Monitoring report form for CDM project activity
(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Heqing Solar Cooker Project II	
UNFCCC reference number of the project activity	5106	
Version number of the PDD applicable to this monitoring report	9	
Version number of this monitoring report	1.0	
Completion date of this monitoring report	01/08/2018	
Monitoring period number	7th monitoring period	
Duration of this monitoring period	01/12/2016-31/07/2018	
Monitoring report number for this monitoring report	N/A	
Project participants	• Beijing Harmonious Energy Development Co., Ltd. • Swedish Energy Agency • Kingdom of Spain (withdrawn) • Asian Development Bank as Trustee of the Asia Pacific Carbon Fund (withdrawn) • Asian Development Bank as Trustee of the Future Carbon Fund • Clean Air Capital Ltd	
Host Party	China	
Sectoral scopes	Energy industries (renewable - / non-renewable sources)	
Applied methodologies and standardized baselines	AMS-I.C (Version 18, EB56), Thermal energy production with or without electricity	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	256,592 tCO_2e
Amount of GHG emission reductions	241,210 tCO_2e	

or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	

SECTION A. Description of project activity

A.1. General description of project activity

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The project installed 49,000 solar cookers for the poor rural residents in north-western 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 CO_2 emission generated by fossil fuel consumption.

The 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 continued operation period for the project is 01/12/2016 – 31/07/2018 which is the current (7^{th}) monitoring period. There were 6 monitoring periods prior to the current monitoring period. The total emission reductions achieved in this monitoring period is 256,592 tCO_2e.

A.2. Location of project activity

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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
Luotuocheng	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

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (host Party)	Beijing Harmonious Energy Development Co., Ltd.	No

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Sweden	Swedish Energy Agency, Asian Development Bank as Trustee of the Asia Pacific Carbon Fund (withdrawn), and Asian Development Bank as Trustee of the Future Carbon Fund	Yes
Spain	Kingdom of Spain (withdrawn), and Asian Development Bank as Trustee of the Asia Pacific Carbon Fund (withdrawn)	Yes
Netherlands	Clean Air Capital Ltd	No

A.4. Reference to applied methodologies and standardized baselines

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Small-scale CDM baseline methodology "AMS-I.C.(Version 18, EB56), Thermal energy production with or without electricity". For more information regarding the methodology, please refer to the link: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

A.5. Crediting period type and duration

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Type: fixed crediting period
Crediting period: 22/09/2011-21/09/2021
Length: 10 years

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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As stated in section A.1, the 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 continued operation period for the project is 01/12/2016 – 31/07/2018 which is the current (7^{th}) monitoring period. There were 6 monitoring periods prior to the current monitoring period. The total emission reductions achieved in this monitoring period is 256,592 tCO_2e. There is no event or situations that occurred during this monitoring period, which may impact the applicability of the methodology.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

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None

B.2.2. Corrections

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None

B.2.3. Changes to the start date of the crediting period

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The start date of the crediting period has been changed to 22 Sep. 2011. This change was approved by UNFCCC on 12 Dec. 2011.

B.2.4. Inclusion of monitoring plan

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None

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

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None

B.2.6. Changes to project design

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None

SECTION C. Description of monitoring system

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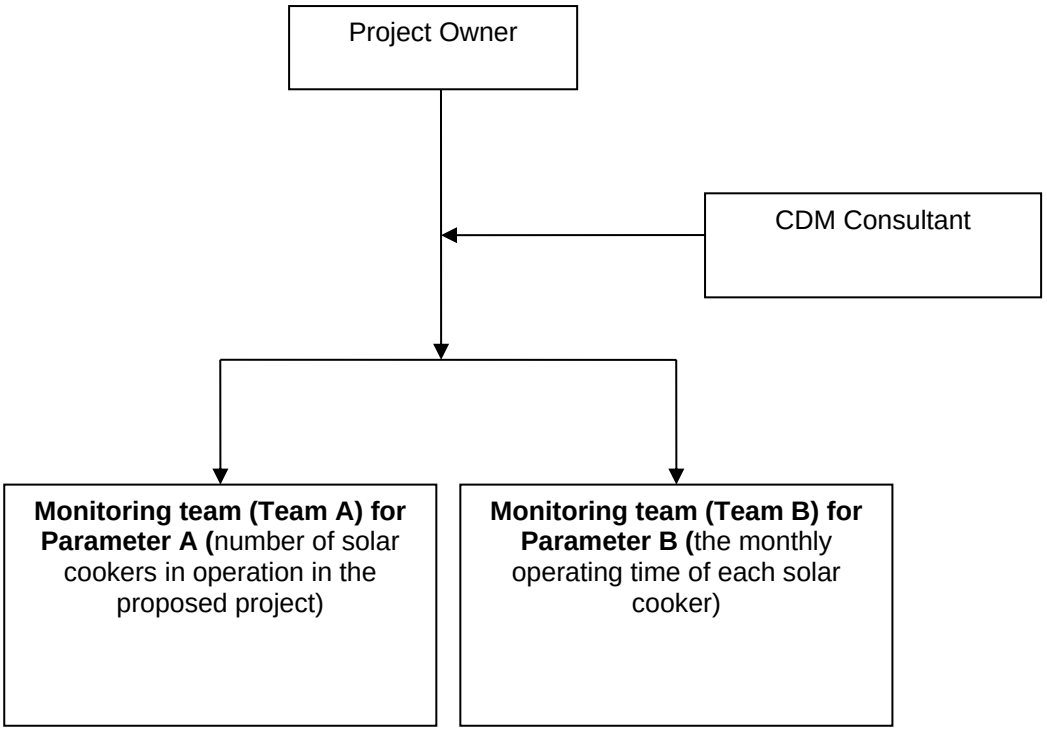
There are 4 parameters listed in section 7.1 of the registered PDD. According to methodology AMS-I.C. (Version 18, EB56) and the registered PDD section 7.2 (sub-section 2. "Data Monitored"), parameter #1 and #2 in section 7.1 of the registered PDD (i.e., parameter A and B below) were monitored:

(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).
Parameter #3 and #4 in section 7.1 of the registered PDD are the data from reference documents which only need to be updated if there is an update on the latest available data. These two parameters are:
"Monthly solar irradiance rate in project region"($\underline{R_i}$) and
"Baseline emission factor of coal" ($\underline{EF_{FF,CO2}}$).
For $\underline{R_i}$, the latest available data released in November 2013 were used in the monitoring report. For $\underline{EF_{FF,CO2}}$, 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 D.2 of this monitoring report.

Since the monitoring of R_i and $\underline{EF_{FF,CO2}}$ only involves obtaining the latest available data from reference documents, which is handled by project owner, the monitoring system only need to address the monitoring of parameter A and B. Below is the organization structure of the monitoring system for parameter A and B:



Roles and Responsibilities:

The monitoring process was conducted through the coordination between the project owner and local Rural Energy Stations[1] (RES), the governmental organization in charge of the rural energy affairs.

In general, the project owner was responsible for overall management of the entire monitoring process as well as data analyzing, checking, and archiving; RES was responsible for the raw data collection and recording, and all the raw data were confirmed by RES. The project owner worked closely with RES to ensure proper equipment installation, training of the users, monitoring, document preservation, and maintenance.

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

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 D.2.

Monitoring Plan in PDD	Monitoring Process Implemented
For number of solar cookers in operation in the proposed 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	**For number of solar cookers in operation in the proposed 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

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

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.[2] ● 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 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	put on each of the cookers during the distribution process. Since the length of this monitoring period is more than one year, to ensure the monitoring frequency to be at least once per year, the monitoring team conducted the monitoring of this parameter twice. Accordingly, there were two sets of 79 sample users randomly selected using survey method with MS Excel software. The two monitoring activities for parameter A were conducted as the following: (1) the first one was during 22 October 2017 to 29 October 2017, for the period of 1 December 2016 to 30 November 2017 (sub-period 1), and (2) the second one was during 17 June 2018 to 24 June 2018, for the period of 1 December 2017 to 31 July 2018 (sub-period 2). The monitoring of this parameter was conducted by monitoring team A. 2 groups in Team A were responsible for on-site monitoring and each group consisted of 2 people (one from local Rural Energy Station ("RES") and the other from project owner). 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 the visit, the monitoring 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. After the visit to households, the monitoring results were recorded in the monitoring table substantially in the form shown in PDD section B.7.2.Clause 3. Then all the operational cookers

[2] 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.

project, and will record the transferor, transferee, and the time of transfer.	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 RES, and then provided the records to the project owner.
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. [3] ● 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):** ● Sampling survey method was used for the monitoring of parameter B. To be more conservative and to match the two sub-periods defined in the monitoring of parameter A in the previous paragraphs, two sets of 79 samples were randomly selected using MS Excel software as below: (1) the first set of 79 sample users was for the period of 1 December 2016 to 30 November 2017 (sub-period 1), and (2) the second set of 79 sample users was for the period of 1 December 2017 to 31 July 2018 (sub-period 2). ● To monitor this parameter, monitoring Team B was set up. Team B consisted of 2 persons from RES 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 the "RES" and project owner separately. Specifically, RES collected data from sampled users every day to guarantee data completeness and recorded data in accordance with the monitoring plan of PDD; RES 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 owner reviewed RES's data records

[3] Same as footnote 2

	and conducted reliability checking to ensure the precision of these data meet the requirement of PDD (For details on reliability checking, please refer to section D.3).

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/Parameter	**1.*R***
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(s) applied	700
Choice of data or measurement methods and procedures	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/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	**2. η**
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(s) applied	65%
Choice of data or measurement methods and procedures	This is the requirement of National Standard of P.R. China (GB), GB No.: NY/T219-2003. The project owner will also require in the technical specification that the solar cookers to be manufactured for this project have an efficiency of at least 65%.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	**3. $\eta_{BL,thermal}$**
Unit	N/A
Description	Thermal efficiency for the traditional coal furnace
Source of data	The highest value of measured data.
Value(s) applied	14.6%
Choice of data or measurement methods and procedures	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 (HXU) measured the efficiency of cooking stove in rural Zhangye. The thermal efficiencies of 100 representative cooking stoves at rural households of Zhangye (including Ganzhou 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% shall be chosen as the baseline

	thermal efficiency for the coal stoves.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

D.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data/Parameter	**1. *n***
Unit	Not applicable
Description	Number of solar cookers in operation in the proposed project
Measured/calculated/ default	Measured and calculated.
Source of data	Sales contract and invoice of the solar cookers and monitoring records of monitoring team
Value(s) of monitored parameter	The following table shows the number of cookers in operation out of the 79 samples:
Monitoring equipment	Monitoring equipment is not necessary, and thus not used.
Measuring/reading/recording frequency	At least once a year
Calculation method (if applicable)	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.

Township	**Number**	
	Data obtained in sub-period 1 (01/12/2016 ~ 30/11/2017)	**Data obtained in sub-period 2 (01/12/2017 ~ 31/07/2018)**
Shahe	9	7
Xinhua	6	9
Banqiao	9	7
Pingchuan	7	5
Liaoquan	6	2
Yanuan	5	7
Nijiaying	5	8
Xiangdao	9	7
Heli	5	6
Nanhua	8	9
Xinba	0	1
Luotuocheng	2	5
Xuanhua	1	2
Heiquan	6	4
Luocheng	1	0
Total number of cookers in operation out of the 79 sample users	**79**	**79**
Percentage of cookers in operation out of 79 sample users	**100%**	**100%**
Total number of operational cookers based on sample user result	**49000**	**49000**

QA/QC procedures	● 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 data/parameter	Calculation of baseline emissions
Additional comments	Records were kept in electronic form and paper form.

Data/Parameter	**2. t_i**
Unit	Hour
Description	The monthly operating time of each solar cooker
Measured/calculated/ default	Measured and calculated.
Source of data	Monitoring result of the usage time of the sampled cookers selected by the sampling survey
Value(s) of monitored parameter	Dec-2016: 139.32 Jan-2017: 136.18 Feb-2017: 122.12 Mar-2017: 148.17 Apr-2017: 134.42 May-2017: 134.33 Jun-2017: 138.86 Jul-2017: 135.28 Aug-2017: 136.71 Sep-2017: 147.84 Oct-2017: 144.12 Nov-2017: 140.21 Dec-2017: 145.47 Jan-2018: 134.41 Feb-2018: 131.25 Mar-2018: 138.84 Apr-2018: 136.77 May-2018: 136.77 Jun-2018: 136.88 Jul-2018: 128.29
Monitoring equipment	Clock or watch No calibration requirement is specified in the registered PDD and the applied Methodology AMS-I.C version 18.
Measuring/reading/recording frequency	● The usage time of cookers were measured and recorded daily. ● At the end of each month, all the daily data of the past month were summarized to produce the monthly usage time.

Calculation method (if applicable)	(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.
QA/QC procedures	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 was 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 data/parameter	Calculation of baseline emissions
Additional comments	Records were kept in electronic form and paper form.

Data/Parameter	**3.R_i**
Unit	W/m^2
Description	Monthly solar irradiance rate in project region
Measured/calculated/ default	Measured

Source of data	Gansu Meteorological Service Centre (latest available data[4] released on 25 Nov. 2013, which is suitable to be applied.)
Value(s) of monitored parameter	Month Value 1 408.7 2 503.4 3 635.1 4 738.5 5 799.7 6 814.4 7 829.2 8 767.8 9 696.3 10 537.1 11 410.8 12 363.0
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	At least once a year with the latest available complete set of data obtained from relevant authoritative resources.
Calculation method (if applicable)	Not applicable
QA/QC procedures	The data is from an official source. No additional QA/QC procedure is necessary.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	**4.$EF_{FF,CO2}$**
Unit	tCO_2/TJ
Description	Baseline emission factor of Coal
Measured/calculated/ default	Default
Source of data	IPCC2006, page 2.22, Table2.5
Value(s) of monitored parameter	94.6
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Not applicable
Calculation method (if applicable)	Not applicable
QA/QC procedures	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 data/parameter	Calculation of baseline emissions
Additional comments	

D.3. Implementation of sampling plan

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According to the registered PDD, simple random sampling (with sample size of 79) was used for number of solar cookers in operation in the proposed project (Parameter A) and the monthly operational time of each solar cooker (Parameter B). Since the monitoring period is more than one year, to be conservative, for each parameter, two sets of 79 sample users were randomly selected from users within the project boundary.

[4] 1996-2011 solar irradiance data

Checking reliability

Parameter A (Number of solar cookers in operation in the proposed project)

The monitoring result of this parameter is that all the cookers are operational for 79 sample users, this means that the proportion of operational cooker is 1, i.e., *p* = 1. According to "Best Practices Examples Focusing on Sample Size and Reliability Calculations"(EB67, Annex 6), paragraph 189, when *p* is very large (as in this case), a 90% confidence interval should be calculated as follows:

$\frac{A-B}{C}$ to $\frac{A+B}{C}$

Where:

$A=2np\hat{}+1.645^2$

$B=1.645\sqrt{1.645^2+4np\hat{}(1-p\hat{})}$

$C=2(n+1.645^2)$

n is the sample size

p^ is the sample proportion calculated

In our case, for both 1st and 2nd sample set: n=79, p^=1

Putting the information together gives:

$\frac{A-B}{C}$=0.9669 $\frac{A+B}{C}$=1

Therefore, for the proportion of solar cookers in operation, the confidence interval is 0.9669 to 1, i.e., *p* = 0.98345 ± 0.01655 (Note: 0.98345 = (1 + 0.9669)/2, and 0.01655 = (1 - 0.9669)/2)

Relative precision is 0.01655/0.98345 = 1.68%

Therefore, the relative precisions of the data for 1st and 2nd sample sets are both 1.68%, both meeting the required precision of 10%.

Parameter B (The monthly operating time of each solar cooker)

According to "Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities" (EB67, Annex 6) appendix 4, paragraph 11-17, confidence/precision should be checked following the steps below:

(i) Standard error of the mean = $\sqrt{(1-f)\frac{s^2}{n}}$

f is the sampling fraction – the proportion of the population that is sampled.

s^2 is the sample variance (*s* is the sample standard deviation) of the monthly usage hours per user.

n is the sample size.

In our case, n = 79, and the population =49000.

Let s_1 denote the standard deviation of the monthly usage hours per user of the first sample set, and s_2 denote the standard deviation of the monthly usage hours per user of the second sample set.

Using Excel, we can calculate the value of s_1 and s_2 as well as the mean value of the two sample sets as below:

s_1 = 8.7377

s_2 = 7.1545

Mean value of monthly usage hours per user (for 1st sample set) = 138.1294
Mean value of monthly usage hours per user (for 2nd sample set) = 136.0854

Putting all these pieces of information together gives:

Standard error of the mean (for 1st sample set) = $\sqrt{(1-\frac{79}{49000})*\frac{{s_1}^2}{79}}$ = 0.9823

Standard error of the mean (for 2nd sample set)= $\sqrt{(1-\frac{79}{49000})*\frac{{s_2}^2}{79}}$ = 0.8043

(ii) t-value

This value depends on the level of confidence and the size of the sample. The exact figure can be acquired from statistical tables for the 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.

(iii) Precision

The precision associated with an estimate is: t-value × standard error of the mean.

The precisions of the monthly usage (in hours) per user, assuming 90% confidence, are therefore:
for 1st sample set: ± (1.6646 ×0.9823) = ± 1.6351
for 2nd sample set: ± (1.6646 ×0.8043) = ± 1.3388.

The ratios of this relative to the mean monthly usage per user are:
for 1st sample set: 1.6351/138.1294= 1.18%,
for 1st sample set: 1.3388/136.0854 = 0.98%.

Therefore, the relative precision of the data over the monitoring period for the 1st and 2nd sample set are 1.18% and 0.98% respectively, both meeting 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 value required, which gives additional assurance that the precision is within the required range. For details of these calculations, please refer to the attached Excel calculation sheet.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

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

$$BE_y = n^* \sum [910.0^*(R_i/700)^* t_i * 3.6 \times 10^{-9}] * EF_{FF,CO2} / \eta_{BL,\ thermal} \qquad (i = 1, 2. \ldots, 12)$$

Where:

R_i — R_i is the actual solar irradiance rate in month *i* in W/ m^2. The values adopted are parameter #3 in the data table D.2

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 D.2

n The total number of solar cookers installed by the proposed project. The value adopted is 49,000 (refer to parameter #1 in table D.2 for details).

$EF_{FF,CO2}$ The CO_2 emission factor of coal (tCO_2e/ TJ). IPCC default emission factor of 94.6tCO_2e/TJ was adopted in the proposed project (refer to parameter #4 in table D.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 D.1).

The result is summarized in the tables below:

From 01/12/2016 to 30/11/2017:

Month	Time Interval	Solar irradiance rate	Actual Power of Solar Cooker	Monthly Usage Time	Net Heat Supplied Monthly	CER 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_2e)
2016-12	01/12/2016 – 31/12/2016	363.0	471.9	139.32	11.59772	7515
2017-01	01/01/2017 – 31/01/2017	408.7	531.3	136.18	12.76340	8270
2017-02	01/02/2017 – 28/02/2017	503.4	654.4	122.12	14.09740	9134
2017-03	01/03/2017 – 31/03/2017	635.1	825.6	148.17	21.57910	13982
2017-04	01/04/2017 – 30/04/2017	738.5	960.1	134.42	22.76423	14750
2017-05	01/05/2017 – 31/05/2017	799.7	1039.6	134.33	24.63351	15961
2017-06	01/06/2017 – 30/06/2017	814.4	1058.7	138.86	25.93311	16803
2017-07	01/07/2017 – 31/07/2017	829.2	1078.0	135.28	25.72309	16667
2017-08	01/08/2017 – 31/08/2017	767.8	998.1	136.71	24.07152	15597
2017-09	01/09/2017 – 30/09/2017	696.3	905.2	147.84	23.60587	15295

2017-10	01/10/2017 – 31/10/2017	537.1	698.2	144.12	17.75089	11502
2017-11	01/11/2017 – 30/11/2017	410.8	534.0	140.21	13.20865	8558

Using Equation (4) in PDD, total Baseline Emissions in the part 1 (01/12/2016 to 30/11/2017) of the monitoring period = $\sum BE_i$ = **154,035 tCO_2e.**

From 01/12/2017 to 31/07/2018:

Month	**Time Interval**	**Solar irradiance rate**	**Actual Power of Solar Cooker**	**Monthly Usage Time**	**Net Heat Supplied Monthly**	**CER 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_2e)
2017-12	01/12/2017 – 31/12/2017	363.0	471.9	145.47	12.10923	7846
2018-01	01/01/2018 – 31/01/2018	408.7	531.3	134.41	12.59757	8163
2018-02	01/02/2018 – 28/02/2018	503.4	654.4	131.25	15.15134	9817
2018-03	01/03/2018 – 31/03/2018	635.1	825.6	138.84	20.22132	13102
2018-04	01/04/2018 – 30/04/2018	738.5	960.1	136.77	23.16268	15008
2018-05	01/05/2018 – 31/05/2018	799.7	1039.6	136.77	25.08122	16251
2018-06	01/06/2018 – 30/06/2018	814.4	1058.7	136.88	25.56298	16563
2018-07	01/07/2018 – 31/07/2018	829.2	1078.0	128.29	24.39548	15807

Using Equation (4) in PDD, total Baseline Emissions in the part 2 (01/12/2017 to 31/07/2018) of the monitoring period = $\sum BE_i$ =**102,557 tCO_2e.**

Using Equation (4) in PDD, total Baseline Emissions in the monitoring period is:
154,035 + 102,557 = 256,592 tCO_2e

Therefore, the total Baseline Emissions generated in the monitoring period is **256,592 tCO_2e**.

E.2. Calculation of project emissions or actual net removals

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

E.3. Calculation of leakage emissions

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

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	256,592	0	0	0	256,592	256,592

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
256,592	241,210

CERs estimated in ex-ante calculation of registered PDD

Month	Time Interval	Monthly CERs in registered PDD (tCO_2e)
2016-12	01/12/2016 – 31/12/2016	6997
2017-01	01/01/2017 – 31/01/2017	7848
2017-02	01/02/2017 – 28/02/2017	9641
2017-03	01/03/2017 – 31/03/2017	12206
2017-04	01/04/2017 – 30/04/2017	14159
2017-05	01/05/2017 – 31/05/2017	15274
2017-06	01/06/2017 – 30/06/2017	15527
2017-07	01/07/2017 – 31/07/2017	15796
2017-08	01/08/2017 – 31/08/2017	14688
2017-09	01/09/2017 – 30/09/2017	13381
2017-10	01/10/2017 – 31/10/2017	10346
2017-11	01/11/2017 – 30/11/2017	7898
2017-12	01/12/2017 – 31/12/2017	6997
2018-01	01/01/2018 – 31/01/2018	7848
2018-02	01/02/2018 – 28/02/2018	9641
2018-03	01/03/2018 – 31/03/2018	12206
2018-04	01/04/2018 – 30/04/2018	14159
2018-05	01/05/2018 – 31/05/2018	15274
2018-06	01/06/2018 – 30/06/2018	15527
2018-07	01/07/2018 – 31/07/2018	15796

Total		**241,210**

E.6. Remarks on increase in achieved emission reductions

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The actual monitored emission reduction (ER) is 256,592 tCO_2e, which is slightly higher than the estimated 241,210 tCO_2e in PDD. The higher actual ER is because the usage time of the cookers is generally higher than the estimated value in PDD in this monitoring period, which leads to the higher actual ER value (The actual average monthly usage time of this monitoring period is 137.39[5] hours. The estimated monthly usage time in PDD is 129.3 hours.). The difference between the actual ER value and estimated value is reasonable.

[5] The entire monitoring period covers totally 608 days, and an average month in a year has 365/12 days. The total usage time during the monitoring period is 2746.24 hours. Therefore, the average monthly usage time during the monitoring period is 2746.24/ [608/ (365/12)] = 137.39 hours.