



HEQING SOLAR COOKER PROJECT II



Document Prepared by Clean Air Trade, Inc.

Contact Information

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project installed 49,000 solar cookers for the poor rural residents in northwestern China. The rated power of each solar cooker is 910 W and the total capacity of the project is 44.59 MW thermal. The project enabled the rural residents to efficiently substitute solar energy for the fossil fuel (coal) used in daily cooking and water boiling, avoiding CO₂ emission generated by fossil fuel consumption.

The preparation of project implementation started since July 2011 by placing order of cookers, arrangement for distribution of cookers, and training of the monitoring team members, etc. The distribution of the cooker started on 23 September 2011. The continued operation period for the project is 01/08/2018 – 21/09/2021 which is the current (9th) monitoring period. There were 8 monitoring periods prior to the current monitoring period. The total emission reductions achieved in this monitoring period is 498,454 tCO₂e.

1.2 Sectoral Scope and Project Type

Sectoral scope: 01 - Energy industries (renewable / non-renewable sources)

Project type: I - Renewable Energy Projects

The project is not a grouped project.

1.3 Project Proponent

Organization name	Clean Air Trade, Inc.
Contact person	Ju Ning
Title	Managing Director
Address	105 Maxess Road, Suite 124 Melville, NY 11747, USA
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1.4 Other Entities Involved in the Project

Organization name	Beijing Harmonious Energy Development Co Ltd
Role in the Project	Project implementation and operation

Contact person	Wei Jiang
Title	General Manager
Address	No. 616, Building 5, Yard 2, Boxing 9th Road, Beijing Economic and Technological Development Zone, Beijing, China
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1.5 Project Start Date

22-September-2011

1.6 Project Crediting Period

Crediting period start date: 22-Sep-2011

Crediting period end date: 21-Sep-2021

Total number of years: 10

1.7 Project Location

The Project is located in Gaotai County and Linze County of Zhangye in Gansu province of P.R. China. The approximate locations of the centers of the townships in which the project is located are:

Linze County

Township	Longitude(E) Degree	Latitude(N) Degree
Shahe	100° 9'20.91"E	39° 8'52.05"N
Xinhua	100° 1'22.76"E	39° 11'38.83"N
Banqiao	100° 17'5.00"E	39° 16'33.04"N
Pingchuan	100° 5'57.48"E	39° 20'10.51"N
Liaoquan	100° 3'50.44"E	39° 19'8.67"N
Yanuan	100° 14'12.34"E	39° 16'21.08"N
Nijiaying	100° 7'50.99"E	39° 1'49.03"N

Gaotai County

Township	Longitude(E) Degree	Latitude(N) Degree
Xiangdao	99° 49'50.50"E	39° 21'57.07"N
Heli	99° 51'0.41"E	39° 23'30.79"N
Nanhua	99° 48'2.86"E	39° 18'23.85"N
Xinba	99° 52'46.83"E	39° 14'37.51"N
Luotuo Cheng	99° 37'29.90"E	39° 21'9.83"N
Xuanhua	99° 42'14.01"E	39° 25'50.49"N

Heiquan	99°37'44.68"E	39°31'57.18"N
Luocheng	99°35'20.67"E	39°41'1.59"N

1.8 Title and Reference of Methodology

Small-scale CDM baseline methodology “AMS-I.C., Thermal energy production with or without electricity” (Version 18).

Standard: Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)

Guideline: Sampling and surveys for CDM project activities and programmes of activities, (Version 04.0)

VCS Standard (Version v4.2)

1.9 Participation under other GHG Programs

The project was registered under CDM and its CDM reference number was 5106. However, the project will not claim any CDM credit or any other form of GHG-related environmental credit for the GHG emission reductions claimed under VCS Program, i.e., the emission reductions generated from the project will not be double counted.

1.10 Other Forms of Credit

Although this project is located in a jurisdiction with an emission trading program (China ETS), according to Measures for the Administration of Carbon Emissions Trading issued by the Ministry of Ecology and Environment of China, which is the regulation governing China ETS, the GHG emissions reduced by this project are not included in the compliance scheme under China ETS and the project participants are not in the current compliance entity list under China ETS.

Therefore, the GHG emissions reduced by this project are not included in an emissions trading program or any other mechanism that includes GHG allowance trading and the GHG emission reductions by this project have not been used, nor will it be used, for compliance under such programs or mechanisms.

Moreover, the project has not sought or received, nor will it seek or receive, any form of GHG-related environmental credit other than VCS during this monitoring period.

1.11 Sustainable Development Contributions

The project provides the low-income rural households with affordable and reliable clean energy, reduces household air pollution, and saves money for the users by reducing their expenditure on coal.

Therefore, the project significantly contributes to the sustainable development of the host country in the areas of poverty relief, promoting clean energy, and improving the health and living conditions of low-income rural population. All these are in line with the national sustainable development priorities of the host country.

The supporting evidence for the SDG table (Table 1 on next page) are in Appendix 1 of this document.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
<i>Sequential row number</i>	<i>SDG Target number</i>	<i>Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator</i>	<i>Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)</i>	<i>Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the project SDG contributions reporting period.</i>	<i>Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.</i>
1)	1.2	Number of households with increased income, and the increased amount of income.	Implemented activities to increase	For the rural households using inefficient cookstoves, because cooking is a necessity of life, purchasing coal for cooking is also a necessity of life. In other words, for these households, the expenditure on coal can't be avoided. Using solar cooker reduces such unavoidable expenditure, and consequently these household will have extra money to spend on other things, which is equivalent to income increase. This project enables the reduction of coal expenditure for the 49000 rural households involved in the project. Therefore, this project enables these 49000 households to have increased income. No further changes in the number of households with increased income in this monitoring period. The increased amount of income in this monitoring period is CNY 319.0 million (CNY 6,510 per household).	The usage of solar cooker reduced the expenditure on purchasing coal, which is equivalent to the increase of income for the 49000 rural households involved in the project. The increased amount of income over project lifetime is CNY 942.1 million (CNY 19,227 per household).

2)	3.9	Number of households and number of years exposed to household air pollution (HAP) caused by burning coal using inefficient cookstoves	Implemented activities to decrease	The project reduced HAP for 49,000 low-income rural households. No further changes in the number of households exposed to HAP in this monitoring period. The 49000 households' exposure to HAP has been reduced by 3.14 years (01/08/2018 – 21/09/2021) in this monitoring period, which consequently reduced their likelihood of illness and death from HAP.	According to World Health Organization (WHO), each year close to 4 million people die prematurely from illness attributable to household air pollution (HAP) from inefficient cooking practices. HAP causes noncommunicable diseases including stroke, ischaemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer. Close to half of deaths due to pneumonia among children under 5 years of age are caused by particulate matter (soot) inhaled from HAP. The project reduced HAP for 49,000 low-income rural households for 10 years, which consequently reduced their likelihood of illness and death from HAP.
3)	7.1	Number of households that get access to affordable and reliable clean energy	Implemented activities to increase	No further changes this monitoring period	The project enabled 49,000 low-income rural households to get access to affordable and reliable clean energy.
4)	10.1	Number of households with increased income, and the increased amount of income.	Implemented activities to increase	The usage of solar cooker reduced the expenditure on purchasing coal, which is equivalent to the increase of income for the 49000 rural households involved in the project No further changes in the number of households with increased income in this monitoring period. The increased amount of income in this monitoring period is CNY 319.0 million (CNY 6,510 per household).	The usage of solar cooker reduced the expenditure on purchasing coal, which is equivalent to the increase of income for the 49000 rural households involved in the project. The increased amount of income over project lifetime is CNY 942.1 million (CNY 19,227 per household). The project is in Gansu province where the average income is in the bottom 1.8% of the entire host country. Therefore, it is reasonable to conclude that the income of the households involved in the project are in the bottom 40% of the host country.
5)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By installing solar cookers to 49000 rural households, the project has prevented the release of 498,454 tonnes of CO ₂ into the atmosphere during this monitoring period.	By installing solar cookers to the rural households, the project prevented the release of 1,472,102 tonnes of CO ₂ into the atmosphere over project lifetime.

2 SAFEGUARDS

2.1 No Net Harm

The project simply involves providing solar cooker to low-income rural residents. There are no potential negative environmental and socio-economic impacts. Therefore, it is not applicable to plan steps to mitigate them.

2.2 Local Stakeholder Consultation

The local stakeholder consultation was conducted during project registration stage in places where the project was planned to carry out. The surveys were done by randomly visiting the villagers as well as assembling the villagers and interviewing them. 100 survey forms were distributed and collected. All people surveyed supported the project. The details of this stakeholder consultation can be found in registered project documents.

The process of engaging local stakeholders continued throughout this monitoring period and the communication channels between the local stakeholder and the project team have been wide-open. The local stakeholders were encouraged to give the project team their comments or suggestions on the project. No major comments were received during this monitoring period and all the minor things have been taken care of by the project team.

2.3 AFOLU-Specific Safeguards

This project is not an AFOLU project. Therefore, this section is not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project was under normal operation during this monitoring period (01/08/2018 – 21/09/2021). The total emission reductions achieved in this monitoring period is 498,454 tCO₂e. There is no event or situations that occurred during this monitoring period, which may impact the applicability of the methodology.

3.2 Deviations

2.1.1 Methodology Deviations

None

2.1.2 Project Description Deviations

None.

3.3 Grouped Projects

This project is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	1.R
Data unit	W/m ²
Description	Standard solar irradiance rate used to calculate rated power of solar cooker
Source of data	National Standard of the People's Republic of China, GB No.: NY/T219-2003
Value applied	700
Justification of choice of data or description of measurement methods and procedures applied	According to National Standard of P.R. China (GB), GB No.: NY/T219-2003, for calculating the rated power of solar cookers, 700 W/m ² should be used for as the standard value of solar irradiance rate.
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	2. η
Data unit	N/A
Description	Solar cooker's thermal efficiency
Source of data	National Standard of P.R. China (GB), GB No.: NY/T219-2003
Value applied	65%
Justification of choice of data or description of measurement methods and procedures applied	This is the requirement of National Standard of P.R. China (GB), GB No.: NY/T219-2003. It is required in the technical specification that the solar cookers to be manufactured for this project have an efficiency of at least 65%.
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	3. $\eta_{BL,thermal}$
Data unit	N/A
Description	Thermal efficiency for the traditional coal furnace
Source of data	The highest value of measured data.
Value applied	14.6%
Justification of choice of data or description of measurement methods and procedures applied	According to paragraph 26 of methodology AMS-I.C. (version 18), for household cooking stoves, the efficiency of the baseline units can be determined by the highest measured operational efficiency over the full range of operating conditions of a representative sample of units with similar specifications. As a prestigious academic institution in Zhangye area, Hexi University measured the efficiency of cooking stove in rural Zhangye. The thermal efficiencies of 100 representative cooking stoves at rural households of Zhangye area, where the project is located, were measured, and the measurement meets the requirements of Chinese National Standard “Test method for household coal and stoves” (GB 6412-2009). The measurement results are: the highest efficiency is 14.6%, the lowest efficiency is 9.8%, and the average is 12.6%. With the above measurement data, according to paragraph 22 of methodology AMS-I.C. (version 18), 14.6% was chosen as the baseline thermal efficiency for the coal stoves.
Purpose of Data	Calculation of baseline emissions
Comments	

4.2 Data and Parameters Monitored

Data / Parameter	1. n
Data unit	Not applicable
Description	Number of solar cookers in operation in the proposed project
Source of data	Sales contract and invoice of the solar cookers and monitoring records of monitoring team

Description of measurement methods and procedures to be applied	Simple random sampling method was used to measure this parameter. To determining the total number of solar cookers operating with a 90/10 confidence/precision level, 79 samples are sufficient according to statistical principles. Therefore, a set of 79 samples (sample set A) were randomly selected from the entire population, and these samples were inspected.
Frequency of monitoring/recording	At least once a year
Value monitored	The following shows the number of cookers in operation out of the 79 samples: <u>For Sub-period 1 (01/08/2018 - 31/07/2019)</u> Number of cookers in operation: 79 Number of operational cookers based on sampling result: $49,000 \times (79/79) = 49,000$ <u>For Sub-period 2 (01/08/2019 - 31/07/2020)</u> Number of cookers in operation: 78 Number of operational cookers based on sampling result: $49,000 \times (78/79) = 48,380$ <u>For Sub-period 3 (01/08/2020 - 31/07/2021)</u> Total number of cookers in operation: 78 Number of operational cookers based on sampling result: $49,000 \times (78/79) = 48,380$ <u>For Sub-period 4 (01/08/2021 - 21/09/2021)</u> Total number of cookers in operation: 77 Number of operational cookers based on sampling result: $49,000 \times (77/79) = 47,759$
Monitoring equipment	Monitoring equipment is not necessary, and thus not used.
QA/QC procedures to be applied	- Before implementing the project, the personnel of monitoring teams were trained on how to properly conduct the monitoring process. - The solar cookers used for the project were tested before the operation of the project by authorities to ensure their specs and quality meets the requirements of the project. - There are maintenance and repair plan ready for the solar cookers. This plan will ensure the cookers in the project can remain in operational condition. - For missing or damaged data record, zero value is used for the missing or damaged data, which is the most conservative approach.
Purpose of the data	Calculation of baseline emissions
Calculation method	The percentage of number of solar cookers in operation out of the 79 samples was calculated, and then the number of solar cookers

	in operation in the proposed project was calculated by using the abovementioned percentage multiplying 49000, the total number of cookers.
Comments	Records were kept in electronic form and paper form.

Data / Parameter	2. t_i
Data unit	Hour
Description	The monthly operating time of each solar cooker
Source of data	Monitoring result of the usage time of the sampled cookers selected by the sampling survey
Description of measurement methods and procedures to be applied	To determining the average monthly hours of operation of the solar cookers with a 90/10 confidence/precision level, 79 samples are sufficient according to statistical principles. Therefore, a set of 79 samples (sample set B) were randomly selected from the entire population, and the usage time of these samples were monitored.
Frequency of monitoring/recording	The usage time of cookers were measured and recorded daily.
Value monitored	Please refer to the table in Section 5.1 of this monitoring report. The data in column "Monthly Usage Time" of that table are the values monitored for this parameter.
Monitoring equipment	Clock or watch
QA/QC procedures to be applied	To ensure the completeness of data, monitoring forms were filled out daily by the monitoring team to record the daily usage data of the sample users. The sampled users and monitoring team were properly trained to collect and record the data strictly according to the monitoring plan of PDD. The data records were checked to ensure the legibility and correctness. The sampled users were requested to further explain the reasons for the data out of normal range (for details, please refer to item 5 of the next subsection "Process conducted for data records that are missing, damaged, or out of normal range"). Reliability checking was performed to ensure the data precision meet requirement of PDD. Process conducted for data records that are missing, damaged, or out of normal range: (1) The general principle is that zero value is used for the missing or damaged data. This is most conservative approach. The monitoring personnel were trained before the starting of the project operation to ensure that each team member is fully aware of and able to strictly follow this conservative principle. During the monitoring process, the monitoring personnel were required to strictly abide by the above conservative principle in data recording,

	i.e., use zero values for all the missing or damaged data. (2) If this is due to the working error of the monitoring personnel, further train the person until he or she can perform the job properly. And in the mean time, use zero value for the missing or damaged data; (3) If this is due to the inability or attitude of a particular worker in monitoring team, dismiss such worker and re-hire those with proper ability and attitude. And in the mean time, use zero value for the missing or damaged data; (4) If the monitoring team as a whole does not meet the job requirement of monitoring process, a new monitoring team that meets the requirement will be created; (5) If the data reported by the user significantly higher than the normal range by common sense, the monitoring personnel asked for the reason. If the reason belongs to one of the following: 1) holidays celebration, 2) wedding or funeral, or 3) family/friends party, the reason is considered to be valid. Then the reason is recorded along with the data. Otherwise, zero value is used for that day's data.
Purpose of the data	Calculation of baseline emissions
Calculation method	(1) For each of the 79 sample users, measure and record their daily usage time, then sum up all the daily usage time in a month to get the monthly usage time of each user; (2) Sum up the monthly usage time of all the 79 users to get the total monthly usage time of the 79 users. (3) Divide the number obtained in (2) by 79 to get the average monthly operating time of each solar cooker.
Comments	Records were kept in electronic form and paper form.

Data / Parameter	3. R_i
Data unit	W/m ²
Description	Monthly solar irradiance rate in project region
Source of data	Gansu Meteorological Service Centre (latest available data released on 25 Nov. 2013, which is suitable to be applied.)
Description of measurement methods and procedures to be applied	Inquired Gansu Meteorological Service Centre and obtained the latest available data.

Frequency of monitoring/recording	Use the latest available data obtained from relevant authoritative resources.																										
Value monitored	<table> <tr> <th>Month</th><th>Value</th></tr> <tr><td>Jan</td><td>408.7</td></tr> <tr><td>Feb</td><td>503.4</td></tr> <tr><td>Mar</td><td>635.1</td></tr> <tr><td>Apr</td><td>738.5</td></tr> <tr><td>May</td><td>799.7</td></tr> <tr><td>Jun</td><td>814.4</td></tr> <tr><td>Jul</td><td>829.2</td></tr> <tr><td>Aug</td><td>767.8</td></tr> <tr><td>Sep</td><td>696.3</td></tr> <tr><td>Oct</td><td>537.1</td></tr> <tr><td>Nov</td><td>410.8</td></tr> <tr><td>Dec</td><td>363.0</td></tr> </table>	Month	Value	Jan	408.7	Feb	503.4	Mar	635.1	Apr	738.5	May	799.7	Jun	814.4	Jul	829.2	Aug	767.8	Sep	696.3	Oct	537.1	Nov	410.8	Dec	363.0
Month	Value																										
Jan	408.7																										
Feb	503.4																										
Mar	635.1																										
Apr	738.5																										
May	799.7																										
Jun	814.4																										
Jul	829.2																										
Aug	767.8																										
Sep	696.3																										
Oct	537.1																										
Nov	410.8																										
Dec	363.0																										
Monitoring equipment	N/A																										
QA/QC procedures to be applied	The data is from an official source. No additional QA/QC procedure is necessary.																										
Purpose of the data	Calculation of baseline emissions																										
Calculation method	N/A																										
Comments																											

Data / Parameter	4. EF _{FF,CO2}
Data unit	tCO ₂ /TJ
Description	Baseline emission factor of Coal
Source of data	IPCC2006, page 2.22, Table2.5
Description of measurement methods and procedures to be applied	Obtained from IPCC
Frequency of monitoring/recording	N/A
Value monitored	94.6
Monitoring equipment	N/A
QA/QC procedures to be applied	The data is from an official source (latest information from IPCC); there is no updated data available. No additional QA/QC procedure is necessary.

Purpose of the data	Calculation of baseline emissions
Calculation method	
Comments	N/A

4.3 Monitoring Plan

There are 4 parameters listed in monitoring plan. Two of them (parameter A and B below) were monitored¹:

- (a) Number of solar cookers in operation in the proposed project (parameter A), and
- (b) The monthly operating time of each solar cooker (parameter B).

The other two parameters² are the data from reference documents which only need to be updated if there is an update on the latest available data. They are:

“Monthly solar irradiance rate in project region” (R_i) and

“Baseline emission factor of coal” ($EF_{FF,CO2}$).

For R_i , the latest available data released in November 2013 were used in the monitoring report. For $EF_{FF,CO2}$, the latest available data is still the IPCC default value used in registered PDD. For more details of these two parameters, please refer to parameter#3 and #4 in section 4.2 of this monitoring report.

Since the monitoring of R_i and $EF_{FF,CO2}$ only involves obtaining the latest available data from reference documents, the monitoring system only need to address the monitoring of parameter A and B. Therefore, the project monitoring is conducted by two monitoring teams: Team A (for parameter A, number of cookers operating) and Team B (for parameter B, monthly operating time of each cooker).

Roles and Responsibilities:

The monitoring process was conducted through the coordination with local Rural Energy Office³ (“REO”), the governmental organization in charge of the rural energy affairs.

In general, Beijing Harmonious Energy Development Co Ltd (project operator) was responsible for overall management of the entire monitoring process as well as data analyzing, checking, and archiving; REO was responsible for the raw data collection and recording, and all the raw data were confirmed by REO. The project operator worked closely with REO to ensure proper equipment installation, training of the users, monitoring, document preservation, and maintenance.

Specifically, under the project operator, there were monitoring teams for the monitoring of parameter A (number of solar cookers in operation in the project) and parameter B (the monthly operating time of each solar cooker). The monitoring teams consist of personnel from REO and project operator. For the details of the monitoring team, please refer to the table below.

¹ Section B.7 of the registered PDD, Parameter #1 and #2

² Section B.7 of the registered PDD, Parameter #3 and #4

³ Refer to Linze Rural Energy Station and Gaotai Energy and Zoning Office (The former name of the latter is Gaotai Rural Energy Station.)

Due to the non-industrial nature of the project, emergency procedures are not applicable to the project. For QA/QC procedures, please refer to QA/QC procedures in section 4.2.

Monitoring Plan ⁴	Monitoring Process Implemented
For number of solar cookers in operation in the project (Parameter A): B.7.1 of PDD: The initial value of this parameter will be determined by the sales contract of the solar cookers and then this parameter will be monitored, recorded, and archived at each monitoring period. B.7.2 of PDD: ● Sampling survey method will be used for the monitoring of parameter A. 79 sample users will be randomly selected from the 49,000 users within the project boundary. Before the beginning of each monitoring period, a set of 79 samples will be drawn for the monitoring of parameter A. Before the beginning of the next monitoring period, a new round of random sampling will be conducted among the 49,000 users to generate a new set of 79 samples which will be monitored during the forthcoming monitoring period.⁵ ● A monitoring team (Team A) will be set up to conduct the monitoring of the number of operating cookers of the sample users. The monitoring personnel will be trained before the starting of the project operation to ensure that each team member is fully aware of and able to strictly follow this conservative principle. ● The monitoring will be conducted during the last 3 months of each monitoring period. A	For number of solar cookers in operation in the project (Parameter A): The sales contracts have been presented to the verification team during the first verification. 49,000 solar cookers were ordered and installed initially. The logo of the project and the user name was put on each of the cookers during the distribution process. Sampling survey method was used in the monitoring of parameter A. For each sub-period (SP)⁶, 79 samples were randomly selected from 49,000 users using MS Excel software. There are totally 4 SPs in this monitoring period, therefore, totally 4 sets of 79 samples were selected for Parameter A during this monitoring period. The monitoring of this parameter was conducted by monitoring team A. All the team members were properly trained beforehand so that they were fully aware of the monitoring procedures and the conservative principle. The monitoring of this parameter involved visiting each of the abovementioned sample users by Team A. During 21-29 June 2019 (for SP1), 22-29 June 2020 (for SP2), 23-30 June 2021 (for SP3), and 25-31 August 2021 (for SP4), Team A checked if the cooker is in operation, and if the logo of the project and the user name is on the cooker through visual observation and short conversation.

⁴ Please refer to B.7.1 and B.7.2 of PDD

⁵ The original text in the registered PDD is: "Before the beginning of each monitoring period, two sets of 79 samples will be drawn, one set for the monitoring of parameter A and the other set is for the monitoring of parameter B. Before the beginning of the next monitoring period, a new round of random sampling will be conducted among the 49,000 users to generate two new sets of 79 samples which will be monitored during the forthcoming monitoring period."

In the above text of PDD, the sampling for parameters A and B are described together as two sets of 79 samples (one set for parameter A and the other set for parameter B). For more clarity, the description in this monitoring report splits the original description in PDD and describes the sampling for each parameter separately. The description in this monitoring report has the exactly same meaning as the original text in PDD.

⁶Sub-period 1 (SP1): 01/08/2018 – 31/07/2019, Sub-period 2 (SP2): 01/08/2019 – 31/07/2020, Sub-period 3 (SP3): 01/08/2020 – 31/07/2021, Sub-period 4 (SP4): 01/08/2021 – 21/09/2021

table will be used for monitoring and recording this parameter. ● To track the solar cookers, the logo of the project will be put on each of the solar cookers involved in the project. Moreover, the name of the user will be put on the cooker that the user is going to receive. ● For the transfer of solar cookers, the monitoring team will ensure that the transferee is also located within the project boundary of the proposed project, and will record the transferor, transferee, and the time of transfer.	After the visit to households, the monitoring results were recorded in the monitoring table as described in monitoring plan. Then all the operational cookers were summed up to generate the total number of cookers in operation. There was no transfer of cookers during this monitoring period. All the monitoring data were collected, recorded, and confirmed by the monitoring team and the personnel of REO, and then provided the records to the project operator.
For the monthly operating time of each solar cooker (Parameter B): B.7.2 of PDD: ● Sampling survey method will be used for the monitoring of parameter B. 79 sample users will be randomly selected from the 49,000 users within the project boundary. Before the beginning of each monitoring period, a set of 79 samples will be drawn for the monitoring of parameter B. Before the beginning of the next monitoring period, a new round of random sampling will be conducted among the 49,000 users to generate a new set of 79 samples which will be monitored during the forthcoming monitoring period.⁷ ● Method of measurement: respondent self-reports, and operational logs. ● A monitoring team (Team B) will be set up to conduct the daily monitoring of the operating hours of the sample users. ● The monitoring forms will be filled out daily by Team B members to record the daily usage data of these sample users. At least once a month Team B leader will collect monitoring forms from Team B members and the quality of data will be checked.	For the monthly operating time of each solar cooker (Parameter B): ● For each sub-period (SP)⁸, 79 samples for Parameter B were randomly selected from 49,000 users using MS Excel software. There were totally 4 SPs in this monitoring period, therefore, totally 4 sets of 79 samples were selected for Parameter B during this monitoring period. ● To monitor this parameter, monitoring Team B was set up. Team B consisted of 2 persons from REO and they recorded the operating hours of the sample users in monitoring forms. The monitoring personnel used phone call, SMS message, or visited the user face-to-face to get and record the data reported by the sampled users. At the end of each month during the monitoring period, the monitoring forms were collected and the paper documents were converted into electronic form and archived. The quality of data was checked by REO and project operator separately. Specifically, REO collected data from sampled users every day to guarantee data completeness and recorded data in accordance with the monitoring plan; REO also ensured the data records (numbers and dates, etc.) were legible and correct, and double-checked with sampled users for the data out of normal range. The project operator reviewed REO's data records and conducted

⁷ Same as footnote 5

⁸ Same as footnote 6

	reliability checking to ensure the precision of these data meet the requirement of PDD (For details on reliability checking, please refer to next section).
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Checking reliability

According to “Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities” (EB67, Annex 6) appendix 4, paragraph 11-17, first calculate the standard error of the mean using formular $\sqrt{(1-f)\frac{s^2}{n}}$, then the t-value, and finally the relative precision. Please refer to footnotes 8 and 9 as well as the left column in the following table for details of the formulae and calculations.

	Sub-period 1	Sub-period 2	Sub-period 3	Sub-period 4
	01/08/2018-31/07/2019	01/08/2019-31/07/2020	01/08/2020-31/07/2021	01/08/2021-21/09/2021
Sample standard deviation (s)	11.0028	12.6980	12.2497	19.5276
Mean value	137.5430	150.3617	140.7812	114.5249
Standard error of the mean⁹ $=[(1-f)s^2/n]^{1/2}$	1.2369	1.4275	1.3771	2.1953
t-value¹⁰	1.6646	1.6646	1.6646	1.6646
Precision $=t*\text{standard error of the mean}$	2.0590	2.3762	2.2923	3.6543
Relative precision $= \text{Precision} / \text{mean value}$	1.50%	1.58%	1.63%	3.19%

As shown in the table above, the values of relative precision during the monitoring period are smaller than the required precision of 10%. The relative precision of data was also calculated on monthly basis using the above method. All the precision values calculated on monthly basis are smaller than the 10% precision

⁹ Standard error of the mean = $\sqrt{(1-f)\frac{s^2}{n}}$, where f is the sampling fraction – the proportion of the population that is sampled. s is the sample standard deviation (s^2 is the sample variance) of the monthly usage hours per user. n is the sample size which is 79, and the population is 49000.

¹⁰ This value depends on the level of confidence and the size of the sample. The exact figure can be acquired from statistical tables for t-distribution or using standard statistical software. The value can also be derived in Microsoft Excel using the TINV function. For a sample size of 79 and 90% confidence, using the TINV function in Microsoft Excel, the t-value is 1.6646.

value required, which gives additional assurance that the precision is within the required range. The details of these calculations are available in Excel calculation sheet.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

According to the registered PDD, the annual emission reduction can be calculated in the following table using the parameters below:

$$BE_y = n * \sum [910 * (R_i / 700) * t_i * 3.6 \times 10^{-9}] * EF_{FF,CO2} / \eta_{BL, thermal} \quad (i = 1, 2, ..., 12)$$

Where:

n The total number of solar cookers in operation. The value adopted is 49,000 (refer to parameter #1 in table 4.2 for details).

t_i t_i is the usage time of the solar cooker in month i in hours. The values adopted are parameter #2 in table 4.2

R_i R_i is the actual solar irradiance rate in month i in W/ m². The values adopted are parameter #3 in the data table 4.2

$EF_{FF,CO2}$ The CO₂ emission factor of coal (tCO₂e/ TJ). IPCC default emission factor of 94.6tCO₂e/TJ was adopted in the proposed project (refer to parameter #4 in table 4.2).

$\eta_{BL, thermal}$ The efficiency of the coal-fired stove that would have been used in the absence of project activity. The value adopted is 14.6% (refer to parameter #3 in table 4.1).

The result is summarized in the tables below:

Month	Dates included in each month	Solar irradiance rate	Actual Power of Solar Cooker	Monthly Usage Time	Net Heat Supplied Monthly	VCU Generated Monthly
		R_i	$P_i = 910 * (R_i / 700)$ Equation (8) in PDD	t_i	$HG_i = n * [P_i * t_i * (3.6 \times 10^{-9})]$ Equation (6) in PDD	$BE_i = HG_i * EF_{FF,CO2} / \eta_{BL, thermal}$ Equation (5) in PDD
		(W/m ²)	(W)	(hour)	(TJ)	(tCO ₂ e)
Sub-period 1:						
2018-08	1 – 31	767.8	998.1	128.34	22.59693	14642
2018-09	1 – 30	696.3	905.2	138.32	22.08602	14311

2018-10	1 - 31	537.1	698.2	149.75	18.44409	11951
2018-11	1- 30	410.8	534.0	146.35	13.78723	8933
2018-12	1- 31	363.0	471.9	136.64	11.37430	7370
2019-01	1 - 31	408.7	531.3	126.37	11.84421	7674
2019-02	1 - 28	503.4	654.4	124.92	14.42110	9344
2019-03	1 - 31	635.1	825.6	144.64	21.06487	13649
2019-04	1 - 30	738.5	960.1	151.74	25.69693	16650
2019-05	1 - 31	799.7	1039.6	121.40	22.26236	14425
2019-06	1 - 30	814.4	1058.7	138.91	25.94229	16809
2019-07	1 - 31	829.2	1078.0	143.14	27.21924	17637
Sub-period 2:						
2019-08	1 - 31	767.8	998.1	143.40	24.92903	16153
2019-09	1 - 30	696.3	905.2	149.99	23.64735	15322
2019-10	1 - 31	537.1	698.2	148.02	18.00096	11664
2019-11	1- 30	410.8	534.0	146.87	13.66088	8852
2019-12	1- 31	363.0	471.9	147.43	12.11713	7851
2020-01	1 - 31	408.7	531.3	153.43	14.19767	9199
2020-02	1 - 29	503.4	654.4	155.02	17.66913	11449
2020-03	1 - 31	635.1	825.6	155.18	22.31484	14459
2020-04	1 - 30	738.5	960.1	152.25	25.45836	16496
2020-05	1 - 31	799.7	1039.6	150.48	27.24724	17655
2020-06	1 - 30	814.4	1058.7	145.43	26.81570	17375
2020-07	1 - 31	829.2	1078.0	156.83	29.44351	19078
Sub-period 3:						
2020-08	1 - 31	767.8	998.1	146.16	25.40960	16464
2020-09	1 - 30	696.3	905.2	140.39	22.13377	14341
2020-10	1 - 31	537.1	698.2	152.96	18.60069	12052
2020-11	1- 30	410.8	534.0	144.76	13.46483	8724
2020-12	1- 31	363.0	471.9	133.16	10.94406	7091
2021-01	1 - 31	408.7	531.3	149.25	13.81118	8949
2021-02	1 - 28	503.4	654.4	130.57	14.88255	9643
2021-03	1 - 31	635.1	825.6	142.03	20.42335	13233

2021-04	1 – 30	738.5	960.1	108.03	18.06303	11704
2021-05	1 – 31	799.7	1039.6	149.34	27.03982	17520
2021-06	1 – 30	814.4	1058.7	141.66	26.12165	16925
2021-07	1 – 31	829.2	1078.0	151.06	28.36124	18377
Sub-period 4:						
2021-08	1 – 31	767.8	998.1	133.82	22.96595	14881
2021-09	1 – 21	696.3	905.2	95.23	14.82044	9603

Using the equation listed at the beginning of this section 5.1, total baseline emissions of the entire monitoring period is the sum of the baseline emissions of all the months in this monitoring period, which equals 498,454 tCO₂e.

5.2 Project Emissions

According to the registered PDD and the applied methodology, there is no project emission.

5.3 Leakage

According to the registered PDD and the applied methodology, there is no project leakage.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2018 1 Aug–31 Dec	57,206	0	0	57,206
2019	156,029	0	0	156,029
2020	164,383	0	0	164,383
2021 1 Jan–21 Sep	120,835	0	0	120,835
Total	498,454	0	0	498,454

This monitoring period covers from 1 Aug 2018 to 21 Sep 2021, which consists of three portions listed below. The ex-ante GHG emission reduction (ER) estimate can be found in the registered VCS Project Description (Section 1.7, Annual ER) and CDM Project Design Document (Section B6.3, monthly ER). According to the two documents above, the ex-ante ER estimates are:

- | | | |
|-----|---|---------------------------------|
| (1) | 3 full years (1 Aug 2018 to 31 Jul 2021): | $143,762 \times 3 = 431,286$ |
| (2) | 1 full month of Aug 2021: | 14,688 |
| (3) | 21 days of Sep 2021 (1 to 21 Sep): | $13,381 \times (21/30) = 9,367$ |

Therefore, the total ex-ante ER estimate for this monitoring period is (1)+(2)+(3):

$$431,286 + 14,688 + 9,367 = 455,341 \text{ tCO}_2\text{e}$$

The actual ER is 498,454 tCO₂e, about 9% higher than the ex-ante estimate, which essentially means that the usage time of the solar cookers is about 9% higher. There are mainly two reasons:

First, the ex-ante estimate was done before the start of the project. Back then, the users were not familiar with solar cookers and the ex-ante estimate was conservative. Now the users are quite aware of the benefits of solar cooker and are familiar with its operation, so that they have been using it as much as they could, leading to higher ER value. And as a matter of fact, during the previous two (7th and 8th) monitoring periods, the actual usage time and ER was already around 5-7% higher than the ex-ante estimate.

Second, due to the outbreak of Covid-19 during this monitoring period, almost all the users had to stay at home for a long time, which resulted in more cooking and water heating at home. This is another factor that contributed to the higher usage time during this monitoring period, making the ER of this monitoring period slightly higher than it would have been without the Covid-19.

Therefore, the difference between the actual ER value and estimated value is reasonable.

APPENDIX 1: SUPPORTING EVIDENCE FOR SECTION 1.11, TABLE 1 (SDC)

The emission reduction of the current monitoring period (9th) is 498,454 tCO₂e as calculated in Section 5.4 of this document. The emission reduction of the previous 8 monitoring periods is 973,648 tCO₂e¹¹. Therefore, the total emission reduction over the project lifetime is 498,454 + 973,648 = 1,472,102 tCO₂e.

Row 1

The emission factor of coal is 94.6 tCO₂/TJ (Parameter 4 in Section 4.2). The Net Calorific Value of coal is 25.8 TJ/Gg¹². Therefore, 1 tonne of CO₂ emission reduction corresponds to 0.4097 tonne of coal saved¹³

The price of coal is CNY 1,562/t¹⁴. Therefore, the increase of income (money saved) by this project is:

During the current monitoring period:

$498,454 \times 0.409722 \times 1,562 = \text{CNY } 319.0 \text{ million (CNY } 6,510 \text{ per household)}$

Over the project lifetime:

$1,472,102 \times 0.409722 \times 1,562 = \text{CNY } 942.1 \text{ million (CNY } 19,227 \text{ per household)}$

Row 2

The household air pollution (HAP) information is obtained from the website of World Health Organization (WHO)¹⁵

Row 4

Please refer to the calculation in Row 1 above.

The project is in Gansu province. According to the income data from the National Bureau of Statistics of China, the average income of the residents in Gansu ranks lowest among all the provincial-level divisions in China. Gansu's population is 1.8% of China's total population¹⁶. This means that on average the income of Gansu residents is in the bottom 1.8% of the entire country. Moreover, the rural households involved in the project have relatively lower income within Gansu province, i.e., their income is in the lower portion of

¹¹ The emission reductions of the previous 8 monitoring periods (MP) are: 1st MP: 143,956, 2nd MP: 150,705, 3rd MP: 89,023, 4th MP: 116,247, 5th MP: 63,580, 6th MP: 153,545, 7th MP: 154,035, and 8th MP: 102,577. The sum is 973,648.

¹² 2006 IPCC Guidelines for National Greenhouse Gas Inventories, page 1.18, table 1.2

¹³ 1 Gg = 1000 t. Thus, 25.8 TJ/Gg = 25.8/1000 = 0.0258 TJ/t. The energy saved by 1t of CO₂ emission reduction = 1/94.6 TJ which corresponds to (1/94.6)/0.0258 = 0.4097t of coal saved.

¹⁴ The average price from several coal retailers in the project region at different times throughout the monitoring period.

¹⁵ <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>

¹⁶ The population of Gansu province is 26 million (Data as of 2019 from the official website of Gansu provincial government: www.gansu.gov.cn). The population of China is 1,411 million (Data as of 2020 from World Bank website: data.worldbank.org)

this bottom 1.8%. Obviously 1.8% is far less than 40%. Therefore, it is reasonable to conclude that the income of the households involved in the project are in the bottom 40% of the host country.

Row 5

Please refer to the calculation in the first paragraph of this Appendix 1.