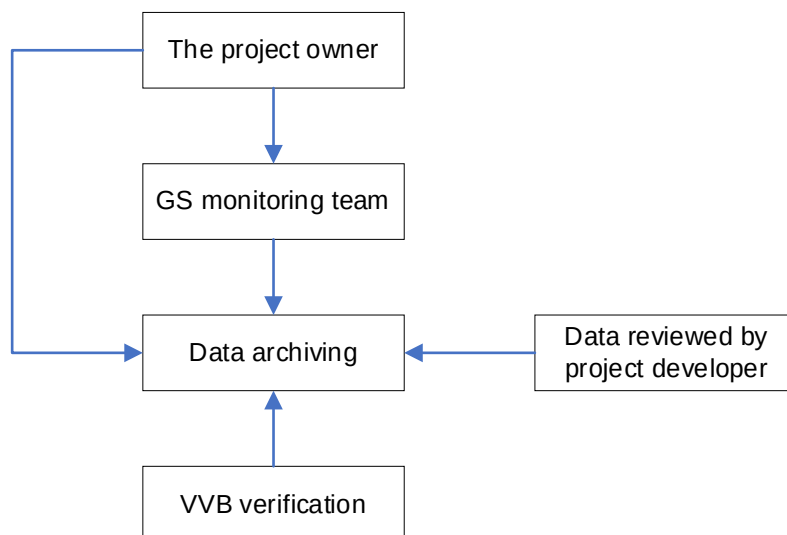


Figure 2 Organization Structure of the Monitoring Team

Monitoring equipment and installation

⁶ http://www.mee.gov.cn/ywgz/ycqhbh/wsqtkz/202012/t20201229_815386.shtml

Inlet and outlet temperatures at the downstream of each heat exchanger are monitored by the ultrasonic calorimeters. There are 11 production wells and 11 re-injection wells. One production well and one re-injection well form one set of heat exchange system. There are totally 11 sets of heat exchange system. 22 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 11 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. 6 electricity meters are needed. The accuracy of the electricity meters is 0.5S.

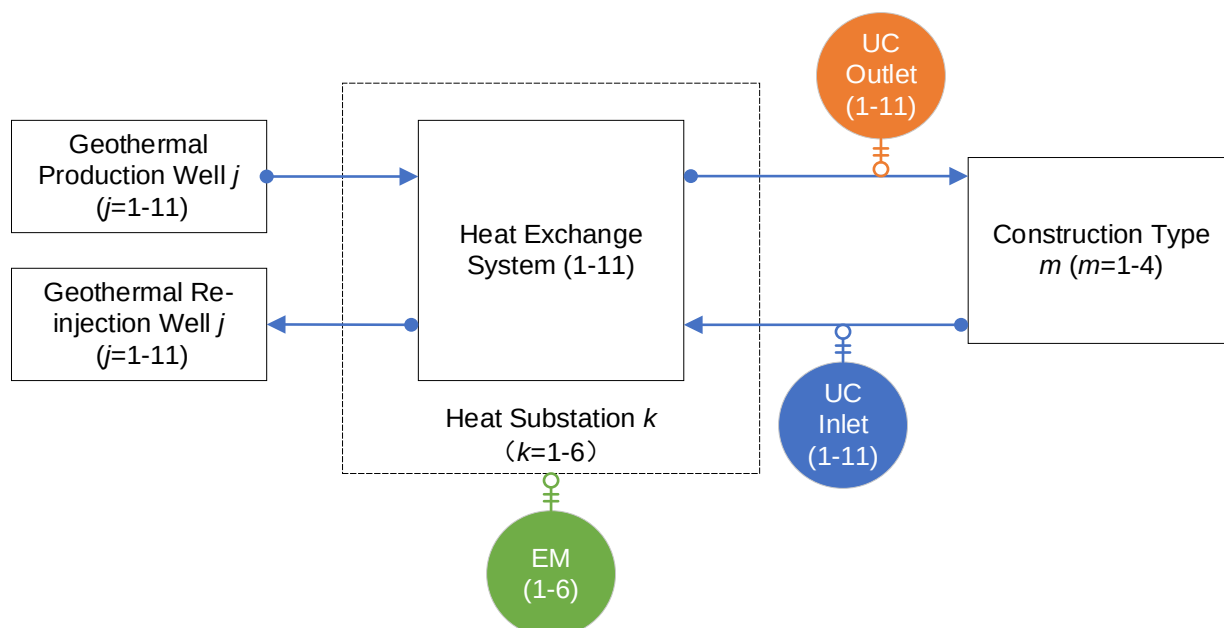
Installation and configuration of monitoring equipment are shown as Figure 3. All the monitoring equipment can measure continuously and installed in a manner that only the heat supplied by the geothermal heating system and the electricity consumed by it are measured.

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*⁷ and the electricity meters are calibrated based on *JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy*⁸. All the monitoring equipment were calibrated during test run period (24/10/2020-31/10/2020) 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.

⁷ <https://www.wdfoxw.net/doc60326801.htm>

⁸ <https://www.wdfoxw.net/doc91019332.htm>



EM (1-6): 6 electricity meters installed at each heat substation to monitor the electricity consumptions of the geothermal heating system.

UC Inlet (1-11): 11 ultrasonic calorimeters installed at downstream of each heat exchange system to monitor the return water temperature from the end users.

UC Outlet (1-11): 11 ultrasonic calorimeters installed at downstream of each heat exchange system to monitor the supply water temperature from the geothermal heating system and the average flow rate of the supply water.

Figure 3 Installation and Configuration of Monitoring Equipment

Data management and archiving

Hourly volume flow rate, inlet temperature and outlet temperature of the heat exchange system were exported by the GS monitoring team at the beginning of the next month to form the monthly record. The average daily value of the related three parameters were calculated based on the 24-hourly data separately. The average monthly value of the related three parameters were calculated based on all the daily value of this month. Finally, the operation record of the geothermal heating system during the related heating season were summarized by all the monthly record.

Monthly operation time of the 11 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.

Before test run of the whole geothermal space heating system, base number of all the 6 electricity meters were recorded by the GS monitoring team under the supervision of

the representative of each sub-area⁹. At the end of each heating month, the GS monitoring team recorded readings of the 6 electricity meters, which can calculate the electricity consumption of this month by minus last month's base number of the related electricity meters. The operation record of the geothermal heating system during the related heating season were summarized by all the monthly record.

As per B.7.3 of the registered PDD, 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.

Training for the GS monitoring team

Only skilled employees are allowed to undertake the monitoring work. During the first monitoring period, one training session was conducted by the project owner on 25/05/2020. The contents included mechanism of GS Standard and emission reductions, basic understanding of climate change, all the parameters to be monitored, monitoring methodology and frequency for related parameters, requirements for data collecting and archiving, internal data verification procedures and some other attentions.

Training plans and attendance lists of the GS Monitoring Team can be taken as evidence.

Emergency procedure

In case of water leakage or other system error, the emergency plan shall be taken immediately and reported to the project owner. If necessary, the use of relevant equipment shall be suspended. The project owner shall arrange professionals to repair and maintain the equipment as soon as possible.

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 registered PDD (12,770,798 MWh/12=1,064,233.17 MWh) or average electricity consumption of the previous months whichever is higher will be used for missing data. This is the most conservative approach.

There was no emergency occurred during the 1st monitoring period.

Corrective actions

The whole GS monitoring team fellow recognized standard data evaluation methods to guarantee that the data was reliable and accurate. There was no correction of nonconformities occurred in implementation of the project or the monitoring plan during

⁹ There are No.4 Village Group, Zhengrongfu, Taishan Villa and Wangdong Community 4 sub-areas.

the 1st monitoring period. For QA/QC procedure, please refer to QA/QC procedures in section D.2 of the monitoring report.

Avoiding of double counting

There is a unique identification code for each heat substation (1# TS4G, 2# TS4G, 3# TSZR, 4# TSTS, 5# TSTS and 6# TSWD), 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, VCS etc.) as well. Besides, the project owner has signed the Declaration of No Double Counting Statement and Declaration of not involved in other GHG scheme on 15/04/2021. The emission reductions were not double counted during the 1st monitoring period.

SECTION D. DATA AND PARAMETERS

D.1. Data and parameters fixed ex ante or at renewal of crediting period

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SDG13

Data/parameter	$EF_{CO_2,i}$
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 <i>AM0072</i> (Version 03.0).
Value(s) applied	87.3
Choice of data or Measurement methods and procedures	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
Additional comment	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.
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Data/parameter	$\eta_{BL,i}$
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 <i>AM0072</i> (Version 03.0).
Value(s) applied	85
Choice of data or Measurement methods and procedures	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 4 Default baseline efficiency for different boilers of <i>AM0072</i> (Version 03.0), the highest value of 85% for new coal-fired boiler is applicable for the project. In summary, the efficiency of 85% is applied for the project.
Purpose of data	To calculate baseline emissions
Additional comment	N/A

Data/parameter	$Loss^{BL}_{i,y}$
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 <i>AM0072</i> (Version 03.0).
Value(s) applied	0
Choice of data or Measurement methods and procedures	The historic information is not available, a conservative value of 0% of losses can be used as per paragraph 66 option 1 of <i>AM0072</i> (Version 03.0).
Purpose of data	To calculate baseline emissions
Additional comment	N/A

Data/parameter	<i>Subscript i</i>
Unit	

Description	Type of technology used in the baseline scenario.
Source of data	<i>Feasibility Study Report</i> of the project
Value(s) applied	Coal fired boilers in boiler houses, supplying several buildings through a heat distribution network.
Choice of data or Measurement methods and procedures	As per section 5.2 of <i>AM0072 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 project activity. Refer to section B.4 of the PDD for more details.
Purpose of data	To calculate baseline emissions
Additional comment	Data shall be stored in an excel sheet/database

Data/parameter	<i>Subscript j</i>
Unit	
Description	Geothermal well number.
Source of data	<i>Feasibility Study Report</i> of the project
Value(s) applied	Geothermal wells number $j = 1$ to 22.
Choice of data or Measurement methods and procedures	There are a total of 22 geothermal wells including 11 production wells and 11 re-injection wells in the boundary of the project activity as per <i>Feasibility Study Report</i> , which can be identified through unique identification code.
Purpose of data	To calculate baseline emissions
Additional comment	Distinct geothermal well with distinct properties of temperature, pressure and flow volume.

Data/parameter	<i>Subscript m</i>
Unit	
Description	Space heating construction type
Source of data	<i>Feasibility Study Report</i> of the project
Value(s) applied	Residential and commercial
Choice of data or Measurement methods and procedures	Identified by local urban planners under a short to medium term development plan for the area.
Purpose of data	To calculate baseline emissions
Additional comment	Areas designated for space heating under the categories of residential, commercial and industrial space heat

Data/parameter	<i>Subscript k</i>
Unit	
Description	Sub-station number
Source of data	<i>Feasibility Study Report</i> of the project
Value(s) applied	Sub-station number $k=1$ to 6
Choice of data or Measurement methods and procedures	There is a total of 6 sub-stations in the boundary of the project activity, which can be identified through unique identification code and GPS coordinates.
Purpose of data	To calculate baseline emissions
Additional comment	Includes a heat exchanger as part of the sub-station.

Data/parameter	$Loss^{PJ}_y$
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(s) applied	Refer to ER calculation sheet for more details.
Choice of data or Measurement methods and procedures	$Loss^{PJ}_y = \sum_m 10\% \times A_m \times HI_m \times T_j \times CF \times 10^{-9}$ 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
Additional comment	N/A

Data/parameter	w_i
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 <i>AM0072</i> (Version 03.0).
Value(s) applied	1
Choice of data or Measurement methods and procedures	As per section B.4 of this PDD, 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 Taishan village</i> published by

	Xinzheng 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 <i>AM0072</i> (Version 03.0), w_i is equal to 1.
Purpose of data	To calculate baseline emissions
Additional comment	N/A

Data / Parameter	H_{ff}
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(s) applied	There are no fossil fuel boilers used to meet the heat demand of the project heating network. Therefore, $H_{ff}=0$ TJ.
Choice of data or Measurement methods and procedures	-
Purpose of data	To calculate baseline emissions
Additional comment	N/A

D.2. Data and parameters monitored

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SDG 13

Data / Parameter	$\Delta t_{j,d,y}$							
Unit	°C							
Description	Average temperature difference between inlet and outlet temperatures at the downstream of each heat exchanger in year y.							
Source of data	Operation record of the geothermal based space heating system.							
Value(s) of monitored parameter	Sub-areas	Heat Substations	Geothermal Wells	Nov -20	Dec -20	Jan -21	Feb -21	Mar -21
	No.4 Village Group	1# TS4G	1# Production and Re-injection Well	11.94	12.02	12.14	12.57	11.28

		2# Production and Re- injection Well	11.9 9	11.5 4	11.7 1	12.2 9	10.6 8
		3# Production and Re- injection Well	11.8 3	12.1 1	11.5 7	12.1 4	11.1 7
		4# Production and Re- injection Well	11.9 9	12.5 3	12.2 9	12.0 6	11.4 7
	Zhengron gfu	5# Production and Re- injection Well	11.9 1	12.2 6	11.5 8	12.8 5	10.6 9
		6# Production and Re- injection Well	11.8 8	12.0 3	12.0 6	11.9 1	11.1 1
	Taishan Villa	7# Production and Re- injection Well	11.8 9	11.2 3	11.9 8	12.3 0	10.7 8
		8# Production and Re- injection Well	11.8 9	11.5 2	11.7 0	12.1 8	11.0 3
		9# Production and Re- injection Well	11.9 6	12.0 7	11.6 0	12.0 3	11.3 9
	Wangdon g Communit y	10# Production and Re- injection Well	11.9 5	12.1 2	11.7 6	12.6 4	10.8 7
		11# Production and Re- injection Well	11.8 2	11.7 5	12.0 7	11.8 4	11.4 1
Measurement	Outlet temperature minus inlet temperature at the downstream of each heat exchanger j . All the temperature data were measured by the						

methods and procedures	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 11 production wells and 11 re-injection wells. One production well and one re-injection well form one set of heat exchange system. There are totally 11 sets of heat exchange system. 22 ultrasonic calorimeters are needed to monitor the inlet and outlet temperatures of all the heat exchange system. Refer to Figure 3 of the MR for more details on installation and configuration of the ultrasonic calorimeters. Serial No. of the ultrasonic calorimeters are Lu00000858, Lu00000859, Lu00000860, Lu00000861, Lu00000862, Lu00000863, Lu00000864, Lu00000865, Lu00000866, Lu00000867, Lu00000868, Lu00000869, Lu00000870, Lu00000871, Lu00000872, Lu00000873, Lu00000874, Lu00000875, Lu00000876, Lu00000877, Lu00000878 and Lu00000879 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 GS 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.					
Monitoring frequency	Measured Hourly/Recording Monthly					
QA/QC procedures	Ultrasonic calorimeters have been checked regularly for potentially performance-reducing anomalies by the GS 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 <i>JJG 225-2001 Verification Regulation of Heat Meters</i>. All the 22 ultrasonic calorimeters were calibrated during test run period (24/10/2020-31/10/2020) of the geothermal heating system. Calibration of the 22 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. All the 22 ultrasonic calorimeters should be recalibrated in the end of October 2025.					
<table><tr><th>NO.</th><th>Serial No.</th><th>Purpose</th><th>Calibration Date</th><th>Term of Validity</th></tr></table>		NO.	Serial No.	Purpose	Calibration Date	Term of Validity
NO.	Serial No.	Purpose	Calibration Date	Term of Validity		

1	Lu00000858	To monitor supply water temperature of 1# heat exchange system	24/10/2020	23/10/2025
2	Lu00000859	To monitor supply water temperature of 2# heat exchange system	24/10/2020	23/10/2025
3	Lu00000860	To monitor supply water temperature of 3# heat exchange system	24/10/2020	23/10/2025
4	Lu00000861	To monitor supply water temperature of 4# heat exchange system	25/10/2020	24/10/2025
5	Lu00000862	To monitor supply water temperature of 5# heat exchange system	25/10/2020	24/10/2025
6	Lu00000863	To monitor supply water temperature of 6# heat exchange system	25/10/2020	24/10/2025
7	Lu00000864	To monitor supply water temperature of 7# heat exchange system	26/10/2020	25/10/2025
8	Lu00000865	To monitor supply water temperature of 8# heat exchange system	26/10/2020	25/10/2025
9	Lu00000866	To monitor supply water temperature of 9# heat exchange system	26/10/2020	25/10/2025
10	Lu00000867	To monitor supply water temperature of 10# heat exchange system	27/10/2020	26/10/2025
11	Lu00000868	To monitor supply water temperature of 11# heat exchange system	27/10/2020	26/10/2025
12	Lu00000869	To monitor return water temperature	27/10/2020	26/10/2025

		of 1# heat exchange system		
13	Lu00000870	To monitor return water temperature of 2# heat exchange system	28/10/2020	27/10/2025
14	Lu00000871	To monitor return water temperature of 3# heat exchange system	28/10/2020	27/10/2025
15	Lu00000872	To monitor return water temperature of 4# heat exchange system	28/10/2020	27/10/2025
16	Lu00000873	To monitor return water temperature of 5# heat exchange system	29/10/2020	28/10/2025
17	Lu00000874	To monitor return water temperature of 6# heat exchange system	29/10/2020	28/10/2025
18	Lu00000875	To monitor return water temperature of 7# heat exchange system	30/10/2020	29/10/2025
19	Lu00000876	To monitor return water temperature of 8# heat exchange system	30/10/2020	29/10/2025
20	Lu00000877	To monitor return water temperature of 9# heat exchange system	30/10/2020	29/10/2025
21	Lu00000878	To monitor return water temperature of 10# heat exchange system	31/10/2020	30/10/2025
22	Lu00000879	To monitor return water temperature of 11# heat exchange system	31/10/2020	30/10/2025

There were no missing data or damaged data during the 1st monitoring period. The average temperature change of the 11 heat exchange

	system of the 2020-2021 heating season (11.81 °C) ¹⁰ 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 11 heat exchange system of the Taishan geothermal heating system is about 12°C.
Purpose of data	To calculate baseline emissions
Additional comment	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	$FR_{j,d,y}$							
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	Operation record of the geothermal based space heating system.							
Value(s) of monitored parameter	Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21
	No.4 Village Group	1# TS4G	1# Production and Re-injection Well	846,93 2.50	850,80 0.59	829,56 8.85	834,80 3.76	841,42 2.74
			2# Production and Re-injection Well	846,83 5.00	835,64 9.56	848,33 8.24	839,81 2.01	839,39 3.09

¹⁰ The average temperature change of the 11 heat exchange system of the 2020-2021 heating season can be calculated as (11.99 °C+11.64 °C+11.77 °C+12.07 °C+11.86 °C+11.80 °C+11.64 °C+11.67 °C+11.81 °C+11.87 °C+11.78 °C)/11=11.81 °C.

		2# TS4G	3# Product ion and Re- injectio n Well	843,49 3.67	847,67 1.25	843,40 6.28	846,50 9.43	840,54 5.49
			4# Product ion and Re- injectio n Well	845,05 2.51	848,50 0.60	839,50 2.96	845,04 6.11	848,66 9.85
	Zhengr ongfu	3# TSZR	5# Product ion and Re- injectio n Well	845,95 4.82	851,08 7.64	846,29 5.17	835,23 8.06	845,14 6.75
			6# Product ion and Re- injectio n Well	845,28 1.06	840,94 3.79	847,59 2.11	843,92 5.79	841,83 2.99
	Taishan Villa	4# TSTS	7# Product ion and Re- injectio n Well	843,80 1.13	834,96 7.41	855,87 5.36	854,11 8.22	836,82 1.99
		5# TSTS	8# Product ion and Re- injectio n Well	843,50 2.69	829,84 5.55	842,75 1.84	845,83 1.83	848,25 7.96
			9# Product ion and Re- injectio n Well	844,42 9.01	841,16 9.38	843,51 4.22	843,22 3.95	840,09 0.70
	Wangd ong Commu nity	6# TSWD	10# Product ion and Re- injectio n Well	846,71 6.85	847,99 1.40	839,35 2.34	826,27 4.58	833,16 9.74
			11# Product ion and Re-	849,90 9.10	846,54 0.10	830,60 9.52	847,78 1.36	850,42 0.90

			injection Well															
Measurement methods and procedures	Average flow rate at the downstream of each heat exchanger are monitored by the 11 ultrasonic calorimeters for outlet temperature. Refer to Figure 3 of the MR for more details on installation and configuration of the ultrasonic calorimeters. Serial No. of the ultrasonic calorimeters are Lu00000858, Lu00000859, Lu00000860, Lu00000861, Lu00000862, Lu00000863, Lu00000864, Lu00000865, Lu00000866, Lu00000867, Lu00000868 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 GS 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.																	
Monitoring frequency	Measured hourly/Recording monthly																	
QA/QC procedures	Ultrasonic calorimeters have been checked regularly for potentially performance-reducing anomalies by the GS monitoring team. The highest measurement flow rate range of the ultrasonic calorimeters are 1,000 m³/h with an accuracy of 0.01 m³/h. The ultrasonic calorimeters are calibrated based on <i>JJG 225-2001 Verification Regulation of Heat Meters</i>. All the 11 ultrasonic calorimeters were calibrated during test run period (24/10/2020-31/10/2020) of the geothermal heating system. Calibration of the 11 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. All the 11 ultrasonic calorimeters should be recalibrated in the end of October 2025. <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>Lu00000858</td><td>To monitor flow rate of 1# heat exchange system</td><td>24/10/2020</td><td>23/10/2025</td></tr></table>								NO.	Serial No.	Purpose	Calibration Date	Term of Validity	1	Lu00000858	To monitor flow rate of 1# heat exchange system	24/10/2020	23/10/2025
NO.	Serial No.	Purpose	Calibration Date	Term of Validity														
1	Lu00000858	To monitor flow rate of 1# heat exchange system	24/10/2020	23/10/2025														

2	Lu00000859	To monitor flow rate of 2# heat exchange system	24/10/2020	23/10/2025
3	Lu00000860	To monitor flow rate of 3# heat exchange system	24/10/2020	23/10/2025
4	Lu00000861	To monitor flow rate of 4# heat exchange system	25/10/2020	24/10/2025
5	Lu00000862	To monitor flow rate of 5# heat exchange system	25/10/2020	24/10/2025
6	Lu00000863	To monitor flow rate of 6# heat exchange system	25/10/2020	24/10/2025
7	Lu00000864	To monitor flow rate of 7# heat exchange system	26/10/2020	25/10/2025
8	Lu00000865	To monitor flow rate of 8# heat exchange system	26/10/2020	25/10/2025
9	Lu00000866	To monitor flow rate of 9# heat exchange system	26/10/2020	25/10/2025
10	Lu00000867	To monitor flow rate of 10# heat exchange system	27/10/2020	26/10/2025
11	Lu00000868	To monitor flow rate of 11# heat exchange system	27/10/2020	26/10/2025

There were no missing data or damaged data during the 1st monitoring period. The average volume flow rate of the 11 heat exchange system of the 2020-2021 heating season (843.13 m³/h)¹¹ were cross checked by the rated flow of the circulating pumps, which are 1,750 m³/h (250 m³/h*7) for 1#TS4G heat substation, 2,340 m³/h (260 m³/h*9) of 2# TS4G heat substation, 2,700 m³/h (300 m³/h*9) for 3#TSZR heat substation, 1,600

¹¹ The average volume flow rate of the 11 heat exchange system of the 2020-2021 heating season can be calculated as (840.71 m³/h +842.01 m³/h +844.33 m³/h +845.35 m³/h +844.74 m³/h +843.92 m³/h +845.12 m³/h +842.04 m³/h +842.49 m³/h +838.70 m³/h +845.05 m³/h)/11=843.13 m³/h.

	m ³ /h (200 m ³ /h*8) for 4#TSTS heat substation, 2,000 m ³ /h (250 m ³ /h*8) for 5# TSTS heat substation and 2,450 m ³ /h (350 m ³ /h*7) for 6# TSWD heat substation (refer to Table 3 of the registered PDD for more details). The average volume flow rate of the 11 heat exchange system of the 2020-2021 heating season were lower than the least rated flow of the circulating pumps (1,600 m ³ /h). As per feedback from the space heating experts at the project site, average volume flow rate of the 11 heat exchange system of the Taishan geothermal heating system is about 845 m ³ /h.
Purpose of data	To calculate baseline emissions
Additional comment	The heat exchanger should handle the heat supplied by geothermal well only and not by any other source.

Data / Parameter	T_j							
Unit	Hours							
Description	Hours per hear heat utilization in well j .							
Source of data	Operation record of the geothermal based space heating system.							
Value(s) of monitored parameter	Sub-areas	Heat Substations	Geothermal Wells	Nov -20	Dec -20	Jan -21	Feb -21	Mar -21
	No.4 Village Group	1# TS4G	1# Production and Re-injection Well	720	744	744	672	744
			2# Production and Re-injection Well	720	744	744	672	744
		2# TS4G	3# Production and Re-injection Well	720	744	744	672	744
			4# Production and Re-injection Well	720	744	744	672	744
	Zhengrong fu	3# TSZR	5# Production and Re-	720	744	744	672	744

			injection Well					
			6# Production and Re-injection Well	720	744	744	672	744
	Taishan Villa	4# TSTS	7# Production and Re-injection Well	540	550	560	545	460 ₁₂
		5# TSTS	8# Production and Re-injection Well	720	744	744	672	744
			9# Production and Re-injection Well	720	744	744	672	744
	Wangdong Community	6# TSWD	10# Production and Re-injection Well	720	744	744	672	744
			11# Production and Re-injection Well	720	744	744	672	744
Measurement methods and procedures	The actual number of heating hours are sourced from operation record of the geothermal based space heating system. Monthly operation time of the 11 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.							
Monitoring frequency	Monthly							

¹² 4# TSTS heat substation mainly supplies heat to commercial buildings of Taishan Villa. It does not require 24-hour of continuous heating supply. Refer to Table 4 Main Parameters of the 6 Heat Substations of the registered PDD for more details.

QA/QC procedures	The winter heating season is usually fixed by local regulations. As per <i>Research on Heating in Winter of Taishan Village</i> published by Xinzheng Housing and Urban-Rural Development Bureau, winter heating season of Taishan Village is usually from November 1 to March 31 of the next year (last day excluded, 150 days). The actual 2020-2021 heating season of Taishan Village is from 01/11/2020 to 31/03/2021 (first and last days included, totally 151 days). For residential buildings, 24-hour continuous heating supply are needed, and for commercial buildings, 24-hour continuous heating supply is not required (usually 15-20 hour a day).
Purpose of data	To calculate baseline emissions
Additional comment	The heat exchanger should handle the heat supplied by geothermal well only and not by any other source.

Data / Parameter	HI_m
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 the standards institute of China (<i>CJJ 34-2010 Design Code for City Heating Network</i> published by Ministry of Housing and Urban-Rural Development of the People's Republic of China).
Value(s) of monitored parameter	45 W/m ² for residential buildings and 55 W/m ² for commercial buildings.
Measurement methods and procedures	-
Monitoring frequency	-
QA/QC procedures	As per feedback from the space heating experts at the project site, heating index of the Taishan geothermal heating system is 45 W/m ² for residential buildings and 55 W/m ² for commercial buildings, which are comply with requirement of <i>CJJ 34-2010 Design Code for City Heating Network</i> published by Ministry of Housing and Urban-Rural Development of the People's Republic of China.
Purpose of data	To calculate baseline emissions
Additional comment	N/A

Data / Parameter	$EC_{PJ,j,y}$ (EC_y)
Unit	MWh

Description	Electricity consumption for the year y in operating the geothermal heating system.																	
Source of data	Record of the Electricity Meters																	
Value(s) of monitored parameter	<table><tr><td>2020/11/01-2020/11/30</td><td>2,566.02</td></tr><tr><td>2020/12/01-2020/12/31</td><td>2,573.25</td></tr><tr><td>2021/01/01-2021/01/31</td><td>2,570.36</td></tr><tr><td>2021/02/01-2021/02/28</td><td>2,568.29</td></tr><tr><td>2021/03/01-2021/03/31</td><td>2,556.35</td></tr><tr><td>2020/11/01-2020/12/31</td><td>5,139.27</td></tr><tr><td>2021/01/01-2021/03/31</td><td>7,695.01</td></tr><tr><td>2020/11/01-2021/03/31</td><td>12,834.27</td></tr></table>		2020/11/01-2020/11/30	2,566.02	2020/12/01-2020/12/31	2,573.25	2021/01/01-2021/01/31	2,570.36	2021/02/01-2021/02/28	2,568.29	2021/03/01-2021/03/31	2,556.35	2020/11/01-2020/12/31	5,139.27	2021/01/01-2021/03/31	7,695.01	2020/11/01-2021/03/31	12,834.27
2020/11/01-2020/11/30	2,566.02																	
2020/12/01-2020/12/31	2,573.25																	
2021/01/01-2021/01/31	2,570.36																	
2021/02/01-2021/02/28	2,568.29																	
2021/03/01-2021/03/31	2,556.35																	
2020/11/01-2020/12/31	5,139.27																	
2021/01/01-2021/03/31	7,695.01																	
2020/11/01-2021/03/31	12,834.27																	
Measurement methods and procedures	Electricity consumptions of the geothermal heating system are monitored by the electricity meters installed at each heat substation. Totally 6 electricity meters are needed. Refer to Figure 3 of the MR for more details on installation and configuration of the electricity meters. Serial No. of the electricity meters are 111520042063, 111520042064, 111520042065, 111520042066, 111520042067 and 111520042068 separately. Before test run of the whole geothermal space heating system, base number of all the 6 electricity meters were recorded by the GS monitoring team under the supervision of the representative of each sub-area¹³. At the end of each heating month, the GS monitoring team recorded readings of the 6 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.																	

¹³ There are No.4 Village Group, Zhengrongfu, Taishan Villa and Wangdong Community 4 sub-areas.

	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.																																			
Monitoring frequency	Measured hourly/Recorded monthly																																			
QA/QC procedures	The accuracy of the electricity meters is 0.5S. The electricity meters are calibrated based on <i>JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy</i>. All the 6 electricity meters were calibrated during test run period (24/10/2020-31/10/2020) of the geothermal heating system. Calibration of the 6 electricity meters is shown as the following table. If the electricity meters can be used normally, recalibration is not required. The validity is 5 years. All the 6 electricity meters should be recalibrated in the end of October 2025. <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>111520042063</td><td>1# TS4G heat substation</td><td>24/10/2020</td><td>23/10/2025</td></tr><tr><td>2</td><td>111520042064</td><td>2# TS4G heat substation</td><td>24/10/2020</td><td>23/10/2025</td></tr><tr><td>3</td><td>111520042065</td><td>3# TSZR heat substation</td><td>24/10/2020</td><td>23/10/2025</td></tr><tr><td>4</td><td>111520042066</td><td>4# TSTS heat substation</td><td>25/10/2020</td><td>24/10/2025</td></tr><tr><td>5</td><td>111520042067</td><td>5# TSTS heat substation</td><td>25/10/2020</td><td>24/10/2025</td></tr><tr><td>6</td><td>111520042068</td><td>6# TSWD heat substation</td><td>25/10/2020</td><td>24/10/2025</td></tr></table>	NO.	Serial No.	Location	Calibration Date	Term of Validity	1	111520042063	1# TS4G heat substation	24/10/2020	23/10/2025	2	111520042064	2# TS4G heat substation	24/10/2020	23/10/2025	3	111520042065	3# TSZR heat substation	24/10/2020	23/10/2025	4	111520042066	4# TSTS heat substation	25/10/2020	24/10/2025	5	111520042067	5# TSTS heat substation	25/10/2020	24/10/2025	6	111520042068	6# TSWD heat substation	25/10/2020	24/10/2025
NO.	Serial No.	Location	Calibration Date	Term of Validity																																
1	111520042063	1# TS4G heat substation	24/10/2020	23/10/2025																																
2	111520042064	2# TS4G heat substation	24/10/2020	23/10/2025																																
3	111520042065	3# TSZR heat substation	24/10/2020	23/10/2025																																
4	111520042066	4# TSTS heat substation	25/10/2020	24/10/2025																																
5	111520042067	5# TSTS heat substation	25/10/2020	24/10/2025																																
6	111520042068	6# TSWD heat substation	25/10/2020	24/10/2025																																

	There were no missing data or damaged data during the 1 st 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. The electricity consumption data of the 2020-2021 heating season used in the MR were consist with the electricity bills and payment receipts of each sub-area excluding the electricity used during the test run period.
Purpose of data	To calculate project emissions
Additional comment	N/A

Data / Parameter	$EF_{EL,j,y}$ ($EF_{grid,CM,y}$)
Unit	tCO ₂ /MWh
Description	Combined margin emission factor for the grid in year y .
Source of data	Taishan village 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 China¹⁴, which calculated $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ based on <i>Tool 07</i> (Version 07.0). As per formular 15 of the registered PDD, $EF_{grid,CM,y}$ 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 1st crediting period. It's the first 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 1st monitoring period.
Value(s) of monitored parameter	0.5721 (0.8587 tCO ₂ /MWh*0.5+0.2854 tCO ₂ /MWh*0.5)
Measurement methods and procedures	Taishan village 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.
Monitoring frequency	Once each monitoring period
QA/QC procedures	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

¹⁴ <http://www.mee.gov.cn/ywgz/ycqhbh/wsqtz/202012/W020201229610353340851.pdf>

Additional comment	N/A
Data / Parameter	$TDL_{j,y}$
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y .
Source of data	As per <i>Tool 05</i> (Version 03.0), 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.
Value(s) of monitored parameter	20%
Measurement methods and procedures	Scenario A: Electricity consumption from the grid is applied to the project. For project electricity consumption sources, a default value of 20% is used for $TDL_{j,y}$.
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	-
Purpose of data	To calculate project emissions
Additional comment	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 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.

SDG7 and SDG 13

Data / Parameter	A_m			
Unit	m^2			
Description	Net heating area for construction type m .			
Source of data	Heating supply contracts.			
Value(s) of monitored parameter	Sub-areas	Heat Substations	Residential	Commercial
	No.4 Village Group	1# TS4G	253,161.25	
		2# TS4G	504,683.47	
	Zhengrongfu	3# TSZR	720,179.48	
	Taishan Villa	4# TSTS	0	94,516.36
		5# TSTS	422,758.61	
	Wangdong Community	6# TSWD	541,200.34	
	Total		2,441,983.15	94,516.36
Measurement methods and procedures	Yearly measurement.			
Monitoring frequency	Yearly			
QA/QC procedures	The data was cross-checked with <i>Certificate of Enterprise Investment Project in Henan Province</i> issued by Xinzheng 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 heating season.			
Purpose of data	To calculate baseline emissions			

Additional comment	N/A
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SDG 8

Data / Parameter	<i>Number of males and females employed by the project</i>
Unit	Number
Description	Jobs created for both men and women.
Source of data	Record keeping book
Value(s) of monitored parameter	10 jobs created including 5 males and 5 females.
Measurement methods and procedures	Source of data was record keeping book and cross checked with the labor contracts.
Monitoring frequency	Once for each monitoring period.
QA/QC procedures	The results were also cross checked with training records of employees.
Purpose of data	To demonstrate contribution to SDG 8.
Additional comment	N/A

Data / Parameter	<i>Average monthly salary</i>
Unit	RMB/person
Description	This parameter states the payment conditions of the people employed within the project. Equal pay for work of equal value regardless of gender.
Source of data	Record keeping book
Value(s) of monitored parameter	3,500 RMB/person with equal salaries for men and women in the same post.
Measurement methods and procedures	The average monthly salary was determined by the record keeping book and cross checked by the salary slips.
Monitoring frequency	Once for each monitoring period.
QA/QC procedures	The results were also cross checked with labor contracts.
Purpose of data	To demonstrate contribution to SDG 8.
Additional comment	N/A

D.3. Comparison of monitored parameters with last monitoring period

Data/Parameter	Value obtained in this monitoring period	Value obtained last monitoring period
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	Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	
$\Delta t_{j,d,y}$ (°C)	No.4 Village Group	1# TS4G	1# Production and Re-injection Well	11.94	12.02	12.14	12.57	11.28	N/A
			2# Production and Re-injection Well	11.99	11.54	11.71	12.29	10.68	
		2# TS4G	3# Production and Re-injection Well	11.83	12.11	11.57	12.14	11.17	
			4# Production and Re-injection Well	11.99	12.53	12.29	12.06	11.47	
	Zhengrongfu	3# TSZR	5# Production and Re-injection Well	11.91	12.26	11.58	12.85	10.69	
			6# Production and Re-injection Well	11.88	12.03	12.06	11.91	11.11	
	Taishan Villa	4# TSTS	7# Production and Re-injection Well	11.89	11.23	11.98	12.30	10.78	
		5# TSTS	8# Production and Re-injection Well	11.89	11.52	11.70	12.18	11.03	
			9# Production and Re-injection Well	11.96	12.07	11.60	12.03	11.39	

Wangdong Community	6# TSWD	10# Production and Re-injection Well	11.95	12.12	11.76	12.64	10.87	
		11# Production and Re-injection Well	11.82	11.75	12.07	11.84	11.41	
FR _{j,d,y} (kg/h)	Sub-areas	Heat Substations	Geothermal Wells	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21
	No.4 Village Group	1# TS4G	1# Production and Re-injection Well	846,932.50	850,800.59	829,568.85	834,803.76	841,422.74
			2# Production and Re-injection Well	846,835.00	835,649.56	848,338.24	839,812.01	839,393.09
		2# TS4G	3# Production and Re-injection Well	843,493.67	847,671.25	843,406.28	846,509.43	840,545.49
			4# Production and Re-injection Well	845,052.51	848,500.60	839,502.96	845,046.11	848,669.85
	Zhengrongfu	3# TSZR	5# Production and Re-injection Well	845,954.82	851,087.64	846,295.17	835,238.06	845,146.75
			N/A					

			6# Produ ction and Re- injecti on Well	845, 281. 06	840, 943. 79	847, 592. 11	843, 925. 79	841, 832. 99	
	Taish an Villa	4# TSTS	7# Produ ction and Re- injecti on Well	843, 801. 13	834, 967. 41	855, 875. 36	854, 118. 22	836, 821. 99	
			5# TSTS	8# Produ ction and Re- injecti on Well	843, 502. 69	829, 845. 55	842, 751. 84	845, 831. 83	
		9# Produ ction and Re- injecti on Well		844, 429. 01	841, 169. 38	843, 514. 22	843, 223. 95	840, 090. 70	
		Wang dong Com munit y	6# TSWD	10# Produ ction and Re- injecti on Well	846, 716. 85	847, 991. 40	839, 352. 34	826, 274. 58	
	11# Produ ction and Re- injecti on Well			849, 909. 10	846, 540. 10	830, 609. 52	847, 781. 36	850, 420. 90	

T_j (h)	Sub- areas	Heat Substati ons	Geother mal Wells	No v- 20	De c- 20	Ja n- 21	Fe b- 21	Ma r- 21	N/A
	No.4 Village Group	1# TS4G	1# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4	

		2# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
	2# TS4G	3# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
		4# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
Zhengro ngfu	3# TSZR	5# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
		6# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
Taishan Villa	4# TSTS	7# Productio n and Re- injection Well	540	55 0	56 0	54 5	46 0
	5# TSTS	8# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
		9# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
Wangdo ng Commun ity	6# TSWD	10# Productio n and Re- injection Well	720	74 4	74 4	67 2	74 4
		11# Productio n and Re-	720	74 4	74 4	67 2	74 4

			injection Well						
HI_m	45 W/m ² for residential buildings and 55 W/m ² for commercial buildings.							N/A	
A_m (m ²)	Sub-areas	Heat Substations	Residential	Commercial					N/A
	No.4 Village Group	1# TS4G	253,161.25						
		2# TS4G	504,683.47						
	Zhengrongfu	3# TSZR	720,179.48						
	Taishan Villa	4# TSTS	0	94,516.36					
		5# TSTS	422,758.61						
	Wangdong Community	6# TSWD	541,200.34						
	Total		2,441,983.15	94,516.36					
$EC_{PJ,j,y}$ (EC_y)	12,834.27 MWh							N/A	
$EF_{EL,j,y}$ ($EF_{grid,CM,y}$)	0.5721 tCO ₂ /MWh							N/A	
$TDL_{j,y}$	20%							N/A	
Number of males and females employed by the project	10 jobs created including 5 males and 5 females.							N/A	
Average monthly salary	3,500 RMB/person							N/A	

D.4. Implementation of sampling plan

>>

Not applicable.

SECTION E. CALCULATION OF SDG IMPACTS

E.1. Calculation of baseline value or estimation of baseline situation of each SDG Impact

>>

SDG 7 Impact of baseline situation

Without the project activity, 0 m² of the building can access to geothermal energy based space heating system in winter season.

SDG 8 Impact of baseline situation

Without the project activity, SDG 8 baseline impact was 0 job created and 0 monthly earning got.

SDG 13 Impact of baseline situation

As per section B.6.1 of the PDD, baseline emissions in year y (BE_y) can be calculated as follows,

$$BE_y = \sum_i (HS_{i,y}^{BL}) \times EF_{CO_2,i} / \eta_{BL,i} \quad (1)$$

Where:

- BE_y = The baseline emissions from heat displaced by the project activity during the year y (t CO₂e/yr).
- $EF_{CO_2,i}$ = The CO₂ emission factor per unit of energy of the fuel of technology i that would have been used in the baseline heating technology in (t CO₂/TJ). Where several fuel types are used in the boiler, use the fuel type with the lowest CO₂ emission factor.
- $\eta_{BL,i}$ = The net thermal efficiency of the heating technology i using fossil fuel that would have been used in the absence of the project activity.
- $HS_{i,y}^{BL}$ = 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).

Baseline scenario of the project is establishment of new isolated district heating networks using isolated coal-fired boilers in boiler houses. $EF_{CO_2,i}=87.3$ tCO₂/TJ (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 for coking coal) and $\eta_{BL,i}=85\%$.

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

$$HS^{BL}_{i,y} = w_i \times (HS_y - Loss^{PJ}_y + Loss^{BL}_y) \quad (2)$$

Where:

- $HS^{BL}_{i,y}$ = The net output of heat generated by the baseline heat supply system using the technology i measured at the end point of the heat facility, during the year y (TJ/yr).
- w_i = Assign weights for heat generated by technology i . As per section B.4 of this PDD, 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 Taishan village* published by Xinzhen 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.

$$HS_y = \min\{H_{CAP}, HS_{y,estimated}\} \quad (3)$$

$HS_{y,estimated}$ 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.

$$HS_{y,estimated} = \sum_j (Q_{j,d,y} \times T_j \times CF) \quad (4)$$

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 (5).
- T_j = Number of hours per year heat utilization at well j .
- CF = Conversion factor from GWh to TJ (3.6).

$$Q_{j,d,y} = \frac{FR_{j,d,y} \times \Delta t_{j,d,y} \times 4.18}{3.6} \times 10^{-9} \quad (5)$$

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.

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

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). 45 W/m ² for residential buildings and 55 W/m ² for commercial buildings.
T_j	=	Number of hours per year heat utilization at well j.
CF	=	Conversion factor from GWh to TJ (3.6).
$Loss^{PJ}_y$	=	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 0TJ.

Based on the results of monitored parameters (refer to section D.2 of the MR for more details), heat supplied by the geothermal based heating system (each heat exchangers) is summarized as Table 5 and Table 6.

Table 5 Net quantity of heat supplied by the geothermal heat resource(s)

Sub-areas	Heat Substations	Geothermal Wells	A_m (m ²)		November 2020		December 2020		January 2021		February 2021		March 2021	
			Residential	Commercial	$Loss_y^{PJ}$ (TJ)	H_{CAP} (TJ)	$Loss_y^{PJ}$ (TJ)	H_{CAP} (TJ)	$Loss_y^{PJ}$ (TJ)	H_{CAP} (TJ)	$Loss_y^{PJ}$ (TJ)	H_{CAP} (TJ)	$Loss_y^{PJ}$ (TJ)	H_{CAP} (TJ)
No.4 Village Group	1# TS4G	1# Production and Re-injection Well	253,161.25		2.95	32.48	3.05	33.56	3.05	33.56	2.76	30.32	3.05	33.56
		2# Production and Re-injection Well												
	2# TS4G	3# Production and Re-injection Well	504,683.47		5.89	64.75	6.08	66.91	6.08	66.91	5.49	60.44	6.08	66.91
		4# Production and Re-injection Well												
Zhengrongfu	3# TSZR	5# Production	720,179.48		8.40	92.40	8.68	95.48	8.68	95.48	7.84	86.24	8.68	95.48

		tion and Re- injectio n Well												
		6# Produc tion and Re- injectio n Well												
Taisha n Villa	4# TSTS	7# Produc tion and Re- injectio n Well	0.00	94,516 .36	0.83	9.10	0.84	9.26	0.86	9.43	0.83	9.18	0.70	7.75
	5# TSTS	8# Produc tion and Re- injectio n Well	422,758 .61		4.93	54.2 4	5.10	56.0 5	5.10	56.0 5	4.60	50.6 3	5.10	56.0 5
		9# Produc tion and Re- injectio n Well												
Wangd ong	6# TSWD	10# Produc	541,200 .34		6.31	69.4 4	6.52	71.7 5	6.52	71.7 5	5.89	64.8 1	6.52	71.7 5

Comm unity		tion and Re- injectio n Well												
		11# Produc tion and Re- injectio n Well												
Total			2,441, 983.15	94,51 6.36	29.31	322. 41	30.27	333. 02	30.29	333. 19	27.42	301. 61	30.14	331. 51

Table 6 Estimated quantity of heat supplied by the geothermal heat resource(s)

November 2020							
Sub-areas	Heat Substations	Geothermal Wells	$FR_{j,d,y}$ (kg/hr)	$\Delta t_{j,d,y}$ (°C)	$Q_{j,d,y}$ (GW)	T_j (h)	$HS_{y,estimated}$ (TJ)
No.4 Village Group	1# TS4G	1# Production and Re-injection Well	846,932.50	11.94	0.01174	720	30.43
		2# Production and Re-injection Well	846,835.00	11.99	0.01179	720	30.55
	2# TS4G	3# Production and Re-injection Well	843,493.67	11.83	0.01159	720	30.03
		4# Production and Re-injection Well	845,052.51	11.99	0.01177	720	30.50
Zhengrongfu	3# TSZR	5# Production and Re-injection Well	845,954.82	11.91	0.01170	720	30.32
		6# Production and Re-injection Well	845,281.06	11.88	0.01166	720	30.22

Taishan Villa	4# TSTS	7# Production and Re-injection Well	843,801.13	11.89	0.01165	540	22.65
	5# TSTS	8# Production and Re-injection Well	843,502.69	11.89	0.01165	720	30.19
		9# Production and Re-injection Well	844,429.01	11.96	0.01173	720	30.41
Wangdong Community	6# TSWD	10# Production and Re-injection Well	846,716.85	11.95	0.01174	720	30.44
		11# Production and Re-injection Well	849,909.10	11.82	0.01166	720	30.24
Total							325.97
December 2020							
Sub-areas	Heat Substations	Geothermal Wells	$FR_{j,d,y}$ (kg/hr)	$\Delta t_{j,d,y}$ (°C)	$Q_{j,d,y}$ (GW)	T_j (h)	$HS_{y,estimated}$ (TJ)
No.4 Village Group	1# TS4G	1# Production and Re-injection Well	850,800.59	12.02	0.01187	744	31.80
		2# Production and Re-injection Well	835,649.56	11.54	0.01120	744	30.00
	2# TS4G	3# Production and Re-injection Well	847,671.25	12.11	0.01192	744	31.94
		4# Production and Re-injection Well	848,500.60	12.53	0.01234	744	33.06
Zhengrongfu	3# TSZR	5# Production and Re-injection Well	851,087.64	12.26	0.01211	744	32.44
		6# Production and Re-injection Well	840,943.79	12.03	0.01175	744	31.46
Taishan Villa	4# TSTS	7# Production and Re-injection Well	834,967.41	11.23	0.01089	550	21.56
	5# TSTS	8# Production and Re-injection Well	829,845.55	11.52	0.01110	744	29.74
		9# Production and Re-injection Well	841,169.38	12.07	0.01178	744	31.56

Wangdong Community	6# TSWD	10# Production and Re-injection Well	847,991.40	12.12	0.01193	744	31.95
		11# Production and Re-injection Well	846,540.10	11.75	0.01154	744	30.92
Total							336.44
January 2021							
Sub-areas	Heat Substations	Geothermal Wells	$FR_{j,d,y}$ (kg/hr)	$\Delta t_{j,d,y}$ (°C)	$Q_{j,d,y}$ (GW)	T_j (h)	$HS_{y,estimated}$ (TJ)
No.4 Village Group	1# TS4G	1# Production and Re-injection Well	829,568.85	12.14	0.01169	744	31.32
		2# Production and Re-injection Well	848,338.24	11.71	0.01154	744	30.90
	2# TS4G	3# Production and Re-injection Well	843,406.28	11.57	0.01133	744	30.35
		4# Production and Re-injection Well	839,502.96	12.29	0.01198	744	32.09
Zhengrongfu	3# TSZR	5# Production and Re-injection Well	846,295.17	11.58	0.01138	744	30.47
		6# Production and Re-injection Well	847,592.11	12.06	0.01187	744	31.79
Taishan Villa	4# TSTS	7# Production and Re-injection Well	855,875.36	11.98	0.01191	560	24.01
	5# TSTS	8# Production and Re-injection Well	842,751.84	11.70	0.01145	744	30.67
		9# Production and Re-injection Well	843,514.22	11.60	0.01136	744	30.42
Wangdong Community	6# TSWD	10# Production and Re-injection Well	839,352.34	11.76	0.01146	744	30.69
		11# Production and Re-injection Well	830,609.52	12.07	0.01164	744	31.18

Total							333.89
February 2021							
Sub-areas	Heat Substations	Geothermal Wells	$FR_{j,d,y}$ (kg/hr)	$\Delta t_{j,d,y}$ (°C)	$Q_{j,d,y}$ (GW)	T_j (h)	$HS_{y,estimated}$ (TJ)
No.4 Village Group	1# TS4G	1# Production and Re-injection Well	834,803.76	12.57	0.01218	672	29.47
		2# Production and Re-injection Well	839,812.01	12.29	0.01198	672	28.99
	2# TS4G	3# Production and Re-injection Well	846,509.43	12.14	0.01194	672	28.88
		4# Production and Re-injection Well	845,046.11	12.06	0.01183	672	28.62
Zhengrongfu	3# TSZR	5# Production and Re-injection Well	835,238.06	12.85	0.01247	672	30.16
		6# Production and Re-injection Well	843,925.79	11.91	0.01167	672	28.24
Taishan Villa	4# TSTS	7# Production and Re-injection Well	854,118.22	12.30	0.01220	545	23.93
	5# TSTS	8# Production and Re-injection Well	845,831.83	12.18	0.01197	672	28.95
		9# Production and Re-injection Well	843,223.95	12.03	0.01178	672	28.49
Wangdong Community	6# TSWD	10# Production and Re-injection Well	826,274.58	12.64	0.01213	672	29.34
		11# Production and Re-injection Well	847,781.36	11.84	0.01166	672	28.20
Total							313.26
March 2021							

Sub-areas	Heat Substations	Geothermal Wells	$FR_{j,d,y}$ (kg/hr)	$\Delta t_{j,d,y}$ (°C)	$Q_{j,d,y}$ (GW)	T_j (h)	$HS_{y,estimated}$ (TJ)
No.4 Village Group	1# TS4G	1# Production and Re-injection Well	841,422.74	11.28	0.01102	744	29.52
		2# Production and Re-injection Well	839,393.09	10.68	0.01041	744	27.89
	2# TS4G	3# Production and Re-injection Well	840,545.49	11.17	0.01090	744	29.19
		4# Production and Re-injection Well	848,669.85	11.47	0.01130	744	30.26
Zhengrongfu	3# TSZR	5# Production and Re-injection Well	845,146.75	10.69	0.01049	744	28.09
		6# Production and Re-injection Well	841,832.99	11.11	0.01086	744	29.10
Taishan Villa	4# TSTS	7# Production and Re-injection Well	836,821.99	10.78	0.01047	460	17.35
	5# TSTS	8# Production and Re-injection Well	848,257.96	11.03	0.01086	744	29.09
		9# Production and Re-injection Well	840,090.70	11.39	0.01111	744	29.76
Wangdong Community	6# TSWD	10# Production and Re-injection Well	833,169.74	10.87	0.01052	744	28.17
		11# Production and Re-injection Well	850,420.90	11.41	0.01127	744	30.19
Total							308.60

Calculation results of baseline emissions in year y (BE_y) are summarized as Table 7.

Table 7 Calculation results of baseline emissions for SDG 13

Date	H_{CAP} (TJ)	$HS_{y,estimated}$ (TJ)	$HS_y(TJ)$	$Loss_{BL_y}$ (TJ)	$HS_{BL_{i,y}}$ (TJ)	$EF_{CO_2,i}$ (t CO ₂ /TJ)	$\eta_{BL,i}$	BE_y (tCO ₂ e/ yr)
	A	B	C	D	E	F	G	$H=E*F/G$
2020/11/01- 2020/11/30	322.41	325.97	322.41	0	293.10	87.3	85%	30,103
2020/12/01- 2020/12/31	333.02	336.44	333.02	0	302.75			31,094
2021/01/01- 2021/01/31	333.19	333.89	333.19	0	302.90			31,110
2021/02/01- 2021/02/28	301.61	313.26	301.61	0	274.19			28,161
2021/03/01- 2021/03/31	331.51	308.60	308.60	0	278.46			28,600
2020/11/01- 2020/12/31	655.43	662.41	655.43	0	595.85			61,197
2021/01/01- 2021/03/31	966.31	955.75	943.40	0	855.55			87,870
2020/11/01- 2021/03/31	1,621.74	1,618.16	1,598.84	0	1,451.40			149,067

SDG 13 baseline impact (baseline emissions) was 61,197 tCO₂e from 01/11/2020 to 31/12/2020, and 87,870 tCO₂e from 01/01/2021 to 31/03/2021. Total SDG 13 baseline impact (baseline emissions) of the 1st monitoring period (01/11/2020-31/03/2021) was 149,067 tCO₂e.

E.2. Calculation of project value or estimation of project situation of each SDG Impact

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SDG 7 Impact of project situation

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

Sub-areas	Heat Substations	A_m (m ²)	
		Residential	Commercial
No.4 Village Group	1# TS4G	253,161.25	
	2# TS4G	504,683.47	
Zhengrongfu	3# TSZR	720,179.48	
Taishan Villa	4# TSTS	0	94,516.36
	5# TSTS	422,758.61	
Wangdong Community	6# TSWD	541,200.34	
Total		2,441,983.15	94,516.36

From 01/11/2020 to 31/12/2020, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in winter season.

From 01/01/2021 to 31/03/2021, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in winter season.

For the 1st monitoring period from 01/11/2020 to 31/03/2021, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in winter season.

SDG 8 Impact of project situation

From 01/11/2020 to 31/12/2020, 10 jobs for local people were created (including 5 females and 5 males), the average monthly earnings of employees were 3,500 RMB/person. Equal salaries were paid for men and women in the same position.

From 01/01/2021 to 31/03/2021, 10 jobs for local people were created (including 5 females and 5 males), the average monthly earnings of employees were 3,500 RMB/person. Equal salaries were paid for men and women in the same position.

For the 1st monitoring period from 01/11/2020 to 31/03/2021, 10 jobs for local people were created (including 5 females and 5 males), the average monthly earnings of employees were 3,500 RMB/person. Equal salaries were paid for men and women in the same position.

SDG 13 Impact of project situation

As per section B.6.1 of the PDD, project emissions can be calculated as follows,

$$PE_y = PE_{FE,y} + PE_{EC,y} + PE_{FF,y} \quad (9)$$

Where:

PE_y	=	Project emissions during the year y (t CO ₂ e/yr).
$PE_{FE,y}$	=	Fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from geothermal resources (t CO ₂ e/yr).
$PE_{EC,y}$	=	Project emissions from additional electricity consumption as a result of the project activity (t CO ₂ e/yr).
$PE_{FF,y}$	=	Project emissions from fossil fuel consumed as a direct result of the operations of the project activity (t CO ₂ e/yr).

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 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 system is considered negligible. Therefore, $PE_{FE,y} = 0$ tCO₂.

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

Project emissions from electricity consumption (PE_{EC}) used to pump geothermal water and operate the geothermal facility were calculated using *Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation* (Version 03.0).

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (10)$$

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

$$TDL_{j,y} = \frac{(t \text{ CO}_2/\text{MWh})}{\text{Average technical transmission and distribution losses for providing electricity to source } j \text{ in year } y.}$$

Calculation results of project emissions during the year y (PE_y) are summarized as Table 8.

Table 8 Calculation results of project emissions for SDG 13

Date	$EC_{PJ,j,y}$ (kWh)	$EC_{PJ,j,y}$ (MWh)	$EF_{EL,j,y}$ (tCO ₂ /MWh)	(1+TD) $L_{j,y}$	$PE_{EC,y}$ (tCO ₂ e/yr)
2020/11/01-2020/11/30	2,566,020.60	2,566.02	0.5721	1.2	1,761
2020/12/01-2020/12/31	2,573,245.05	2,573.25	0.5721	1.2	1,766
2021/01/01-2021/01/31	2,570,361.09	2,570.36	0.5721	1.2	1,764
2021/02/01-2021/02/28	2,568,294.97	2,568.29	0.5721	1.2	1,763
2021/03/01-2021/03/31	2,556,349.88	2,556.35	0.5721	1.2	1,755
2020/11/01-2020/12/31	5,139,265.65	5,139.27	0.5721	1.2	3,528
2021/01/01-2021/03/31	7,695,005.94	7,695.01	0.5721	1.2	5,283
2020/11/01-2020/12/31	12,834,271.59	12,834.27	0.5721	1.2	8,811

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

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, SDG 13 project impact (project emissions) was 3,528 tCO₂e from 01/11/2020 to 31/12/2020, and 5,283 tCO₂e from 01/01/2021 to 31/03/2021. Total SDG 13 project impact (project emissions) of the 1st monitoring period (01/11/2020-31/03/2021) was 8,811 tCO₂e.

E.3. Calculation of leakage

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As per section B.6.1 of the PDD, no leakage emissions have been identified for the project activity. Therefore, for SDG 13, $LE_y=0$ tCO₂.

E.4. Calculation of net benefits or direct calculation for each SDG Impact

SDG	SDG Impact	Baseline estimate	Project estimate	Net benefit
1 3	Emission reductions	2020/11/01-2020/12/31 61,197 tCO ₂ e	2020/11/01-2020/12/31 3,528 tCO ₂ e	2020/11/01-2020/12/31 57,669 tCO ₂ e
		01/01/2021-31/03/2021 87,870 tCO ₂ e	01/01/2021-31/03/2021 5,283 tCO ₂ e	01/01/2021-31/03/2021 82,587 tCO ₂ e
		01/11/2020-31/03/2021 149,067 tCO ₂ e	01/11/2020-31/03/2021 8,811 tCO ₂ e	01/11/2020-31/03/2021 140,256 tCO ₂ e
8	Number of males and females employed by the project	01/11/2020-31/12/2020, 0 10 jobs for local people were created (including 5 people were females and 5 males)	01/11/2020-31/12/2020, 0 10 jobs for local people were created (including 5 people were females and 5 males)	01/11/2020-31/12/2020, 0 10 jobs for local people were created (including 5 people were females and 5 males)
		01/01/2021-31/03/2021, 0 10 jobs for local people were created (including 5 people were females and 5 males)	01/01/2021-31/03/2021, 0 10 jobs for local people were created (including 5 people were females and 5 males)	01/01/2021-31/03/2021, 0 10 jobs for local people were created (including 5 people were females and 5 males)
		01/11/2020-31/03/2021, 0 10 jobs for local people were created (including 5 people were females and 5 males)	01/11/2020-31/03/2021, 0 10 jobs for local people were created (including 5 people were females and 5 males)	01/11/2020-31/03/2021, 0 10 jobs for local people were created (including 5 people were females and 5 males)
7	Average monthly salary	01/11/2020-31/12/2020, 0 3,500 RMB/person, and income.	01/11/2020-31/12/2020, 0 3,500 RMB/person, and equal salaries were paid for men and women in the same position.	01/11/2020-31/12/2020, 0 3,500 RMB/person, and equal salaries were paid for men and women in the same position.
		01/01/2021-31/03/2021, 0 3,500 RMB/person, and income.	01/01/2021-31/03/2021, 0 3,500 RMB/person, and equal salaries were paid for men and women in the same position.	01/01/2021-31/03/2021, 0 3,500 RMB/person, and equal salaries were paid for men and women in the same position.
		01/11/2020-31/03/2021, 0 3,500 RMB/person, and income.	01/11/2020-31/03/2021, 0 3,500 RMB/person, and equal salaries were paid for men and women in the same position.	01/11/2020-31/03/2021, 0 3,500 RMB/person, and equal salaries were paid for men and women in the same position.
7	A _m	01/11/2020-31/12/2020, 0 2,441,983.15 m ²	01/11/2020-31/12/2020, 0 2,441,983.15 m ²	01/11/2020-31/12/2020, 0 2,441,983.15 m ²

m² of the residential buildings and residential buildings and building can 94,516.36 m² of 94,516.36 m² of access to commercial buildings can commercial buildings can geothermal access to geothermal access to geothermal energy based energy based space heating energy based space heating space heating system in winter season system in winter season system in winter season

01/01/2021-

31/03/2021, 0 01/01/2021-31/03/2021, 01/01/2021-31/03/2021, m² of the 2,441,983.15 m² of 2,441,983.15 m² of building can residential buildings and residential buildings and access to 94,516.36 m² of 94,516.36 m² of geothermal commercial buildings can commercial buildings can energy based access to geothermal access to geothermal space heating energy based space heating energy based space heating system in system in winter season system in winter season winter season

01/11/2020-

31/03/2021, 0 01/11/2020-31/03/2021, 01/11/2020-31/03/2021, m² of the 2,441,983.15 m² of 2,441,983.15 m² of building can residential buildings and residential buildings and access to 94,516.36 m² of 94,516.36 m² of geothermal commercial buildings can commercial buildings can energy based access to geothermal access to geothermal space heating energy based space heating energy based space heating system in system in winter season system in winter season winter season

E.5. Comparison of actual SDG Impacts with estimates in approved PDD

SDG	Values estimated in ex ante calculation of approved PDD for this monitoring period	Actual values ¹⁵ achieved during this monitoring period
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¹⁵ Whenever emission reductions are capped, both the original and capped values used for calculations must be transparently reported. Use brackets to denote original values.

13	01/11/2020-31/12/2020, 58,555 tCO ₂ e ¹⁶	01/11/2020-31/12/2020, 57,669 tCO ₂ e
	01/01/2021-15/03/2021, 85,432 tCO ₂ e	01/01/2021-31/03/2021, 82,587 tCO ₂ e
	1 st monitoring period, 143,987 tCO ₂ e	1 st monitoring period, 140,256 tCO ₂ e
8	01/11/2020-31/12/2020, 10 jobs for local people created (including 5 females and 5 males). Average monthly salary 3,500 RMB/person, and equal salaries paid for men and women in the same position.	01/11/2020-31/12/2020, 10 jobs for local people created (including 5 females and 5 males). Average monthly salary 3,500 RMB/person, and equal salaries paid for men and women in the same position.
	01/01/2021-31/03/2021, 10 jobs for local people created (including 5 females and 5 males). Average monthly salary 3,500 RMB/person, and equal salaries paid for men and women in the same position.	01/01/2021-31/03/2021, 10 jobs for local people created (including 5 females and 5 males). Average monthly salary 3,500 RMB/person, and equal salaries paid for men and women in the same position.
	01/11/2020-31/03/2021, 10 jobs for local people created (including 5 females and 5 males). Average monthly salary 3,500 RMB/person, and equal salaries paid for men and women in the same position.	01/11/2020-31/03/2021, 10 jobs for local people created (including 5 females and 5 males). Average monthly salary 3,500 RMB/person, and equal salaries paid for men and women in the same position.

¹⁶ The estimated emission reductions in the PDD are 143,987 tCO₂e per year (150 days). There are 61 days from 01/11/2020 to 31/12/2020 (both the start date and end date are included). Thus, the estimated emission reductions can be calculated as $143,987/150 \times 61 = 58,555$ tCO₂e. The emission reductions from 01/01/2021 to 31/03/2021 can be calculated as $143,987 - 58,555 = 85,432$ tCO₂e.

01/11/2020-31/12/2020, 2,480,907 m² of residential buildings and 94,516 m² of commercial buildings can access to geothermal energy based space heating system in winter season.	01/11/2020-31/12/2020, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in 2020-2021 winter season.
7 01/01/2021-31/03/2021, 2,480,907 m² of residential buildings and 94,516 m² of commercial buildings can access to geothermal energy based space heating system in winter season.	01/01/2021-31/03/2021, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in 2020-2021 winter season.
01/11/2020-31/03/2021, 2,480,907 m² of residential buildings and 94,516 m² of commercial buildings can access to geothermal energy based space heating system in winter season.	01/11/2020-31/03/2021, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in 2020-2021 winter season.

E.5.1. Explanation of calculation of value estimated ex ante calculation of approved PDD for this monitoring period

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For SDG 7, as per section B.6.3 of the PDD, based on *Feasibility Study Report* of the project, the geothermal based space heating system can supply heat to 2,480.907 thousand m² of residential buildings and 94.516 thousand m² of commercial buildings. Actual heating areas of the 1st monitoring period were determined by the heating supply contracts. As per heating supply contracts signed by the project owner and the property management company of each community, 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in 2020-2021 winter season.

For SDG 8, as per section B.7.1 of the PDD, *Number of males and females employed by the project* and *average monthly salary* should be monitored. For ex ante calculation, it assumes that 10 jobs for local people will be created (including 5 females and 5 males), the average monthly earnings of employees are 3,500 RMB/person (equal salaries paid for men and women in the same position). According to the *Record Keeping Book, Labor*

contracts and *Payrolls*, during the 1st monitoring period (01/11/2020-31/03/2021), 10 jobs for local people were created (including 5 females and 5 males). The average monthly salary was 3,500 RMB/person (equal salaries paid for men and women in the same position).

Emission reductions of SDG 13 can be calculated based on *AM0072 Fossil Fuel Displacement by Geothermal Resources for Space Heating* (Version 03.0). The estimated outcomes for SDG 13 for the 1st monitoring period (01/11/2020-31/03/2021) is 143,987 tCO₂e. 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 140,256 tCO₂e, and the changes of the four parameters lead to the difference between the estimated value and actual value for emission reductions.

E.6. Remarks on increase in achieved SDG Impacts from estimated value in approved PDD

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The outcomes for SDG 7 Affordable and Clean Energy and SDG 13 Climate Action were lower than the estimated value in the PDD.

The estimated outcomes of SDG 7 are 2,480.907 thousand m² of residential buildings and 94.516 thousand m² of commercial buildings can access to geothermal energy based space heating system. And the actual outcome was 2,441,983.15 m² of residential buildings and 94,516.36 m² of commercial buildings can access to geothermal energy based space heating system in 2020-2021 winter season, which is about 98.49% of the estimated value. The difference mainly due to the actual heating areas supplied by the geothermal energy based space heating system, which is determined by the heating supply contract signed by the project owner and the property management company of each community.

The estimated value of the outcomes of SDG 13 for the 1st monitoring period is 143,987 tCO₂e, and the actual value is 140,256 tCO₂e, which is about 97.41% of the estimated value. 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 ($FR_{j,d,y}$) and hours per hear heat utilization in well j (T_j) were monitored by ultrasonic calorimeters installed at each monitoring points of the project. Electricity consumption for the year y in operating the geothermal heating system ($EC_{PJ,j,y}$ (EC_y)) were monitored by electricity meters. The changes of the four parameters lead to the difference between the estimated value and actual value for emission reductions. Changes of T_j is mainly related to the local heating duration and the continuous heating hours of different building types. The parameters of $\Delta t_{j,d,y}$ $FR_{j,d,y}$ $FR_{j,d,y}$ and $EC_{PJ,j,y}$ (EC_y) are mainly determined by the heating demand of

the end-users, which are affected by atmospheric environment temperature, running status of the geothermal heating system and other aspects.

Number of males and females employed by the project and average monthly salary were determined by the Record Keeping Book, Labor contracts and Salary slips, during the 1st monitoring period (01/11/2020-31/03/2021), 10 jobs for local people were created (including 5 females and 5 males). The average monthly salary was 3,500 RMB/person (equal salaries paid for men and women in the same position). Outcomes of SDG 8 are consistent with the estimated outcomes in the PDD.

SECTION F. SAFEGUARDS REPORTING

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As per section D.1 Safeguarding principles assessment and appendix 1 of the approved PDD, all the safeguarding principles are not relevant to the project and the safeguards reporting is not needed.

SECTION G. STAKEHOLDER INPUTS AND LEGAL DISPUTES

G.1. List all Inputs and Grievances which have been received via the Continuous Input and Grievance Mechanism together with their respective responses/mitigations.

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The inputs/grievances methods are Continuous Input / Grievance Expression Process Book and email access. In addition, people can give inputs/grievances through visiting Zhengzhou Onar Heating Co., Ltd.

Method	Include all details of Chosen Method (s) so that they may be understood and, where relevant, used by readers.
Continuous Input / Grievance Expression Process Book (mandatory)	A grievance book was put in Taishan village. All stakeholders are allowed to record their grievances or comments in the book. The project owner will assign specific person in each sub county to deal with related issues. When assessing the relevance and appropriateness of the stakeholders' comments, the project owner will apply a gender lens.
GS Contact (mandatory)	help@goldstandard.org
Other	Feedback can be made directly through visiting Zhengzhou Onar Heating Co., Ltd. (260m to the north at the intersection of Yanhuang Avenue and Daodong Road, Hezhuang Town, Xinzheng City, Henan Province, China) or through e-mail yliu_onar@163.com .

No inputs/grievances received during the 1st monitoring period through all the methods.

G.2. Report on any stakeholder mitigations that were agreed to be monitored.

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This is the first monitoring period due to which there is no input/grievance to follow up action.

G.3. Provide details of any legal contest that has arisen with the project during the monitoring period

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No legal contest or dispute has been arisen with the project during the 1st monitoring period.

Revision History

Version	Date	Remarks
1.1	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Section for POA monitoring Forward action request section Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on safeguard reporting Clarity on design changes Leakage section added for VER/CER projects Addition of Comparison of monitored parameters with last monitoring period Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.0	10 July 2017	Initial adoption