Monitoring report form for CDM programme of activities (Version 04.0)

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

MONITORING REPORT			
Title of the PoA	Solar Water Heater Program in India		
UNFCCC reference number of the PoA	8855		
Version numbers of the PoA-DD applicable to this monitoring report	Version: 11, Date: 12/02/2020		
Version number of this monitoring report	04		
Completion date of this monitoring report	15/07/2021		
Monitoring period number	07		
Duration of this monitoring period	01/02/2020 to 31/12/2020 (first and last days included)		
Monitoring report number for this monitoring period	01		
Coordinating/managing entity	Nuetech Solar Systems Pvt. Ltd.		
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)	
	India	Yes	
	N/A	N/A	
Applied methodologies and standardized baselines	Methodology: AMS-I.C- Thermal energy production with or without electricity, Version 21.		
Sectoral scopes	Sectoral Scope: 1 : Energy industries (renewable - / non-renewable sources)		
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013 until 31 December 2020	Amount achieved from 1 January 2021
	0 tCO_2	18,264 tCO_2	0 tCO_2
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	30,504 tCO_2		

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

>> The purpose of the small scale Programme is to install Solar Water Heaters (SWHs) in residential as well as commercial buildings throughout India. The program saves electricity generated from fossil fuel by using renewable energy to meet hot water requirement and results in reduction of CO_2 emissions.

SWH is a device that uses thermal energy of the sun to produce hot water for various applications. SWH consists of a solar collector in which a surface area facing the sun collects solar energy, or solar energy is directly used, to heat water. An insulated tank stores the hot water until it is used and pipes finally transfer the hot water to its point of usage. The SWH also includes supporting structures and piping. In most systems, circulation of fluid from the tank through the collectors and back to the tank happens naturally due to thermo-siphon effect. For some, typically larger systems, a pump is used to circulate fluid. These systems have the potential of capturing solar energy, as per one estimate, of up to 1,000 kWh/m^2/year, depending on location[1].

Nuetech Solar Systems Pvt. Ltd. (Nuetech) is the coordinating/managing entity (CME) for this PoA. Its responsibility is to communicate with the CDM Executive Board and coordinate the work relating to validation, verification, registration and issuance of carbon credits generated by the PoA. The PoA is a voluntary activity proposed by Nuetech, the CME of the PoA. The project participant Nuetech is voluntarily taking part in this programme.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
2nd Crediting Period Title: Solar Water Heater Program in India – "CPA-XX" The generic CPA is part of the PoA.	Version 11 dated 12/02/2020.	Sectoral Scope: 1 : Energy industries (renewable - / non-renewable sources)	Methodology: AMS-I.C - Thermal energy production with or without electricity, Version 21.

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
Solar Water Heater Program in India- "CPA-1", Version 11 8855-P2-0001-CP2	Version 11 dated 12/02/2020.	Title: Solar Water Heater Program in India – "CPA-XX" The generic CPA is part of the PoA	Renewable Crediting Type 7 years, 0 months 01/02/2020 to 31/01/2027 (start and end date included)	Yes

[1] *XITHPlan proposals for new and renewable energy* (2006) MNRE, Govt of India

As of now, only CPA-1 (8855-P2-0001-CP2) is part of the second crediting period after renewal. Rest of the included CPAs are still part of First Crediting Period .

This is the first monitoring report of the second crediting period. This Monitoring Report, includes CPA-1, 8855-P2-0001-CP2 and covers the monitoring period 01/02/2020 to 31/12/2020,

A.2. Coordinating/managing entity

>> CME: Mr.Ananth, Nuetech Solar Systems Pvt. Ltd., Bangalore

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

>> A SWH is a device that uses thermal energy of the sun to produce hot water for various applications. A SWH consists of a solar collector in which a surface area facing the sun collects solar energy, or solar energy is directly used, to heat water. An insulated tank stores the hot water until it is used and pipes finally transfer the hot water to its point of usage. The SWH also includes supporting structures and piping. In most systems, circulation of fluid from the tank through the collectors and back to the tank happens naturally due to thermo-siphon effect. For some typically larger systems a pump is used to circulate fluid. Under CPA1 (8855-P2-0001-CP2), two types of solar water heaters are provided, a Flat Plate Collector (FPC) and an Evacuated Tube Collector (ETC).

In the FPC model, which is the simplest and the most common type of solar thermal device, the system works basically on a flat, blackened absorber plate inside the collector. When sunbeams are allowed to strike this plate, heat gets trapped inside the collector. This heats up the water in the copper tubes that run through the plate, causing the water to circulate through the system by natural conduction or convection. The heated water then gets transported to a storage tank placed above the collector, under well insulated conditions, for further channeling to the user point. FPC models typically have a surface area of around 2.0 m^2/100 liters.

In the ETC model, the system works on two concentric tubes made of tough borosilicate glass. The outer tube is transparent and allows sunrays to pass through it with minimal reflection. The outer surface of the inner tube is selectively coated with an ultra-efficient absorber (A1-N/A1) for maximal solar spectrum absorption and minimal heat loss. The tops of the two tubes are fused tight and all gases in the space between the two glass layers are pumped out while exposing the tube to high temperature. The resulting vacuum acts as an excellent insulator just like in a glass-lined thermos flask. ETC models typically have a surface area of around 1.5 m^2/100 liters.

ETC Model

FPC Model

Management system

The objective of the operation and management plan is to make systematic project execution and operation for the purpose of achieving real and measurable emission reductions and supporting the verification process. To achieve this, the following is put in place:

A record keeping system for each CPA under the PoA

The CME, Nuetech Solar Systems Pvt. Ltd. maintains a digital database with all SWH systems in the PoA, with a clear division between the different CPAs. For each SHW installed also a paper copy of the sales record or invoice is kept by the CPA implementer, Nuetech Solar Systems Pvt. Ltd.

A system/procedure that avoids double counting

Double counting can occur if (components of) a proposed CPA are already part of a registered CDM project or part of a different PoA. Double counting is avoided through the unique identification of each SWH through its address or serial number. Unique serial numbers are attached to the collectors and/or the tank. Double counting within the project cannot occur since all systems have a unique serial number and/or address. Each tank and SWH panel gets a unique serial number. The database with details on each individual SWH in the programme is maintained by the CME. CME can periodically check the systems to ensure:

- That the recorded address at which the SWH collectors are installed is still correct,
- That the SWH collectors are still operational (as part of the monitoring procedure),
- That all serial numbers are unique and that the number in the database correspond with the numbers on the tank and/or panel.

In 2017, Nuetech launched a review of the full database with on-site visits, to check the addresses and serial numbers in the database, and make corrections where needed.

The CME has archived the serial numbers of each SWH system that is part of the CPA. The database is maintained in association with the CPAIs and can be used by the CME and the DOE to identify and locate each individual collector sold. The central database and data collection is maintained by the CME and in this case also the CPA Implementer (CPAI),Nuetech Solar Systems Pvt. Ltd. The database supports the following entries for all SWH users:

1. Name of CPA
2. Name of CPA Implementer
3. Name of dealer, if the SWH is supplied through a dealer,
4. Collector type (ETC/FPC) installed,
5. Serial number of the systems installed,
6. Collector area installed (m^2),
7. System capacity (litres),
8. Date of sale,
9. Date of commissioning/installation.
10. Customer name, address, mobile number,
11. State,
12. Capacity of pumps installed (if applicable).

There are three situations in which the address or serial number may change.

- A collector or tank is replaced. In this case typically the owner of the system has to contact the manufacturer to support with the replacement. The manufacturer records these cases and puts the new serial number in the database.
- A collector is moved to a different location. Also here, typically, the dealer or supplier is informed. The new address is recorded in the database.
- The system capacity is increased or decreased. With a decrease in system capacity the capacity in the database is adjusted. With an increase a new entry is added to the database for the new

system[2]. In that case the same address can appear twice in the database but with two different serial numbers. Also in the monitoring plan these are treated as two separate systems.

Changes in the database are recorded while making a comment describing the change and listing the old data. This way, the database will also contain the history of each individual system in terms of changes, replacements, additions or relocations.

If systems have changed or relocated, this is mentioned in the monitoring report. This way the monitoring report also provides insight in the accuracy of the database management.

Double counting of systems in different CDM projects is also avoided in a legal way. Each participant to the PoA signs a statement in which they transfer the title of the CERs ultimately to Nuetech Solar Systems Pvt. Ltd. This is directly to Nuetech or via a different entity, the dealer.

The SSC-CPA in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.

The small scale threshold defined by AMS.I-C is "the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel shall not exceed 45 MW thermal". The calculation in the table below shows the SWH do not individually exceed 1% of the SSC threshold, and that therefore the program is exempted from the de-bundling check.

AMS-I.C threshold

AMS I C Threshold	1% of SSC Threshold	Surface area of SWH distributed through program
45 MW_{th}	0.45 MW_{th}	maximum 640 m^2

The annual average solar radiation defined by the Small Scale Working Group is 700 W_{th}/sq m^3. The maximum surface area of a single system in the PoA cannot exceed 640 m^2. With the given amount of solar radiation such a system would have a capacity of 0.448 MW_{th}, which is below 1% of the small-scale threshold. The CPA comply with this criteria as shown in the CER Calculations excel sheet for CPA1 (8855-P2-0001-CP2) and mentioned in Section D.1.

Provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA.

Each SWH owner participating in the PoA is required to sign a sales agreement in which they transfer the title to the emission reductions to the CPAI or CME. Each CPAI has to sign an agreement with the CME before its participation in the PoA. Nuetech, which is the CME is also the CPAI of CPA1 (8855-P2-0001-CP2).

Most SWH manufacturers rely on local dealers for the promotion, sale and sometimes also installation of the SHW systems. Invoices for the SWH are the verifiable evidence of the sale of a system, since the sale of each SWH should be taxed and communicated to the national government. Therefore, copies of invoices for the purchase of a SWH are used to keep the database with all SWHs up to date. The share of systems that are operational is determined through an annual survey amongst all system users.

[2] The capacity addition cannot be recorded under the existing entry in the database. That would create confusion with the start date and may lead to capacity additions to an already registered CPA, creating a risk that the size thresholds are exceeded. To avoid that, capacity additions is listed as a new system in the database but with the same address as an existing system

[3] SSC WG 07, Annex 3, Analysis and explanation of the conversion factor for solar thermal collectors. https://cdm.unfccc.int/Panels/ssc_wg/SSCWG7_repan3_Convers_fact_solar_collectors.pdf

The main monitoring parameters are different for small and large systems. For small systems the annual energy production is determined through the number of days of operation. These systems are referred to as Category I systems.

For large systems with a capacity of over 45kW_{th}, the energy consumption is determined with energy meters, which meters the water flow and the ingoing and outgoing temperature. These systems are referred to as Category II systems. The General Guidelines to SSC CDM methodologies state that a thermal solar energy project shall define the capacity with a conversion factor of 700W_{th}/m^2. For 45 kW this gives 64 m^2 (Executive Board (EB) meeting 61 Annex 21, paragraph 4). Note in this respect that a system is defined as an individual system that is not physically interconnected with other SWHs.

For small systems, the amount of systems that are operational is determined through an annual survey, which aims at determining the percent capacity of systems and number of days the systems were operational. The survey was done for CPA1 and the details of sample survey and the results are reported in section E.3, based on which the emission reductions are calculated.

B.2. Post-registration changes to PoA

B.2.1. Corrections

>> There were no corrections to PoA-DD (including the generic CPA(s)) project information fixed at validation during the second crediting period during this monitoring period.

B.2.2. Inclusion of monitoring plan

>> There is no inclusion of a monitoring plan to the registered PoA-DD. It was already included at the time of validation and re-registration for 2nd CP of the project activity.

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>> There are no permanent changes to the registered monitoring plan or permanent deviation of monitoring from applied methodologies and other methodological regulatory documents during this monitoring period, which falls under CP2.

B.2.4. Changes to programme design

>> There are no changes to the project design of the registered PoA-DD; to the project design of the generic CPA-DD; and to specific-case CPAs in the PoA-DD under CP2.

B.2.5. Changes specific to afforestation or reforestation activities

>> Not applicable

PART II Monitoring of CPAs

>> The specific case CPA that has undergone inclusion and included in this monitoring report under CP2 of the project is as follows:

- CPA-1**:** Solar Water Heater Program in India-“CPA-1” hereafter referred to as CPA1 (8855-P2-0001-CP2).

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

>>(a) **Purpose of the project activity and the measures taken for GHG emission reductions**

The purpose of CPA1 (8855-P2-0001-CP2) is the installation of solar water heaters (SWHs) in residential as well as commercial buildings, throughout India. The project activity saves electricity generated from fossil fuels, by using renewable energy to meet hot water demand and thus results in a reduction of CO_2 emissions.

CPA1 (8855-P2-0001-CP2): CPA1 includes SWH systems with a total surface area of 59,412 m^2, and a total capacity of 3,192 m^3/day of which 66% are Flat Plate Collectors (FPCs) and the remaining, Evacuated Tube Collectors (ETCs).

(b) Brief description of the installed technology and equipment

A SWH is a device that uses thermal energy of the sun to produce hot water for various applications. A SWH consists of a solar collector in which a surface area facing the sun collects solar energy, or solar energy is directly used, to heat water. An insulated tank stores the hot water until it is used and pipes finally transfer the hot water to its point of usage. The SWH also includes supporting structures and piping. In most systems, circulation of fluid from the tank through the collectors and back to the tank happens naturally due to thermo-siphon effect. For some typically larger systems a pump is used to circulate fluid. CPA1 (8855-P2-0001-CP2) includes two types of solar water heaters, a Flat Plate Collector (FPC) and an Evacuated Tube Collector (ETC).

In the FPC model, which is the simplest and the most common type of solar thermal device, the system works basically on a flat, blackened absorber plate inside the collector. When sunbeams are allowed to strike this plate, heat gets trapped inside the collector. This heats up the water in the copper tubes that run through the plate, causing the water to circulate through the system by natural conduction or convection. The heated water then gets transported to a storage tank placed above the collector, under well insulated conditions, for further channeling to the user point. FPC models typically have a surface area of around 2.0 m^2/100 liters.

In the ETC model, the system works on two concentric tubes made of tough borosilicate glass. The outer tube is transparent and allows sunrays to pass through it with minimal reflection. The outer surface of the inner tube is selectively coated with an ultra-efficient absorber (A1-N/A1) for maximal solar spectrum absorption and minimal heat loss. The tops of the two tubes are fused tight and all gases in the space between the two glass layers are pumped out while exposing the tube to high temperature. The resulting vacuum acts as an excellent insulator just like in a glass-lined thermos flask. ETC models typically have a surface area of around 1.5 m^2/100 liters.

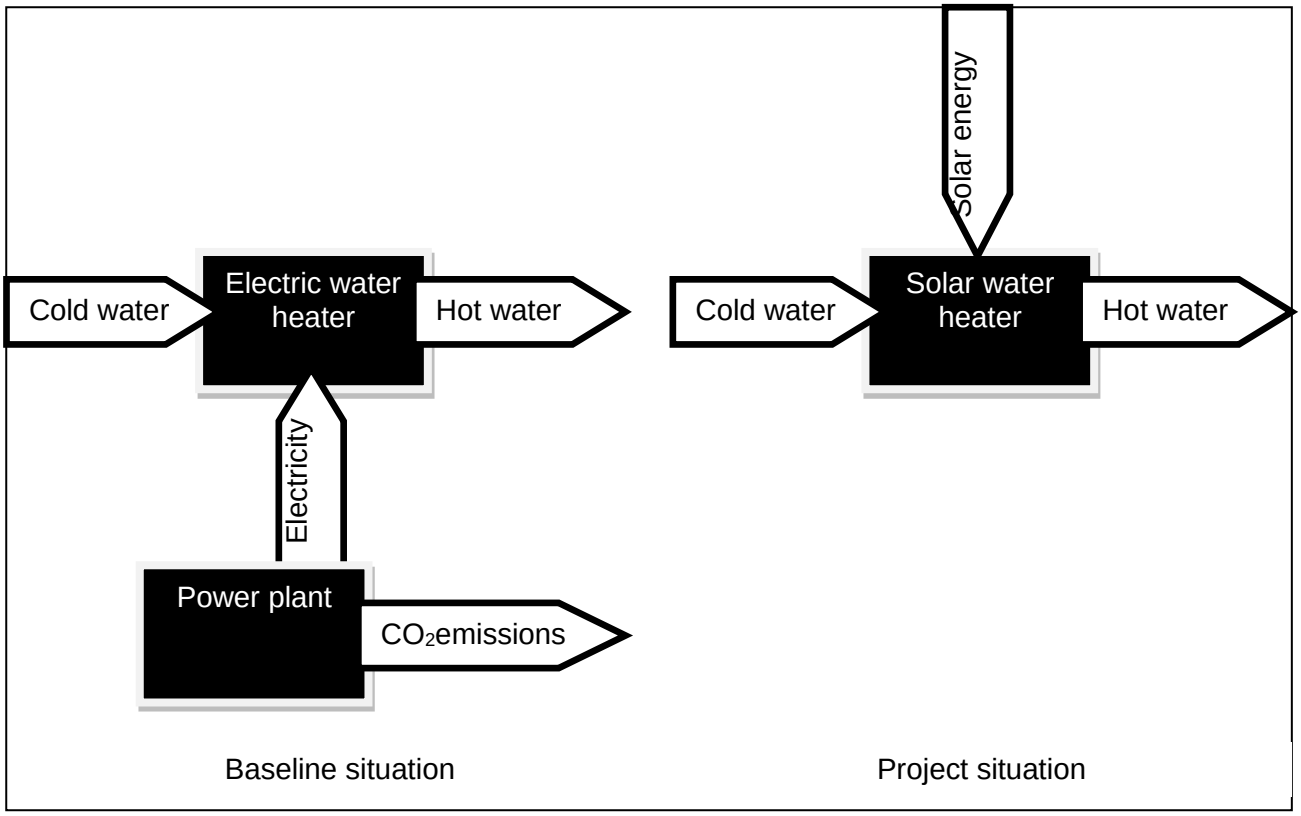


Figure 1: Flow diagram for the baseline (left) and project situation (right).

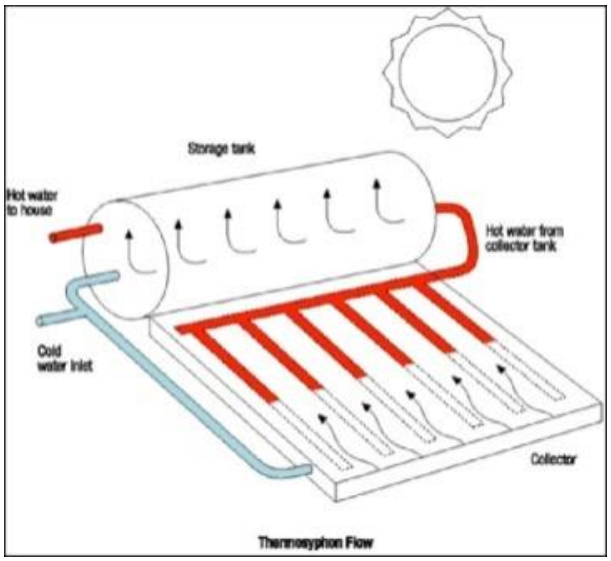


Figure 2: Solar water heating system (example with thermosyphon)

There were no events or situations that impacted the implementation of the project activity during the monitoring period. The implementation was carried out in accordance with the registered CPA-DD.

For a state-wise overview of the SWHs, refer to section C.2.

The details of the implemented project under CPA-1, is as follows:

Parameter	Value for CPA1 (8855-P2-0001-CP2)
Total surface installed (m^2)	59,412
Total capacity installed (l/day)	3,191,975
of which FPC (%)	66%
Small scale limit (m^2)	64,000
Household/SME limit W (1% of small scale limit)	450,000
Household/SME limit (m^2)	640
Limit for Category I units (m^2)	64
FPC Surface area per 100 l capacity (m^2)	2.08
ETC Surface area per 100 l capacity (m^2)	1.43
Number of systems	12,472
of which Cat II (Number)	1
Maximum surface installed of an individual system (m^2)	104
Solar radiation to be used for SSC limit(W/m^2)	700
Capacity of the largest system installed (MW_{th})	0.07
Total capacity installed (MW_{th} – Below 45 MW_{th})	41.59

The monitoring data was monitored and collected in line with the monitoring procedure/plan as described in the CPA-DD and in section E.2. of this MR.

Fullfillment of Eligibility Criteria

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
1	(a) Geographical boundaries	All SWH listed in the proposed SSC-CPA must be within the geographical boundary of India.	The address at which all SWHs are installed, and the state, is recorded in the order form and invoice. The database can only include addresses and states in India.	Data entry into the database only allows Indian states to appear in a drop-down menu. This menu also ensures consistency in spelling of the state names and allows for easy cross-checking of data and use of pivot tables to get an overview of all SWH installed per state

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
2	(d) Specifications of technology/ measure	The technology used under the proposed SSC-CPA consists of a solar energy based water heating system.	The technology that can be used in the CDM project is described in section A.4.2.1. It allows for the use of technologies other than the ETC and FPC systems described there.	Innovation and deviations from the standards ETC and FPC technology will be recorded in the CPA. Any technology that is not a Solar Water Heater will not be included in the PoA. For CPAIs other than Nuetech, this will be checked through the SWH test reports. Internal checking includes limiting data entry into the database by only allowing SWH models to appear in the drop-down menu. New model types can be added to the list as and when they are added to the PoA. Each model type will be connected to a default ratio between the capacity of the system in litres and the surface area. Since this ratio differs only for a few systems that require deviating output temperatures, it does allow for cross-checking.
3	(k) small-scale or microscale threshold	The aggregated surface of the collectors of all systems in the CPA should not exceed 64,000 m^2.[4]	The total surface area of the SWHs will be recorded as part of the CME's database, derived from the installation record.	The total surface area of all the SWHs for CPA-01 is 59,412 m^2, which is less than 64,000 m^2.

[4] Value obtained from Annex 3 of the Small Scale Working Group (SSC WG) Meeting 07.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
4	(f) compliance with the applicability of the applied methodologies	The SSC-CPA follows the baseline and monitoring methodology AMS-I.C. version 21 and should meet its eligibility criteria as discussed in section B.2. of Part II.	The eligibility criteria include that the technology employed are solar water heaters (already covered above), and that the total installed/rated thermal energy generation capacity of the project equipment stays below the small-scale limit of 64,000 m^2.	The total capacity in the CPA is 59,412 m^2, below the small-scale limit of 64,000 m^2. Referring to the next criteria, the largest system it no more than 0.45 MW_{th}. The baseline and monitoring methodologies are applied and fixed in the generic CPA-DD template. This ensures that the approach in AMS-I.C. version 21 and in the PoA-DD is followed in detail.
5	(l) requirements for the debundling check	The SWH collector area of an individual system should not be more than 640 m^2.	The size of each system will be recorded in the order form and installation form entered into the CME database. In the SWH database, which will be used to show the SWH in each CPA as well, a dedicated cell will select the SWH with the largest surface area. This allows for easy checking that the surface stays below 640m^2. Cross-checks will be performed to ensure that the actual SWH capacity corresponds with that recorded in the database.[5]	The largest system in the database has a surface area of 104 m^2, well below 640m^2.

[5] These cross-checks will be implemented from CPA-2 onwards.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
6	(c) CPAs are neither registered as CDM project activities, included in another registered PoAs	Confirmation that this SSC-CPA, nor any of its SWH systems is not yet registered and not being registered as a standalone CDM project by ensuring that the CPAI has the full title over the emission reductions generated by the SWH users listed in the CPA. To confirm this, all owners of the SWH systems in the CPA should have transferred the title to the emission reductions to the CME, either directly or through the CPAI.	Ensure that each SWH owner participating in the PoA signs an agreement in which it ultimately transfers the title to the emission reductions to the CPAI or CME. This agreement can be part of the sales contract. Ensure that each CPAI signs an agreement with the CME before its participation in the PoA in which its commits to signing similar agreements with Nuetech. For CPAIs other than Nuetech the title to the CERs can be transferred to Nuetech directly or through the CPAI, as long as ultimately the title rests with Nuetech.	Each SWH owner participating in the PoA has signed a sales agreement in which it transfers the title to the emission reductions to the CPAI or CME.
7	(b) Conditions to avoid double counting	Each SWH in the SSC-CPA shall be uniquely identified and defined in an unambiguous manner by providing the address, and/or the system serial number of the collectors installed at each location.	The address and serial numbers should be collected at completion of the sales agreement and invoice and entered into the centralised database. Data entry for serial numbers can easily be checked for repetition by ranking on serial numbers.	For each SWH there are either address or serial numbers included in the database.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
8	(e) conditions to check start dates	The start date of the CPA is not after the date of delivery or construction of the first SWH installed. Documented evidence is available to confirm that date. For example an invoice, installation or delivery form	Invoice dates should be recorded in the SWH database. The earliest data will define the start date of the CPA. Ranking the database on date allows for easy checking.	Invoice dates ae recorded in the SWH database. The earliest date is 02/07/2007.
9	(g) demonstration of additionality (i) target group	The CPA is additional according to the criteria for confirmation of additionality for its inclusion into the PoA in section C.	Depending on the method used to demonstrate additionality a record of the following will need to be kept: *Option 1: Off-grid activity* that the market penetration of SWH in households does not exceed 33% on state level, as substantiated by latest publications from, commissioned or funded by the Indian government at the time of CPA implementation. Demonstration that there are no legal obligations to use SWH for water heating in states where the SWH in the CPA are located. *Option 2: Micro-scale* – 1.Each of the independent subsystems in the project activity is smaller than or equal to 4500kW thermal installed capacity, 2.End users of the subsystems or measures are households, communities or SMEs (Tool 19, v08.0).	The largest system in CPA-1 is 104 m2. And has a capacity of 70 kW_{th}. That is below 4500kW. All end-users are households, communities or SMEs.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
10	(h) affirmation on funding from Annex I Parties	A confirmation that no funding from Annex 1 parties has been used for this CPA or that, if used, this did not result in a diversion of official development assistance.	Confirmation will have to be provided as part of the CPA-DD.	No funding has been received from Annex 1 parties.
11	Stakeholder consultation	Stakeholder consultations can be organised for a group of CPAs if they can be demonstrated to be in similar geographic areas and time (start of construction/ implementation within the same two years), similar socio-economic situations, identical activity or technology etc.	Stakeholder consultation minutes, or a confirmation from the CME/CPA Implementer that the meeting is conducted.	Stakeholder's consultation was conducted for CPA-01 on 14th December 2009, the details of which were provided during the first crediting period.
12	Leakage	Leakage is not relevant since there is no energy generating equipment transferred from outside the project boundaries and no second-hand installations will be used in the project.	Confirmation by the CME/CPA Implementer that no second-hand installations have been used in the project.	None of the installations are second-hand installations. They are new installations as evidenced by invoices. A confirmation by Nuetech Solar Systems Pvt. Ltd is provided.

(a) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.);

The project was registered as a PoA on 31/12/2012. The CP2 for the PoA was re-registered on 27/04/2020 and CPA-01(8855-P2-0001-CP2) included under CP2 on 29/04/2020. The start date, the implementation dates and the start date of crediting period for the CPA is shown below:

CPAs	Start date of crediting period	Start date of CPAs	Implementation dates	
			From	To
CPA1 (8855-P2-0001-CP2)	CP1: 01/02/2013 CP2: 01/02/2020	02/07/2007	02/07/2007	31/12/2009

The date of commissioning of each and every SWHs in the CPA is given in the excel sheets: MR-CPA1.xlsx.

(b) Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period

The total GHG emission reductions achieved in this monitoring period is as follows:

Summary of the Project Activity and ERs Generated for the Monitoring Period	
Start date of Monitoring Report of the PoA	01/02/2020
Carbon credits claimed for CP2 up to	31/12/2020

CPAs	**Start of Crediting Period**	**Credits claimed**	
		From	**To**
2nd Crediting Period			
CPA1 (8855-P2-0001-CP2)	01/02/2020	01/02/2020	31/12/2020

Total Emission Reductions (after considering project emissions and leakage)	**18,264 tCO_2**

C.2. Location of CPAs

(a) >> Host Party(ies); India

The geographical boundary of the SSC PoA is Republic of India and the location of the project activity for CPA1 (8855-P2-0001-CP2) is also the Republic of India. The geographic reference is as follows:

Latitude – North 6.75 degree to North 37.10 degree; Longitude – East 68.03 degree to East 97.40 degree [6].

Figure1: Geographical boundary for the SWH India PoA and CPA1 (8855-P2-0001-CP2)

(b) **Region/State/Province:** The states in which the SWHs in CPA1 (8855-P2-0001-CP2), are installed are as follows:

[6] Source: http://www.mapsofworld.com/lat_long/india-lat-long.html

States	**CPA1 (**8855-P2-0001-CP2)
Andhra Pradesh	514
Assam	5
Chattisgarh	
Daman and Diu	6
Delhi (National Capital Territory of)	174
Goa	78
Gujarat	230
Haryana	9
Himachal Pradesh	
Jammu & Kashmir	31
Jharkhand	
Karnataka	9,930
Kerala	1
Madhya Pradesh	3
Maharashtra	1,094
Manipur	
Meghalaya	
Mizoram	
Orissa	
Pondicherry	
Punjab	46
Rajasthan	39
Tamil Nadu	107
Telangana	
Uttar Pradesh	204
Uttarakhand	1
West Bengal	
Total	**12,472**

(c) City/Town/Community: The city is which each of the SWHs is installed is given in the Excel Sheet *MR-CPA1.xlsx.*

(d) Physical/Geographical location: The residential or commercial address at which these SWH units have been installed for CPA1, are given in the Excel Sheet *MR-CPA1.xlsx*.

C.3. Post-registration changes to CPAs

C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents

>> There are no temporary deviations from the registered monitoring plan and applied methodology in the current monitoring period under CP2.

C.3.2. Corrections

>> Under CP2, and under this monitoring period there are no corrections.

C.3.3. Changes to the start date of the crediting period

>> This is CP2 of the project activity and there are no changes to the start date of the crediting period of the specific-case CPA1 (8855-P2-0001-CP2).

C.3.4. Inclusion of monitoring plan

>> There is no inclusion of a monitoring plan into the specific-case CPA. It was already included at the time of validation and re-registration of the project activity under CP2.

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>> There are no permanent changes to the sampling plan that was incorporated in the CP2 of PoA-DD,generic CPA-DD and the specific CPA-1 (8855-P2-0001-CP2).

C.3.6. Changes to project design

>> There are no changes to project design to CPA1 ((8855-P2-0001-CP2).

C.3.7. Changes specific to afforestation or reforestation CPA

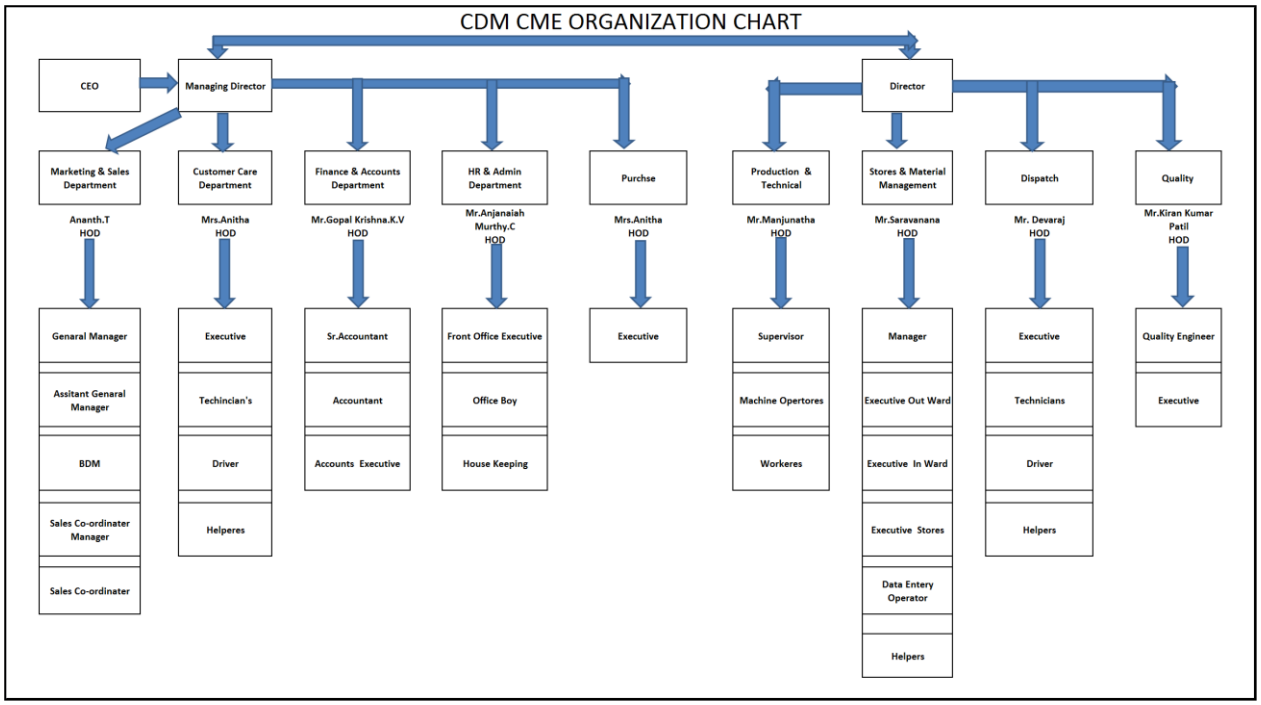
>> Not Applicable

SECTION D. Description of monitoring system of CPAs

>> The monitoring system based on the Project Standard for CPA1 (8855-P2-0001-CP2) is as follows:

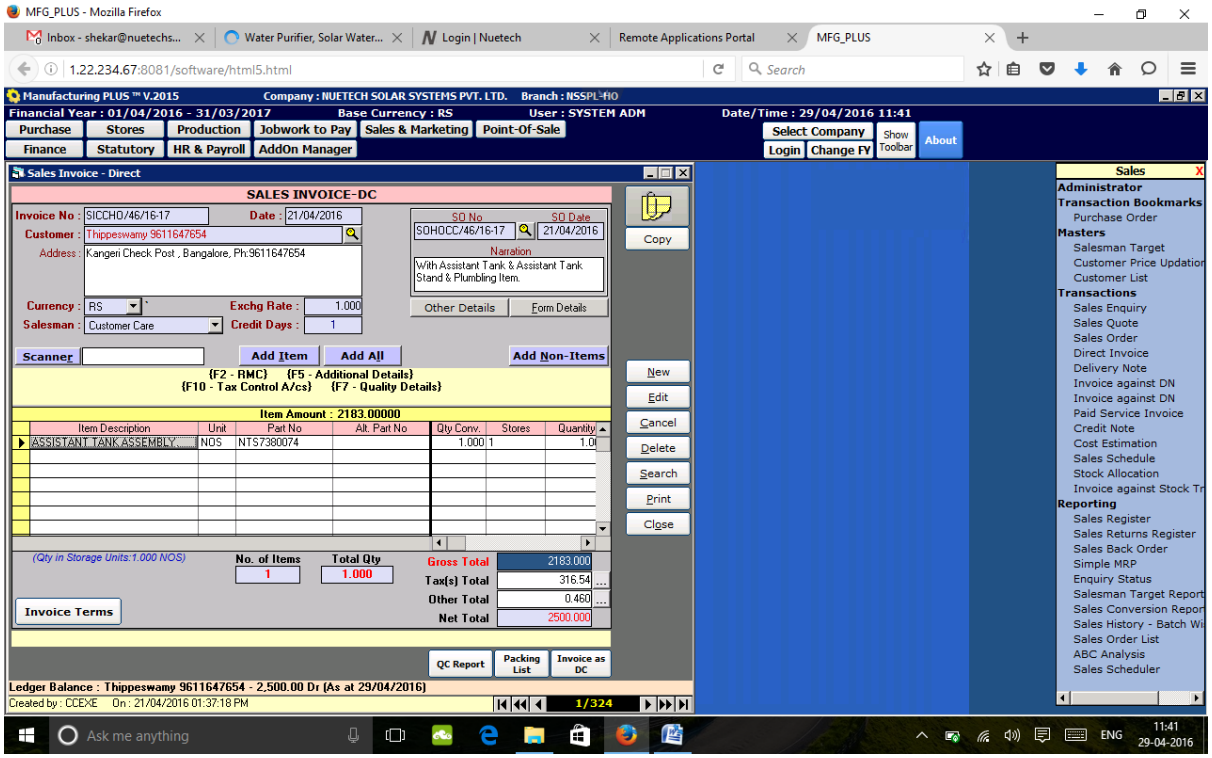
(a) The operational and management structure to implement the monitoring plan

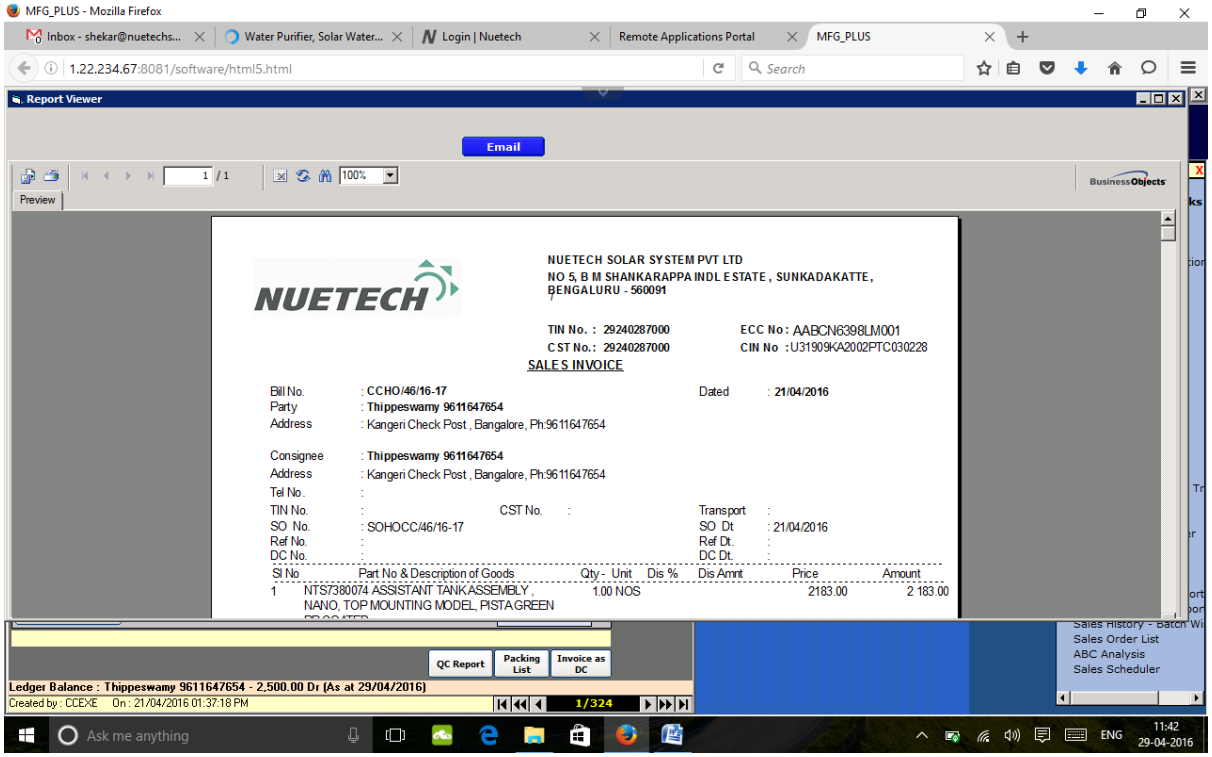
The objective of the monitoring plan is to conduct consistent, clear and accurate monitoring and calculation of emission reductions during the whole crediting period. The CME – Nuetech Solar Systems Pvt. Ltd. – is mainly responsible for the implementation of the monitoring plan for the CPA (CPA1 (8855-P2-0001-CP2). The organogram of the company is as follows:



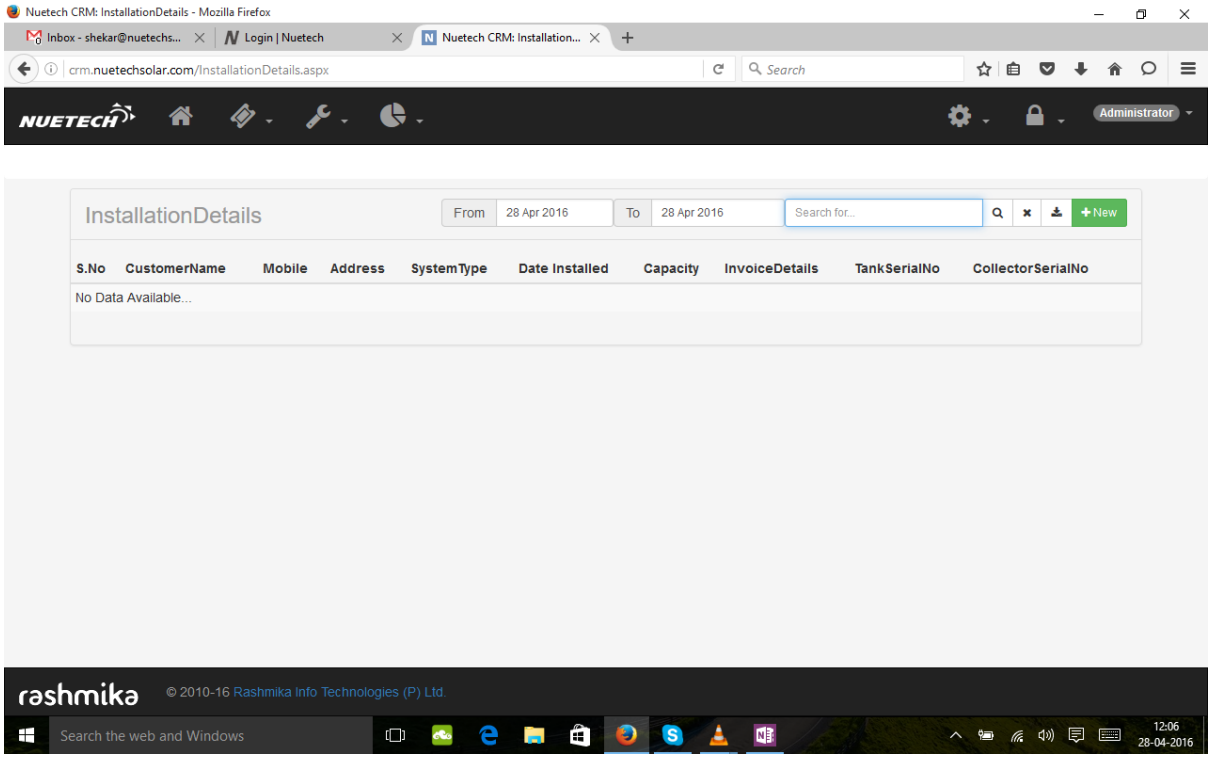
(b) Archiving of Monitoring Data

Nuetech solar have custom made softwares to manage all the activities of the company and its data. The Manufacturing Plus (MFG PLUS) software is used for most of the operational activities, i.e. purchasing of raw material, which notes the material that was purchased through various vendors and quality status of that material. The Dealer Management System Software links to the sales related activities which has the details of the customer data (address and contact number) and links to the serial number of the SWH.





The Customer Support Manager Software (CSM) maintains the maintenance service details such as the description of problems of the SWHs and action take to address the issues. The solar water heater details like collector serial number and tank serial number are recorded in “installation details” module which is entered by installation team after the installation.



The accounts software Tally is not used for any customer related data reference directly but is used for cross reference.

Quality Management Systems (QMS) software is also maintained, which is for maintenance and up grading of manuals and procedure formats for documentation of ISO 9001:2000 certification. This certification is to ensure all the processes are running as per the manual for customer service satisfaction.

The data monitored and required for verification and issuance is kept and archived for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

(c) Responsibilities and Institutional arrangements for data collection and archiving

The roles and responsibilities of the CDM Staff of CME are as follows:

Roles and responsibilities of CDM Staff

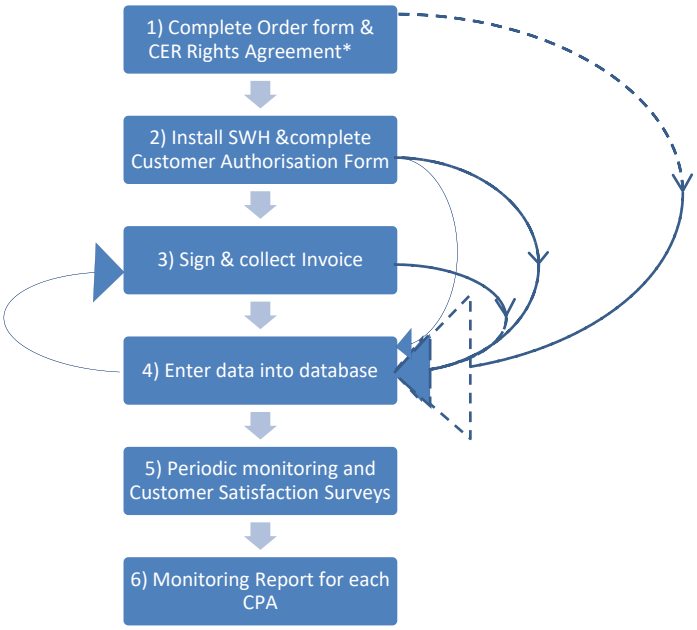
Role	Core responsibility	CDM responsibilities
Managing Director	Coordinates activities of the Customer Care, Finance & Administration and Sales & Marketing Department	Overall responsibility on the integrity of the management system, including database management, for the PoA project.
Director	Coordinates activities of the Production, Technical & Quality and Materials & Dispatch Departments	- Ensure compliance of the SWH with the requirements from the Bureau of Indian Standards (BIS). - Check whether all manufacturers participating in the POA have SWH systems with a performance test report.

Sales &Marketing Department	Keep a record of the sales contracts	- Completion of Sales Contracts. - Ensure that hardcopies of the sales contract are maintained for all SWH and available for third party checking during inclusion. - Periodical Training to staff, Distributors, Dealers and Sub-dealers regarding the modalities and requirements under CDM
Customer Care Department	Carrying out customer satisfaction surveys Forwarding details of any repairs or replacements to the Technical & Quality Department	- Management of the SWH database. - Implementation of CDM monitoring surveys, possibly in parallel to the customer satisfaction reports. Implement regular checking of the database to avoid discrepancies between the database and the actual SWH system installed and to avoid discrepancies with the hardcopy document. - Updating the User information and data periodically. - Receiving and archiving all data and information on all new installation regularly from the Despatch/Logistics Department. - Receiving and checking the data received from other CPAIs. - Periodical Training of CME's internal concerned staff regarding the data archiving, requirements and modalities of CDM PoA. - Periodical Training of CPAI's designated staff regarding the data archiving, requirements and modalities of CDM PoA.
Finance & Administration Department	Archive hard-copies of sales invoices Forward copies of sales invoices to Technical & Quality Department	- Ensure that hardcopy files are available for checking upon inclusion of the CPA. - To evolve and maintain a CDM Secretariat at the CME level. - To scrutinize all new CPAIs, prepare the Agreements/MoUs and all other such documents and store safely as part of the CPAI records - All accounts and financials of each CPA and CPAIs.
Production Department	Product manufacturing (issuing serial numbers for SWH).	- Ensuring the correct, unique and permanent labelling of the SWH tanks and panels and report changes in the serial numbers on each site to the customer care department who maintains the SWH database.
Technical & Quality Control Department	Product testing & development	- Ensure that innovations are recorded in future CPA-DDs with a technical description of the new type of SWH that is being introduced. - To check and keep control of all issued Unique Identification Serial numbers Authenticate any changes / replacements of serial nos. During the life span of the SWHs.

		- Periodical checking and confirmation of other CPAIs that the installed SWHs confirm to the prescribed standards.
Material & Logistics Department	Product transportation, storage	- Product Identification and maintaining a continuing record of the issued serial numbers along with despatch/packing batch nos. To facilitate cross check. - Marking the serial numbers on the packages for easy identification of designated numbers during delivery of SWHs at individual sites. - Organise installation and commissioning of new systems. -Customer training and induction to the SWH(s) regarding O&M during installation and commissioning of the SWH(s). - Taking acknowledgements and signatures of the end users on the delivery notes, Invoice/bills, installation and commissioning certificates and the Customer Authorization Forms (CAFs) at the time of delivery and installation.

Control process for all records and documentation

The process for documentation management for CPA1 (8855-P2-0001-CP2) which are all being managed by Nuetech is as follows:



*CER Rights Agreement refers to the document in which the user confirms the transfer of rights of any CERs to the CME.

Figure 2: Documentation process

The database has three objectives:
1. Recording the number of systems and aggregated capacity of the systems in operation,
2. Keeping up-to-date information on the location and capacity in operation of each system,
3. Avoiding double-counting of systems.

Data recorded in the Order form include:
- Type of SWH model to be installed
- Surface area of SWH model to be installed
- Name and address of user

Data recorded in the CER Rights Agreement as part of the order form include:
- Confirmation of the transfer of rights of CERs to Nuetech Solar Systems Pvt. Ltd.
- Confirmation that the SWH will not be participating in another CDM project

This is physically attached to the Order form and a copy is sent to the Customer Care Department.

At installation of the SWH, the following installation records are completed:
- Confirmation that the building has a connection to the grid
- Company name of the CPA Implementer, which is Nuetech Solar Systems Pvt. Ltd for CPA-1.
- Serial number of SWH
- Reference to the Order form
- Surface area of SWH installed
- System capacity (in litres) of the SWH installed
- If the system has a pump installed, the capacity of the pump should be recorded
- User name, address and contact details.
- Type of user: household, SME, community
- Date of installation

The 'Customer Authorization Form' (CAF), has been individually signed by each Customer/individual participating in CPA-1 and collected at the time of delivery and installation of the SWH(s), that contains all the above data. These forms form the basis for recording of data (soft copy) and the relevant Invoice/Bill numbers which also is included in the CAFs, will allow cross checking.

Even when a system is replaced it is ensured that the serial number of the old system and the date in which it was replaced is recorded. However, other solutions can be applied to this objective as well.

(d) Quality assurance and quality control (QA/QC) procedures

The quality assurance and quality control procedures followed are as follows:
1. All items listed in the database are checked to see if it meets the criteria listed in section C of the PoA-DD. For that purpose all entries listed in section C of the PoA-DD is accurately recorded in the database. The procedures and checks on database entries followed for proper database management is as follows:
   a. Entry data are verified internally.
   b. All entries are completed, including a complete address and the serial number of the system.
   c. Surface of the collector area is recorded. Some systems have a larger surface area than the standard ratio of 2.0 m^2/100 litres for FPC models and 1.5 m^2/100 litres for ETC models to be able to deliver water with different temperatures than the standard 60 degrees. Therefore collector surface as well as system capacity in litres are recorded.
   d. If the system has a pump installed, the capacity of the pump is recorded.
   e. Connection of the building to a power grid is confirmed on each site.

2. The delivery of spare parts is recorded as a replacement in a separate record and not as capacity additions and that the serial numbers of the new systems are recorded.

3. The CER Rights Agreements per SWH in the database are arranged is such a way that all forms are easily found (e.g. sort by date and CPA, or reference number).

4. Procedure to avoid double counting: Double counting can occur if (components of) a proposed CPA are already part of a registered CDM project or part of a different PoA or if SWH systems

are listed double within the PoA. The latter type of double counting is avoided by recording the serial number of each SWH system installed in each CPA and by registering these numbers in the central SWH database together with the address and contact details of the user. That provides different unique identifiers for each system. Within that database checks are performed on duplication of entries.

Double counting of systems in different CDM projects is also avoided in a legal way. Each participant to the PoA signs a statement in which they transfer the title of the CERs ultimately to Nuetech Solar Systems Pvt. Ltd. This is directly to Nuetech or via a different entity, the dealer.

As part of QA/QC procedure of data maintenance, backup procedure of data is also done regularly. Data from the earlier server was backed up by burning data into DVDs. The existing server data is backed up by in built Raid configured mirroring feature in the server, wherein data is automatically fed to another hard disk simultaneously. A back up of the data from here too is being done on DVDs annually.

(e) Uncertainty levels, methods and the associated accuracy level of measuring instruments to be used for various parameters and variables

There are no measuring instruments to be used for any monitoring parameters and variables in CPA1 (8855-P2-0001-CP2) of the PoA.

(f) Specifications of the calibration frequency for the measuring equipment

There is no equipment to be calibrated.

There is one category II system in CPA-1 which has a pump installed. The power consumption and the thermal energy generated by that system have not been monitored. To take a conservative approach on this issue, the system with a pump has been taken out of the emission reduction calculation completely.

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

Data/Parameter	Build Margin Emission Factor
Unit	tCO_2/MWh
Description	Build Margin for Second Crediting Period
Source of data	Based on latest CO_2 Baseline Database for the Indian Power Sector User Guide Version 15.0, December 2019 Government of India Ministry of Power Central Electricity Authority, at the time of submission of CPA-DD for renewal of crediting period. http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver15.pdf
Value(s) applied	0.8811
Choice of data or measurement methods and procedures	This is the second crediting period of CPA-01. As the ex-post option is chosen, according to option 2, for the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 of the Tool. Accordingly, for the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE.
Purpose of data/parameter	Calculation of Baseline Emissions
Additional comments	The BM is the latest available for Unified India and is for the year 2018-19. This is fixed for the entire second crediting period for CPA-01.

Data/Parameter	$V_{catl,n}$
Unit	m^3/day
Description	Aggregated amount of water heated daily in each CPA by Category I systems. Category I systems are SWH with less than 64 m^2 installed surface.
Source of data	Aggregated water capacity of the systems installed in the CPA1 (8855-P2-0001-CP2 by Category I from the sales register of Nuetech Solar Systems Pvt. Ltd.
Value(s) applied	CPAs: CPA1 (8855-P2-0001-CP2) — FPC: 2,113 — ETC: 1,074
Choice of data or measurement methods and procedures	The water capacities of the systems installed are tailored to the needs of the user. The relation with the different SWH types is typically as follows: • FPC uses 2.08m^2 for a 100 litre/day system for CPA1 (8855-P2-0001-CP2 • ETC uses 1.43 m^2 for a 100 litre/day system for CPA1 (8855-P2-0001-CP2),
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	This is the sum of the total capacity of all Category I SWH systems installed in CPA1 (8855-P2-0001-CP2).

Data/Parameter	η_{EWH}
Unit	%
Description	Efficiency of an electric water heater system
Source of data	Methodology AMS-I.C., version 21, paragraph 27.
Value(s) applied	100%
Choice of data or measurement methods and procedures	This value is conservative. 100% efficiency assumes no losses. Electric geysers always have a lower efficiency than a 100%.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	This value will only be used for category I SWH.

Data/Parameter	$Q_{,n}$
Unit	kWh/day/100l
Description	Average amount of energy collected by the SWH during a Thermal Performance Test at day-time under standard conditions for 100l water
Source of data	(FPC) Test Report, (RTC file no 730) Regional Test Centre (Solar Thermal) of the Madurai Kamaraj University, dated 18/07/2011. (ETC) Test Report, (RTC file no 730) Regional Test Centre (Solar Thermal) of the Madurai Kamaraj University, dated 18/07/2011.
Value(s) applied	FPC: 4.6 ETC: 3.17

Choice of data or measurement methods and procedures	The Thermal Performance Test provides a conservative estimate of the amount of heat a SWH delivers. The total energy collected is measured as the change in the energy content of the water in the storage tank during a period of 3.5 hours before and after noon[7].
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	The test procedure is conservative since it measures only 7.0 hours of sunlight, equally spread around noon. In India, the average sunshine hours per year are 2,856, or 7.8 hours per day.[8] In addition, during the daytime hours in which there are no sunshine solar heaters can still deliver hot water.

Data/Parameter	**TDL_y**
Unit	%
Description	Average technical transmission and distribution losses for providing electricity to the category II system
Source of data	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01), EB 39, Annex 7, page 12.
Value(s) applied	20%
Choice of data or measurement methods and procedures	This is the default factor for scenario A for project or leakage electricity consumption sources.
Purpose of data/parameter	Calculation of project emissions
Additional comments	As no category II unit is taken into consideration in this monitoring period, this parameter is included, but not applied throughout the calculation.

E.2. Data and parameters monitored

Data/Parameter	**D**
Unit	days/year
Description	Number of operational days in year y
Measured/calculated/ Default	Measured
Source of data	Annual surveys conducted among users in CPA1 (8855-P2-0001-CP2) for 2020.
Value(s) of monitored parameter	256 days or 6,144 operational hours/year for the installed systems for the year 2020
Monitoring equipment	During 2020, a sample of owners of a category I SWH was approached with a survey to determine to what extent their systems have been used. For this the sampling plan described in B.5.2. of the CPA-DD was used. A key question in this survey was "how many days during the monitoring period did you rely on the SWH system for hot water supply?" (see Annex 6 of the PoA-DD). The outcome of the survey was used to record annually the number of days the systems were operating.
Measuring/reading/recording frequency	Annually

[7] Ministry of New and Renewable Energy, Test Procedure for Thermosyphon –Type Domestic Solar Hot water Systems

[8] See: http://www.climatetemp.info/india, site visited at 1 February 2012.

Calculation method (if applicable)	This value was determined for category I SWHs for CPA1 (8855-P2-0001-CP2). This parameter constitutes parameter 1 in AMS-I.C, version 21, Paragraph 82. SWHs work 24 hours a day, without an on/off switch or are otherwise manually activated during the course of the day. It collects solar energy to heat the water in the tank constantly. Converting to hourly basis, the operational hours @24 hours/day is 256 days/year x 24 hours/day = 6144 hours/year. The survey was performed during January-March 2021 to collect data for the monitoring period.
QA/QC procedures	Stratified Sample Survey was conducted in High and Low Radiation region of India for CPA1 (8855-P2-0001-CP2). The sample size was determined statistically to give 90/10 precision levels. Additional samples were done to account for non-response.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	The survey was conducted for CPA1

Data/Parameter	S_{op}
Unit	%
Description	Share of systems confirmed to be operational
Measured/calculated/ default	Measured
Source of data	Surveys among users in a CPA.
Value(s) of monitored parameter	60.42%
Monitoring equipment	Annually
Measuring/reading/recording frequency	This value will only be determined for category I SWH. This parameter constitutes parameter 1 in AMS-I.C,, version 21. paragraph 82.
Calculation method (if applicable)	The percent capacity of systems operating was determined from the sample survey based on the responses/non responses of the sample survey. Of the total 24,090 l/day capacities surveyed, i.e. 12,390 l/day systems from high radiation and 11,700 l/day from low radiation, there was a response for 9,380 l/day. That is 7,880 l/day for high radiation and 1,500 l/day for low radiation accounting for 63.60% and 12.82% of the capacity surveyed respectively. Applying these percentages to the total capacity installed for the CPA, the aggregate systems operating based on installed capacity is 60.42%.
QA/QC procedures	Systems with non response (After repeated attempts, if there was no contact established with the family members), they have been considered as non-operational. This is conservative since the system could still be operational.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$EG_{thermal,\ CAT\ II,y}$
Unit	MWh/year
Description	The aggregated amount of thermal energy generated by SWH category II unit in monitoring year 2020 (MWh)
Measured/calculated/ default	Measured
Source of data	The monitoring has not been taking place. Therefore, the respective unit is excluded from the ER calculation.
Value(s) of monitored parameter	The monitoring has not been taking place. Therefore, the respective unit is excluded from the ER calculation.
Monitoring equipment	BTU meter installed per unit
Measuring/reading/recording frequency	The monitoring has not been taking place. Therefore, the respective unit is excluded from the ER calculation.

Calculation method (if applicable)	The amount of heat generated per unit will be measured and recorded annually. The BTU meter should be installed to measure the fluid flow on the system outlet (to avoid that water losses in the system are included). The temperature should be metered in both the inlet and the outlet of the system, to include any storage capacity that is part of the system. In case the BTU meters are not installed for the CAT II systems, these systems will not be accounted for emission reduction calculations for the entire crediting period. Also, in case SWH systems with pumps do not have electric meters installed to determine the project emissions, the respective SWH systems will not be included for emission reduction calculations too. This is a conservative approach, as the emission reductions from the systems are much higher than the project emissions from the use of flow pumps.
QA/QC procedures	Maintenance of BTU meters according to the requirements of the manufacturer. BTU readings will be recorded annually. Where large differences occur with previous readings, an explanation will be sought from the user and archived.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	This value is determined only for category II SWH. This parameter constitutes parameter 7 of AMS-I.C. version 21, paragraph 82.

Data/Parameter	$EC_{PJ,n,y}$
Unit	MWh/unit/year
Description	Quantity of electricity consumed by the Category II system in 2020
Measured/calculated/ default	Measured
Source of data	Electricity meter
Value(s) of monitored parameter	The monitoring has not been taking place. Therefore, the respective unit is excluded from the ER calculation.
Monitoring equipment	Among the installed units in CPA1 (8855-P2-0001-CP2), there is one system with pump. Because the electricity consumption of this system was not monitored, this unit is excluded from the calculation of emission reduction.
Measuring/reading/recording frequency	Continuous measurement and at least monthly recording. Among the installed units in CPA1 (8855-P2-0001-CP2), there is only one system with pump. Because the electricity consumption of this system was not monitored, this unit has been excluded from the calculation of emission reduction.
Calculation method (if applicable)	Calculations are not applied as the monitoring has not taken place.
QA/QC procedures	Not applicable
Purpose of data/parameter	Calculation of project emissions
Additional comments	In case SWH systems with pumps do not have electric meters installed to determine the project emissions, the respective SWH systems will not be included for emission reduction calculations too. This is a conservative approach, as the emission reductions from the systems are much higher than the project emissions from the use of flow pumps.

Data/Parameter	$EF_{CO2,grid,n,y}$
Unit	tCO_2/MWh
Description	The CO_2 emission factor of the grid to which system n is connected
Measured/calculated/ default	Calculated
Source of data	Based on latest CO_2 Baseline Database for the Indian Power Sector User Guide Version 16.0 March 2021, Government of India Ministry of Power Central Electricity Authority

Value(s) of monitored parameter	2nd Crediting Period: 0.8997
Monitoring equipment	For the ex-post calculations latest CO_2 emission factor of the Indian grid has been used. Since this is the 2nd crediting period, wOM=0.25 and wBM= 0.75 is applied, following *TOOL07 Methodological tool: Tool to calculate the emission factor for an electricity system* Version 07.0, paragraph 86
Measuring/reading/recording frequency	Latest emission factor during the submission of monitoring report.
Calculation method (if applicable)	As per the registered PoA and CPAs, for each monitoring report the latest value for the Indian national grid baseline is used. The carbon intensity of the grid is updated as per AMS-I.D. The calculations method is based on the "Tool to calculate emission factor for electricity systems " (Version 07) It is the latest set of data available at the time of verification.
QA/QC procedures	There are no QA/QC procedures. The emission factor is calculated from the CEA database.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	This parameter constitutes parameter 2 in AMS-I.C,, version 21. paragraph 82.

E.3. Implementation of sampling plan

>> A specific-case CPA level sampling plan was conducted. It has been done as a sampling survey covering CPA-1 (8855-P2-0001-CP2).

Implementation of sampling plan(s)

The monitoring plan is based on AMS-I.C. version 21 for CP2, and describes the ways in which data is gathered that is needed to determine the emission reductions. The sampling plan is applied for CPA1 (8855-P2-0001-CP2). The essence of the monitoring plan is to gather data on the energy delivered by the SWH systems, which determines the amount of electricity that is saved by the programme.

The following parameter was monitored through sample survey to determine the actual emission reductions ex post.[9]

1. Continuous operation of the equipment/system (including a sampling plan)

A sample of owners of a category I SWH for CPA1 (8855-P2-0001-CP2) were approached with a survey to determine to what extent their systems have been used. Key question in this survey was "How many days during the last 335 days did you rely on the SWH system for hot water supply?". The average outcome of the question was used to determine the number of days the systems has been operating for the monitoring period. The survey was implemented at a sample of SWH users included in the CPA. For sampling plan, 90/10 confidence/precision levels was followed[10].

The monitoring parameter in AMS-I.C. version 21, "Continuous operation of the equipment/system for CAT I systems" has two components:

- Recording annually the number of systems operating
- Estimating the annual hours of operation of an average operational system

[9] AMS-I.C., version 21, paragraph 82.

[10] CDM-EB67-A06-GUID. Guideline Sampling and surveys for CDM project activities and programmes of activities Version 04. 0EB 69, The sampling plan in table 9 is based on section 6. Recommended outline for a sampling plan.

Both components of this parameter were monitored using survey methods according to the methodology.

The number of systems operating was determined through the sample survey and applied to quantify the total heat generated from the capacity installed in the CPA. In effect, emission reductions is claimed only from the share of systems which is operational. The survey results on the systems that are no longer operational, is not used to calculate the share of the capacity of the sample which is operational. Since systems vary in size, this can have a slightly different outcome from just counting the number of systems which is operational. The share of the capacity in the survey which is operational, is used to determine the capacity, and resulting heat output and emission reductions for the whole population of SWHs in the CPAs.

Table 2: Sampling design.

Objective	Determine how many days the systems have been operating during the monitoring period.
Reliability requirements	90/10 confidence/precision levels were applied.
Target population	The population of Category I SWH systems in CPA1 (8855-P2-0001-CP2). A sampling plan for category I systems for CPA1 was applied. The reliability requirements will be 90/10 confidence/precision and also the sample size was determined using this criterion.
Sampling method	Stratified sampling: The Category I systems were divided in systems located in regions with relatively high radiation and systems located in regions with lower radiation. The number of days of operation shows to what extend the system can meet the demand of the user throughout the year. This differs typically depending on the latitude in which the systems are located. Whether a system is a low radiation or high radiation area was determined according to the state in which the SHW is located, following the overview in Appendix 4 of the PoA-DD. If the results from the actual samples fail to achieve the target minimum levels of precision, the CPAI(s) shall perform additional data collection that is a supplemental or new sample to reach the required precision level.
Sample size	The sample size depends on the number of Category I systems located in states with relatively high solar radiation and in states with relatively low solar radiation (see Appendix 4 of the PoA-DD). The sample size was determined with equation (21) of the guideline for sampling and surveys for CDM project activities and programmes of activities Version 4., CDM-EB67-A06-GUID, which is as follows: $$n \geq \frac{1.645^2 NV}{(N-1) \times 0.1^2 + 1.645^2 V}$$ $$V = \left(\frac{SD}{mean} \right)^2$$ Where: n = Sample size N = Total number of SWHs Mean = Mean SD = Standard Deviation 1.645 = Represents the 90% confidence required Overall Standard Deviation: $$SD = \sqrt{\frac{(g_a \times SD_a^{\ 2}) + (g_b \times SD_b^{\ 2})}{N}}$$ Where: SD = Weighted overall standard deviation,

SD_a is the standard deviation for SWHs in high solar radiation states and
SD_b is the standard deviation for SWHs in low radiation states.

g_a = size of the group in high solar radiation
g_b = size of the group in low solar radiation
N = Population total

mean = $\frac{(g_a \times m_a) + (g_b \times m_b)}{N}$

where:
mean = weighted overall mean
m_a = mean of high solar radiation states
m_b = mean of low solar radiation states

Further, proportional allocation to high solar radiation and low solar radiation was done based on the proportion of the strata to the total SWHs for the CPA as follows:

$n_a = \frac{g_a}{N} \times n$ and $n_b = \frac{g_b}{N} \times n$

n_a is the sample size for high radiation and n_b for low radiation

In anticipation of a certain amount of non-response the survey included a larger sample than the minimum required according to the formula above.

The expected proportion was updated based on the sample survey undertaken during 2019-20.

The Excel based sample size calculator available on the UNFCCC website[11] was used to determine the sample size using the sheet “Stratified – Mean”.

Reliability Calculations: To demonstrate that the conducted sample meets the confidence and precision level, the following analysis was made:

Based on the guideline on sampling and surveys for CDM activities and programme of activities (CDM-EB67-A06-GUID), Version 4, the calculation for level of precision was done as follows:

m_{strat} ± z value x s.e. (m_{strat})

Where
m_{strat} is the stratified estimated overall mean
z value corresponding to 90% confidence level (for a single CPA)
s.e. (m_{strat}) = standard error of the stratified estimated overall mean

The m_{strat} is calculated as

$$m_{Strat} = \sum_{i=a}^{k} \frac{g_i}{N} \times m_i$$

Where:

m_{Strat}	=	The stratified estimated overall mean
g_i	=	Size of the i^{th} group (CPA) where i=a,…,k
N	=	Population total
m_i	=	Mean of the i^{th} group (CPA) where i=a,…,k

[11] https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20150813144045237/Meth_guid48Calculator.xlsx

	The standard error of stratified estimated overall mean was calculated as follows: $$s.e.(m_{Strat}) = \sqrt{\sum_{i=a}^{k} \left(\frac{g_i}{N}\right)^2 \times \left(1 - \frac{n_i}{g_i}\right) \times \frac{SD_i^2}{n_i}}$$ Eq Where: $s.e.(m_{Strat})$ = Standard error of the stratified estimated overall mean g_i = Size of the i[th] group (CPA) where i=a,…,k N = Population total n_i = Number of sampled units in the i[th] group (CPA) where i=a,…,k SD_i^2 = Variance of the i[th] group (CPA) where i=a,…,k Reliability was calculated as follows: Reliability, expressed as a percentage, is quantified using the following equation: $$Reliability = \frac{0.5 \times Width\ of\ Confidence\ Interval}{Estimated\ Stratified\ Overall\ Mean} \times 100$$ Equation (50)
Sampling frame	The category I systems was divided in two strata. The first consists of systems in states with high radiation and the second of systems in states with lower radiation (see Appendix 4 of the PoA-DD).
Field measurements	The survey targets days of operation in the year before the survey is conducted. The timing therefore is not relevant. The survey was done during January-March 2021.
QA/QC	The value targeted was the number of operation days of the system. The response was verified with verification questions. These questions are listed in Appendix 6 of the PoA DD.
Analysis	The average result for the number of days of operation in the sample was used in the monitoring report. The results was corrected for the size of the individual systems that were surveyed. Non-response was not be taken into account (see also: Sampling method above).
Implementation Plan	Data collection was performed by surveyors or local contact persons of the CMEs. The surveyors visited the household and captured the details of the survey on a App. Data processing took place centrally by the CMAI(s) or CME by staff which is qualified to process data in excel or a different statistics processing or spread sheet programme, whose knowledge of statistics is/are at least sufficient to implement the Standard. Due to partial lockdown in India to tide over the pandemic and some of the households not allowing entry into their homes, remaining surveys were conducted telephonically.
Result of the sample survey	**Sample size calculations:** A CPAI may choose not to approach all owners of a category I system but survey a sample of the owners, as long as the sampling and survey approach meets the criteria in the General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities. The sample size depends on the number of Category I systems located in relatively high solar radiation and low solar radiation states. Based on the sampling survey conducted during the previous monitoring period for the year 2019-20, the sample size required across the low radiation and high radiation is as follows. The excel sheet based sample size calculator available in the CDM website was used to calculate the sample size using the “Stratified – Mean” Excel Sheet. **Number of strata** | 2

Stratum	expected mean, m	expected standard deviation, s	population size, g
High Radiation	287.45	19.10	12,002
Low Radiation	254.76	22.77	470

Sample Size Determination for a Mean Parameter	confidence/ precision criterion
Survey design: Stratified random sampling Calculation method: Precision via confidence interval	90/10
Input	**Value**
Confidence level	90%
Relative precision	10%
z multiplier	1.645
Overall mean	286.21
Overall variance	370.601
V, ratio of variance to mean squared	0.005
Population size, N	12,472
Predicted sample size, n	2
Individual stratum sample sizes in column H summing to	3
Stratum	**proportional allocation**
High Radiation	2
Low Radiation	1

As the sample size returns a value less than 30, Student's t distribution was used. The student t-distribution test was conducted for the overall sample size and for strata I of high radiation and strata II of low raditation after applying response rate @75.48%. The iterated value till there is no change in the value of sample size n gives a value of 4 for the total sample size. Iteration high radiation high radiation gave a value of 4 sampled. For low radiation strata, with a sample size value of 1, the iterated value gives an error. Hence increasing it to 2, the iterated value is 18 till there is no change in the value of sample size.

Survey Details: Based on sampling conducted for previous monitoring period, the response rate was 75.48%. Applying this response rate @ 75.48% for the determination of sample size, the sample size is 4. Rounding off, the proportional sample size for high and low radiation is 4 and 1 respectively.

	High Radiation	Low Radiation	Total
Number of Units	12,002	470	12,472
Number of operational units based on response rate during previous MP			75.48%
Minimum sample size	2	1	3
Sample size@75.48% response rate	4	1	5
Sampled Units	50	20	70

Oversampling i.e. 50 for high radiation and 20 for low radiation was done as good practice and is higher than the iterated value based on student's t-test.

The CME decided to sample a larger number of SWHs than the CDM guidance requires. The samples were randomly selected from existing data of SWHs in Microsoft Excel. Random selections are useful for creating fair, non-biased samples for data collection. The survey was conducted during January-March 2021. In total,

70 samples with representation in Low Radiation and High Radiation were conducted. The details of the samples are as follows:

High Radiation	Low Radiation	Total Sample
50	20	70

Oversampling was done to account for outliers.

Survey results with abysmally "low number of non-sunshine days" has been revised to conservatively 60 days. This is based on the estimate that India has on average 300 clear sunny days, according to several sources, including Krishna, B., 2013[12]. Proportionally for 335 days for this monitoring period 60 of non-sunny days is considered. The average mean days of operation was 256/335 days at 90/10 confidence/precision level for CPA1. Thus 256 days has been applied to calculate the emission reductions.

Calculation of mean and precision level of the surveyed data:

Applying the calculations for determining mean of stratified random sampling (m_{strat}), the estimated mean is 256 operational days for the monitoring period (Feb-Dec 2020). The mean is applied to estimate emission reductions for CPA1.

The analysis to demonstrate that the conducted sample size meets the minimum requirements of 90/10 confidence/precision level, shows that reliability is 3.29%.

Years	**High Radiation**	**Low Radiation**	**Total**
Mean (Number of operational days)	259.65	185.00	
Standard Deviation	37.86	0.00	
Number of Samples	50	20	70
Total Number of Systems	12,002	470	12,472
Overall Mean	256		
Overall Standard Deviation	37.14		
m_{strat}	256.83		
SE(m_{strat})	5.14		
SD (Overall SD)	37.14		
Confidence Interval	8.46		
Reliability	3.29%		

Thus the required confidence/precision has been met.

The details of the sample survey and the Microsoft Excel sheet are submitted to the DOE for verification.

The number of systems confirmed to be operating

The number of systems confirmed to be operating was determined through the sample survey and applied to quantify the total heat generated from the capacity installed in the CPA. In effect, emission reductions are conservatively claimed only from the share of systems which is operational. The percent capacity of systems operating was determined from the sample survey based on the responses/non

[12] http://www.joace.org/uploadfile/2013/0705/20130705030359508.pdf

responses of the sample survey. Of the total 24,090 l/day capacities surveyed, i.e. 50 systems from high radiation and 20 from low radiation, there was a response for 9,380 l/day. That is 7,880 l/day for high radiation and 1,500 l/day for low radiation accounting for 63.60% and 12.82% of the capacity surveyed respectively.

Capacity of systems operating based on sample survey

Stratum	Response (l/day)	Not Responded (l/day)	Total (l/day)	Percentage Response
High Radiation	7,880	4,510	12,390	63.60%
Low Radiation	1,500	10,200	11,700	12.82%
Total	9,380	14,710	24,090	

Applying these percentages to the total capacity installed for CPA1, the aggregate systems confirmed to be operating based on installed capacity is 60.42%.

Strata	**Capacity of the systems installed from all CPAs (l/day)**	**Operational Capacity based on Survey results**	**Share of systems confirmed to be operational for 2019-2020 based on sample survey**
High Radiation	2,992,265	1,903,071	
Low Radiation	199,710	25,604	
Total	3,191,975	1,928,675	**60.42%**

Thus 60.42% of installed capacity is confirmed to be operational, which is considered for emission reductions. Essentially, only 60.42% of heat generated annually for Feb-Dec 2020 is considered for emission reduction calculations.

Reliability test for proportion of systems operational	
Pstrat (stratified estimated overall proportion)	0.6042
s.e. (pstrat)	0.0040
confidence interval (90%) [1.645 x s.e.pstrat)	0.0079
Reliability	1.10%

The analysis to demonstrate that the conducted sample size meets the minimum requirements of 90/10 confidence/precision level, shows that reliability is 1.10%. Thus the required confidence/precision has been met for the proportion of operational units too.

The survey was performed after the monitoring period for which the survey is used, i.e. January-March 2021.

2. Net quantity of thermal energy supplied by the project activity during the year y[13]

According to the registered generic CPA-DD and the specific CPA - CPA1 (8855-P2-0001-CP2) for all category II SWH, continuous monitoring will demonstrate the total amount of thermal energy supplied. For this purpose BTU meters have to be installed for all these systems. For systems that do not have a BTU meter installed, the energy production will be assumed to be zero.

Among the installed units in CPA1, there is only one Category II system. Because the thermal energy supplied from the systems was not monitored with BTU meters, this unit is excluded from the calculation of emission reductions. As mentioned in the registered CPA1, since the system do not

[13]AMS-I.C. version 21, paragraph 82, Parameter Table 7.

have a BTU meter installed, the energy production is assumed to be zero. This is conservative since the system is likely to be operated just like the category I systems.

3. CO_2 emission factor for the grid electricity in year y[14]

According to the registered CPA, the carbon intensity of the grid will be annually updated. For each monitoring report the latest value for the Indian national grid baseline is used. The latest emission factor as given by the CEA is used which is explained in section E.1.[15]

4. Electricity consumption by the project[16]

Some systems will have a forced flow pump installed. All systems with a pump will have a power meter installed to determine the project emissions.

In CPA1 (8855-P2-0001-CP2), there is 1 system with flow pump installed. Since it was not monitored, the emission reduction from the system is also not accounted.

SECTION F. Calculation of emission reductions or net anthropogenic removals

Emission reductions are calculated as the difference between the baseline emission from displaced electricity and the sum of the project emissions (PEy) and leakage (LEy).

ERy= BEy - (PEy + LEy)[17]

In which:

Symbol	Description	Unit
ER_y	Emission reductions by the project activity during a given year *y*	tCO_2e/year
BE_y	Baseline emissions of the project activity during the year *y*	tCO_2e/year
PE_y	Project emissions of the project activity during the year y	tCO_2e/year
LE_y	Leakage emissions in the year *y*	tCO_2e/year

See the ER calculation spread sheet for the details of emission reductions calculations.

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

>> This section is in line with what is elaborated on PoA level and generic CPA-DD and specific CPA - CPA1 (8855-P2-0001-CP2) for baseline emissions calculations.

The baseline scenario for a CPA is that electricity is imported from the grid for water heating by consumers:

$$BE_{thermal,CO2,y} = \sum_{n=1}^{n=N} \frac{EG_{thermal,n,y}}{\eta_{EWH}} \times EF_{CO2,grid,y}$$

In which:

$BE_{thermal, CO2,y}$	The baseline emissions from steam/heat displaced by the project activity during the year y	(tCO_2e/year)

[14]AMS-I.C, version 21, paragraph 82; Parameter Table 2.

[15] Based on latest CO_2 Baseline Database for the Indian Power Sector User Guide Version 15.0, December 2019 Government of India Ministry of Power Central Electricity Authority, http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver15.pdf

[16]AMS-I.C, version 21, paragraph 82; Parameter Table 9.

[17] AMS-I.C.Version 21, para 81.

$EG_{thermal,y}$	The net quantity of steam/heat supplied by the project activity during the year y	(GJ/year)
η_{EWH}	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity	-

Determination of Baseline Emission Factor Estimation ($EF_{CO2,grid,y}$)

The Baseline Emission Factor Estimation will be based on the latest report of the Central Electricity Authority (CEA). At the time of Validation of this CPA, Version 7 of Tool 07 is applied.

The baseline emission factor estimation is based on Methodological Tool ("Tool to calculate emission factor for electricity systems" (Version 07). The latest emission grid factor is used to calculate the emission reductions. The emission factor is derived from the latest version as given by the CEA[18] The steps as provided in the PoA-DD are followed:

Step 1: Identify the relevant electricity systems.

To select the relevant grid system, official publication of the Government of India for the purpose of CDM baselines has been used, this is based on the most recent data available with the Central Electricity Authority (CEA). This database is based on "Tool to Calculate the Emission Factor for an Electricity System". Therefore, the latest CO_2 Baseline Database for the Indian Power Sector User Guide Version 16.0 March 2021, Government of India Ministry of Power Central Electricity Authority, has been used. The grid emission factor is calculated for a unified India, which is used for estimation emission reductions for the project activity.

For the purpose of determining the operating margin emission factor, option a), for imports from connected electricity systems located in another host country(ies), the emission factor is 0 tons CO_2 per MWh.

Step 2: Choose whether to include off-grid power plants in the project electricity system (Optional)

Option 1 has been followed for the project activity i.e. only gird power plants are included in the calculations.

Step 3: Select a method to determine the operating margin (OM).

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on the following method:

(a)Simple OM;

CO_2 Baseline Database for Indian Power Sector, Version 16.0, published by Central Electricity Authority has been referred for the values of Operating Margin.

For simple OM, the emissions factor needs to be calculated based on ex-post option as the emission factor is determined ex-post at the time of Monitoring Report. Based on the Tool, if the ex- post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year *y-1* may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year

[18]Based on latest CO_2 Baseline Database for the Indian Power Sector User Guide Version 16.0, March 2021, Government of India Ministry of Power Central Electricity Authority, https://cea.nic.in/wp-content/uploads/baseline/2021/06/2019_20_CO2_database.zip

proceeding the previous year *y-2* may be used. The same data vintage (*y, y-1* or *y-2*) should be used throughout all crediting periods.

The chosen year to calculate grid emission factor is y-1, which will be followed for throughout the crediting period. If the data of y-1 is not available on CEA website, the second option would be y-2 that will be applied. If that option is also not available, other sources will be relied upon to estimate the grid emission factor in line with the relevant tool.

For calculating simple OM, the data of (y-1) i.e. 2019-20 is considered for the current monitoring period. This is the latest data (Version 16) available from the CEA for Indian Grid.

Step 4: Calculate the operating margin emission factor according to the selected method.

The Simple OM

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

To calculate the operating margin, the year 2019-20 is considered as it is the latest data available for Unified India.

The simple operating margin CO_2 emission factor in year y-1 (tCO2/MWh) $EF_{grid,OMsimple,y}$ is 0.9555 for Unified India Grid.

Depending on the year of availability of data on CEA website, year y-1 will be chosen. If data of y-1 is not available, y-2 will be chosen alternatively.

Step 5: Calculate the build margin (BM) emission factor.

Based on the Tool, this is the second crediting period of CPA-01. As the ex-post option is chosen, according to option 2, for the second crediting period, the build margin emissions factor shall be determined ex ante, as described in Option 1 of the Tool.

The BM Emission Factor calculated and considered for the entire second crediting period as given in the registered CPA-DD for CPA-01 is 0.8811 tCO_2/MWh.

Step 6: Calculate the combined margin (CM) emissions factor.

The weighted average CM method (option a) is the preferred option in the Tool and has been chosen to calculate $EF_{grid,CM,y}$

Based on the Tool, as this is the second crediting period, the CO_2 Emission Factor (baseline emission factor) is calculated as the combination of the OM and BM emission factors with the weightage value of $W_{OM} = 0.25$ and $W_{BM} = 0.75$.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} w_{BM}$$

Where,

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)
w_{OM}= 0.25 w_{BM}= 0.75

Hence, the Baseline Emission Factor is calculated as below:

Combined Margin CO_2 Emission Factor (tCO_2/MWh)	
India	**0.9555 x 0.25 + 0.8811 x 0.75 = 0.8997**

This set of data is the latest available at the time of verification and hence applied for this monitoring period.

Calculations for $EG_{thermal}$

For the calculation of the baseline emissions, the same approach has been used for both Category I and Category II systems. The baseline emissions are calculated using Method 2 from section E.6.2. of the PoA-DD. Formula 3 of the PoA-DD is therefore applied to both Category I and Category II systems

$$EG_{thermal,n,y,catI} = \frac{V_{catI,n} \times Q_n \times D}{100}$$

$$EG_{thermal,n,y,catII} = \frac{V_{catII,n} \times Q_n \times D}{100}$$

Where:

Symbol	Description	Value (FPC)	Value (ETC)	Unit
$V_{catI,n}$	Amount of water heated daily in the CPA by Category I system n	2,113	1,074	m^3/day
$V_{catII,n}$	Amount of water heated daily in the CPA by Category II system n	5	0[19]	m^3/day
Q_n	Average amount of energy collected by the SWH during a Thermal Performance Test at day-time under standard conditions for 100l water	4.6	3.17	kWh/day/100l
D	Number of operational days in year y	256/335 days		days

Kindly refer to the MR- CPA1 (8855-P2-0001-CP2 excel sheets for the calculations of all the installations.

Which gives (formula 2 from the PoA-DD):

$$BE_{thermal,CO2,y} = \sum_{n=1}^{n=N} \frac{EG_{thermal,n,y,catI}}{\eta_{EWH}} \times EF_{CO2,grid,n,y} + \sum_{n=1}^{n=N} \frac{EG_{thermal,n,y,catII}}{\eta_{EWH}} \times EF_{CO2,grid,n,y}$$

gives:

Symbol	Description	Value	Unit
$EF_{CO2,grid,n,y}$	The CO_2 emission factor of the grid to which systems is connected	**0.8997**	tCO_2e /MWh
$EG_{thermal,\ CAT\ I,y}$	The net quantity of steam/heat supplied by the project activity from Category I systems during the year y. Combined heat for all units, that are operational (@ 60.42% operational based on sample surveys).	20,300	MWh for the monitoring period
$EG_{thermal,\ CAT\ II,y}$	The net quantity of steam/heat supplied by the project activity from Category II	0	MWh for the monitoring period

[19]Not considered for ER calculations.

	systems during the year y[20]		0
η_{EWH}	The efficiency of an electric water heater	100%	%
$BE_{thermal,\ CO2,y}$	The baseline emissions from steam/heat displaced by the project activity during the year y (@ 60.42% confirmed to be operational based on sample surveys)	18,264	tCO_2e for the monitoring period

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

>> The project emissions of CPA1 (8855-P2-0001-CP2) have been calculated as follows:

$$PE_{EC,y,n,II} = \sum_{n=1}^{N} EC_{PJ,n,y} \times EF_{CO2,grid,n,y} \times (1 + TDL_y) \quad (5)$$

gives:

Symbol	Description	Value	Unit
$PE_{EC,y,n,II}$	Project emissions from electricity consumption by category II system n from the grid during the year *y*[21]	0	tCO_2e/year
$EF_{CO2,grid,y,n}$	The CO_2 emission factor of the grid to which systems is connected	**2nd Crediting Period: 0.8997**	tCO_2e /MWh
$EC_{PJ,n,y}$	Quantity of electricity consumed by the Category II system n in year *y*	0	MWh/year
TDL_y	Average technical transmission and distribution losses for providing electricity to the category II system	20	%

Since the 1 pump in CPA1 (8855-P2-0001-CP2) was not monitored, the emission reduction from this system too has not been accounted. Thus, the project emission is also not accounted for this monitoring period.

F.3. Calculation of leakage emissions

>> There is no leakage from CPAs as there is no transfer of energy generating equipment from another activity.

[20]Not considered for ER calculations

[21] There is only one system with a pump, located in Karnataka; hence the emission factor of the Southern grid applies.

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

CPA UNFCCC reference number	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 until 31/12/2020	From 01/01/ 2021	Total amount
8855-P2-0001-CP2 (**CPA-1)**	18,264	0	0	0	18,264		18,264
Total	18,264	0	0	0	18,264		18,264

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

The monitoring period is from 01/02/2020 to 31/12/2020 (inclusive of both the days). This is multiplied with the ex-ante estimated emission reduction to estimate the value for the monitoring period (33,236 tCO_2/365 days x 335 days).

Accordingly, the estimated value in ex-ante calculations in the included CPA-DD(s) and actual values achieved by the specific-case CPA(s) during this monitoring period is as follows:

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante for this monitoring period in the CPA-DD (t CO_2e)
8855-P2-0001-CP2 (**CPA-1)**	18,264	30,504

F.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the CPA-DD"

>> The ex-ante amount estimated for this monitoring period for CPA1 (8855-P2-0001-CP2) is based on the parameters as given in the CPA. The defining parameters that determine the emission reductions for a monitoring period are the i. net quantity of heat supplied by the project activity of Cat I and Cat II systems of all the installed SWHs, ii. the number of operational days of SWHs in an year and the iii. grid emission factor.

Ex-ante amount estimated in the CPA-DD for this monitoring period are estimated for the net quantity of heat supplied by all the installed SWHs (100% operational) at an average of 280 operational days in an year with the grid emission factor determined during the year of validation. An average of 280 days is a very conservative approach as the average sunny days in an year in India is 300 days according to several sources, including Krishna, B., 2013[22].

F.6. Remarks on increase in achieved emission reductions

>> There is no increase in achieved emission reductions. The actual GHG emission reductions achieved is lesser than that estimated ex ante in the CPA-DDs.

F.7. Remarks on scale of small-scale CPAs

>> The small scale CPAs of the PoA belong to only Type I for which the limit is 45 MW_{th}. As shown in section C.1. and ER calculations sheet, the total capacity installed for each of the CPAs is less than 45 MW_{th}.

[22] http://www.joace.org/uploadfile/2013/0705/20130705030359508.pdf; http://www.sunwattindia.com/whysolar.html

CPAs	**CPA1 (8855-P2-0001-CP2)**
Total capacity installed for the CPA (MW_{th} – Below 45 MW_{th})	41.59

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Document information

Version	*Date*	*Description*
04.0	6 April 2021	Revision to: • Reflect the “Clarification: Regulatory requirements under temporary measures for post-2020 cases” (CDM-EB109-A01-CLAR).
03.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
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