

Gold standard for the global goals Monitoring report



June 2017, version 1

Title of the project	Solar DC programme in off-grid regions in India
Gold Standard project id	GS7467
Version number of the monitoring report	1.1
Completion date of the monitoring report	21/03/2020
Date of project design certification	Not yet completed
Start date of crediting period	21/03/2018
Duration of this monitoring period	(21/03/2018) to (20/03/2019)
Duration of previous monitoring period	1 st Monitoring Period
Project representative(s)	Value Network Venture Advisory Services PTE LTD.
Host Country	India
Certification pathway (activity certification/impact certification)	Impact statements & Product
SDG Contributions targeted (as per approved PDD)	<p>1 – Good health and well-being (SDG 03) : Target 3.9.1 Mortality rate attributed to household and ambient air pollution .</p> <p>2 – Affordable and Clean Energy (SDG 7) : Target 7.3.1 Energy intensity measured in terms of primary energy and GDP :</p> <p>3 – Climate Action (SDG 13) . Target 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning</p>
Gold Standard statement/product certification sought (GSVER/ADALYs/RECs etc.)	GS VER
Selected methodology(ies)	CDM small scale methodology, AMS III BL, version 1.0
Estimated amount of annual average certified SDG impact (as per approved PDD)	<p>1 – SDG 03 - Reduction in smoke related illness due to use of Solar DC home electricity system instead of fossil fuel.. 100% users provided positive feedback</p> <p>2 –SDG 7 – 50,000 households are accessed to clean and energy sources</p> <p>3 – SDG 13 36,605 tCO₂e</p>
Total amount of certified SDG impact (as per approved methodology) achieved in this monitoring period	<p>1 – SDG 03 - : 100% users responded positively to improvement in health and illnesses</p> <p>2 –SDG 7 – 40,595 households are accessed to clean and energy sources</p> <p>3 – SDG 13 - 29,719 tCO₂e</p>

SECTION A. Description of project

A.1. Purpose and general description of project

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The project involves the installation of solar DC based PV systems for household users that displace fossil fuel use, such as in fuel-based lighting systems in those households which are not connected to the regional/national grid

Today, India is pushing for a future powered by Solar Energy with a vision of 50% of electrical power from renewable technologies by 2030. But, so far decentralized rooftop solar deployments have all been subsidy driven and haven't really made significant inroads into Indian homes. However, this narrative is, today, being changed by Solar DC Inverterless solution.

Developed by Indian Institute of Technology Madras (IITM), Solar DC Inverterless systems offer the most efficient way of utilizing solar power without compromising on affordability.

The Solar DC concept works. Solar DC Inverterless solution includes solar PV generating DC power, battery charging and discharging in DC, and DC loads with wiring at home which is DC

Solar DC electrification for rural communities: The project involves the installation of a solar DC system for each home powered by a rooftop solar panel by Cygni Energy Pvt Ltd. Each consumer is provided with a small sized battery, inverter-less converter, bulbs, fan, a mobile charging unit and a socket.

The technical specifications of the solar DC based PV set-up are:

PV roof top array : 200 Peak capacity in Wp

1 Inverterless controller

1 Li-ion /lead acid Battery

1 DC mobile charger socket

5 DC bulb

1 BLDC ceiling fan

Solar PV system with a suitable PV array capacity will be installed on the roof of households. Under the "Average Daily Solar Radiation", the minimum electrical output could be 0.2kw. The PV Modules are warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

The number of consumers that falls under each group or type is mentioned below –

Type	Project technology/measure		
	Individual System	Mini-Grid	Grid Extension
I	40,595 HH	0	0
II	0	0	0
III	N/A	0	0
IV	0	0	0

Thus, 40,595 household consumers will be included under type I , Individual system, since Solar DC system will be disseminated in individual households only.

The designation of consumer type (i.e. Type I) has been done only once, at start date of the project inline to the applied methodology AMS III BL. Ver 01.0 para 23.

The project is a retroactive project. The start date of the project is 21/03/2018 which is the date of 1st installed solar DC systems. As per GS rule start date can be the date one year before the first date of

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submission to GS. The first submission date to GS is 20/03/2019 and therefore, solar DC system commissioned from 21/03/2018 onwards are taken in the project activity. This was the date when first solar DC systems were installed. The Solar DC systems are in continued operation during this monitoring period.

Sl no	State	Number of Solar DC system installed
1	Assam	23004
2	Meghalaya	210
3	Manipur	4932
4	Madhya Pradesh	1033
5	Jammu & Kashmir	7934
6	Rajasthan	3482

The project involves 40,495 solar DC home electricity system in various villages Assam, Meghalaya, Manipur, Madhya Pradesh, Jammu & Kashmir & Rajasthan from 21/03/2018 onwards until 20/03/2019

A.2. Location of project

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Host country :India

State	Geo-coordinates
Assam	26° 8' 52.9548" N and 91° 43' 52.9572" E.
Manipur	24° 48' 50.2812" N and 93° 57' 1.0044" E
Meghalaya	25° 29' 14.6004" N and 90° 24' 45.8460" E
Madhya Pradesh	23° 15' 0" N, and 77° 25' 1.2" E
Jammu & Kashmir	34° 5' 1.1616" N and 74° 47' 50.5356" E
Rajasthan	27° 23' 28.5972" N and 73° 25' 57.4212" E

A.3. Reference of applied methodology

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Type – I – Renewable energy project

Methodology – AMS- III. BL- “Integrated methodology for electrification of communities”

Version – 1.0

Reference - <http://cdm.unfccc.int/methodologies/DB/XJQ7APPRHQWLO6VSC3161I5Q8MCMNQ>

A.4. Crediting period of project

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Start date of crediting period - 21/03/2018

Length of crediting period – 5 years renewable

SECTION B. Implementation of project

B.1. Description of implemented project

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Considering the eligibility of start date (i.e. 21/03/2018), project developer has taken Solar DC system commissioned from 21/03/2018 onwards until 20/03/2019. Total 40,595 Solar DC systems are commissioned until 20/03/2019, which are taken in this monitoring period.

States	Total installation number
Assam	23004
Manipur	4932
Madhya Pradesh	1033
J & K	7934
Meghalaya	210
Rajasthan	3482
Total HH	40,595

B.2. Post-registration changes

B.2.1. Temporary deviations from Certified Key Project Information, Project Design Document, Monitoring & Reporting Plan, applied methodology or applied standardized baseline

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N/A

B.2.2. Corrections

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N/A

B.2.3. Changes to start date of crediting period

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N/A

B.2.4. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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N/A

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B.2.5. Changes to project design of approved project

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N/A

SECTION C. Description of monitoring system applied by the project

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Below are the monitoring parameters and monitoring arrangements applied to estimate the emission reductions.

Parameter	Purpose	How
SDG 13: Operational status of solar DC system systems covered in the project activity during the monitoring period (Proportion of operational systems and connections)	This is to calculate the baseline emissions	Survey is done applying sampling plan as per monitoring plan. Survey results are applied conservatively for the entire population.
SDG 13: Electricity consumption at Type I	This is to calculate the baseline emissions	once at installation as per manufacturer's specification
SDG 13: Number of Household	This is to calculate the baseline emissions	Survey is done applying sampling plan as per monitoring plan. Survey results are applied conservatively for the entire population.

The below sustainable development parameters are monitored:

Parameter	Purpose	How
SDG 03: Good Health and well-being	This is to ensure the project results health improvement of end users and decrease in illness contributing the sustainable development.	Qualitative survey is done applying sampling plan as per monitoring plan.
SDG 07: Ensure access to affordable, reliable, sustainable and modern energy for all	This is to ensure the project results in access to clean & sustainable energy	Qualitative survey is done applying sampling plan as per monitoring plan.

Project developer Cygni Energy Pvt Ltd and Value Network Venture Advisory Service PTE LTD maintain all records as per monitoring plan. In addition, a continuous grievance mechanism system is in place for the project to records any grievance whenever received and its status.

SECTION D. Data and parameters

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

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
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Data/parameter	Emission factor for type I consumer(EF CO ₂ , T ₁ -upto 0.055 MWh/year)
Unit	tCO ₂ /MWh
Description	Emission factor for type I consumer(EF CO ₂ , T ₁)-upto 0.055 MWh/ year
Source of data	Default value, AMS III BL, version 1.0
Value(s) applied	6.8
Choice of data or Measurement methods and procedures	Default value for type I consumer upto 0.055 MWh/year
Purpose of data	Baseline emission calculation
Additional comment	

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter	(EF CO ₂ , T ₁ -Between 0.055 to 0.125 MWh/year)
Unit	tCO ₂ /MWh
Description	Emission factor for type I consumer(EF CO ₂ , T ₁ -Between 0.055 to 0.250 MWh/year)
Source of data	Default value, AMS III BL, version 1.0
Value(s) applied	1.3
Choice of data or Measurement methods and procedures	Default value for type I consumer between 0.055 to 0.250 MWh/year
Purpose of data	Baseline emission calculation
Additional comment	

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter	(EF CO ₂ , T ₁ -For the portion greater than 0.250 MWh/year)
Unit	tCO ₂ /MWh
Description	Emission factor for type I consumer(EF CO ₂ , T ₁ -For the portion greater than 0.250 MWh/year)
Source of data	Default value, AMS III BL, version 1.0
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	Default value for type I consumer between 0.250 to 0.500 MWh/year
Purpose of data	Baseline emission calculation
Additional comment	

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
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Data/parameter	Solar Availability factor
Unit	%
Description	Annual average solar availability factor based on manufacturer's data
Source of data	Manufacturer's data
Value(s) applied	20.24%
Choice of data or Measurement methods and procedures	As per Option D3 under para 54 of applied methodology AMD III BL, ver 01.0
Purpose of data	Baseline emission calculation
Additional comment	

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter	Annual hours
Unit	hr
Description	Annual hours
Source of data	As per methodology foot note 11 under page 19
Value(s) applied	8760
Choice of data or Measurement methods and procedures	
Purpose of data	For calculating energy consumption
Additional comment	

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter	Type of DC equipment installed at households
Unit	No
Description	Type of DC equipment installed at households DC Fan, DC LED Bulb & DC mobile Charging point/ socket
Source of data	Distribution records
Value(s) applied	PV roof top array - 1no Inverterless controller - 1 no Li-ion Battery/ lead –acid battery – 1 no BLDC FAN – 1 no, DC LED Bulb – 5 Nos & DC mobile Charging socket – 1 no
Choice of data or Measurement methods and procedures	During installation the information will be recorded
Purpose of data	For calculating the energy consumptions
Additional comment	

D.2. Data and parameters monitored

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter:	$EC_{T_1, X, Y}$
Unit	MWh
Description	Electricity consumption at Type I,
Measured/calculated/default	Calculated
Source of data	Distribution records
Value(s) of monitored parameter	0.355
Monitoring equipment	NA
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Option D – recording of capacity at installation, based on manufacturer's specifications. Deemed consumption will be estimated as described in paragraphs 54, 55 and 56. Annual checks that individual systems are still working, done with a statistically significant sample of consumers. Use 90/10 precision for annual checks
QA/QC procedures:	Sales database/ installation records are cross checked
Purpose of data:	Baseline emission calculations
Additional comments:	Only used for monitoring option A, option B and option D. Options C is not included because it is calculated from other parameters

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter:	Proportion of operational systems and connections
Unit	No of units
Description	Check for continued operation
Measured/calculated/default	Measured
Source of data	Sample survey
Value(s) of monitored parameter	100%
Monitoring equipment	NA
Measuring/reading/recording frequency:	Annual

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Calculation method (if applicable):	Annual checks that individual systems are still working, by taking a statistically significant sample of consumers. Use 90/10 precision for annual checks.
QA/QC procedures:	Periodic cross checking of database
Purpose of data:	Baseline emission calculations
Additional comments:	Only used for individual energy systems applying monitoring Option D

Relevant SDG Indicator	SDG 13: 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
Data/parameter:	Number of Household(Ny)
Unit	Number
Description	Total number of household where the DC based solar system is installed
Measured/calculated/default	Calculated
Source of data	Distribution records
Value(s) of monitored parameter	40595
Monitoring equipment	NA
Measuring/reading/recording frequency:	Continuous
Calculation method (if applicable):	NA
QA/QC procedures:	Cross check with the end user through periodic site visits/ phone calls
Purpose of data:	Baseline emission calculations
Additional comments:	

Relevant SDG Indicator	SDG 3 (Good health and well being) 3.9.1 Mortality rate attributed to household and ambient air pollution
Data/parameter:	Air Quality
Unit	Qualitative (%)
Description	Users' perception on smoke reduction and Incidence of disease
Measured/calculated/default	Calculated
Source of data	Sample survey records

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Value(s) of monitored parameter	<table border="1"> <thead> <tr> <th rowspan="2">Smoke reduction</th> <th colspan="2">Total</th> </tr> <tr> <th>Number</th> <th>Percent</th> </tr> </thead> <tbody> <tr> <td>Reduced drastically</td> <td>50</td> <td>100%</td> </tr> <tr> <td>Reduced to some extent</td> <td>0</td> <td>0%</td> </tr> <tr> <td>Not reduced at all</td> <td>0</td> <td>0%</td> </tr> </tbody> </table>			Smoke reduction	Total		Number	Percent	Reduced drastically	50	100%	Reduced to some extent	0	0%	Not reduced at all	0	0%
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	Number	Percent															
Respiratory diseases	0	0%															
Eye infection	1	2%															
Cough	3	6%															
Monitoring equipment	NA																
Measuring/reading/recording frequency:	Annually																
Calculation method (if applicable):	Air quality will be assess through users interviews during the solar DC home lighting system User Survey. Observations as to inside/outside cooking area to confirm answers. During the survey HH users will be interviewed for the number of disease related caused by the smoke and also the number of times they (HH) visit hospitals for treatment related to breathing problems in the monitoring year																
QA/QC procedures:																	
Purpose of data:	Sustainable development assessment																
Additional comments:																	

Relevant SDG Indicator	SDG 7 (Affordable and clean energy) 7.1.2. Proportion of population with primary reliance on clean fuels and technology
Data/parameter:	Access to affordable and clean energy services
Unit	Numbers
Description	Total number of household where the DC based solar system is installed
Measured/calculated/default	Calculated
Source of data	Distribution / installation records
Value(s) of monitored parameter	40595 solar DC home lighting system are covered in the project, which are in operation during the monitoring period. Hence, 40,595 households are accessed to clean and affordable energy services
Monitoring equipment	NA
Measuring/reading/recording frequency:	Annually

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Calculation method (if applicable):	Sample survey to confirm if solar DC home lighting system are operational. Operational status will confirms that the users are accessed to affordable and clean energy
QA/QC procedures:	Cross check with the end user through periodic site visits/ phone calls
Purpose of data:	Sustainable development assessment
Additional comments:	

D.3. Implementation of sampling plan

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(a) Sampling Approach:

i. Objectives and reliability requirements: The objective of the sampling plan is to achieve unbiased and reliable estimates of the proportion or the mean value of the key variables over the crediting period. As per the sampling and survey standard (EB 105 annex 1, version 8, para 11) in case "where there is no specific guidance in the applicable methodology, project proponents shall use 90/10 confidence/precision as the criteria for reliability of sampling efforts for small-scale project activities and 95/10 for large scale project activities."

Since it is small scale project and PP has opted for the annual inspection, the survey has been conducted to achieve the confidence/precision of 90/10 and this is in accordance with the requirements set out as per the sampling standard.

Parameter	Description	Method
"Proportion of operational systems and connections" of the solar DC system	Number of units in operation	Sample survey, annually

ii. Target Population

The target population is the total number of operational solar DC systems for which the emission reductions has been accounted for the monitoring period.

iii. **Sampling frame**

All beneficiaries with installed solar PV systems have been in the sampling frame.

iv. **Sampling Method**

A simple random sampling has been adopted for estimating the sample size for the monitoring surveys. Simple random sampling is suited to populations that are homogenous (EB 105 annex 01).

v. **Sample Size**

The calculation of the required sample size for each parameter has been calculated at 90/10 confidence/precision as required for the annual monitoring. The sample size is determined using the Guidelines for Sampling and Surveys for CDM Project activities and Programme of Activities Ver. 4.0 (EB86, Annex 4)

The minimum sample size is determined as follows:

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$$n \geq \frac{1.645^2 N \times p(1 - p)}{(N - 1) \times 0.1^2 \times p^2 + 1.645^2 p(1 - p)}$$

Where,

n= sample size

N = Total number of solar DC system installed under the project

P = expected proportion (0.9)

1.645 = represent the 90% confidence required

0.1 = represent the 10% relative precision

The value for N will be included into the equation for each monitoring period to get the sample size for the monitoring survey.

Data.

(i) Field measurements:-

1. Checking of a representative sample of Solar DC system within the project to ensure that they are still operating (Proportion of operational systems and connections).

Total Population (N)	40595
Expected proportion (p)	90%
Sample size (n)	31
Sample considered in actual for survey	50
Monitored operating fractions	0.98

The selection of households are done using online tool

'Stattrek random number' (<http://stattrek.com/statistics/random-number-generator.aspx>).

On a conservative side, 50 samples are taken for survey.

2. The survey has been conducted annually with the objective to target 10 percent precision and to achieve 90 percent confidence.

vi. Quality Assurance/Quality Control

A survey questionnaire has been prepared to seek responses of operating status of solar DC PV units. The survey has been performed by the project developer.

The project developer has collect, compile and analyse the data to derive the number of beneficiaries, the solar PV system in operation, and other events. The developer has prepared monitoring report based on the survey report.

SECTION E. Calculation of SDG outcomes

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

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SDG indicator 13:

According to methodology AMS III.BL version 1.0, emission reductions has been calculated as:

$$BE_{T1,y} = \sum_{x=1}^N (EC_{T1,x,y} \times EF_{CO2,T1})$$

Now consumption for type I is

$$EC_{T1,x,y} - EC_{T1,x,y}$$

The detailed calculation is shown below

Description	Capacity(KWh)	Unit	Remarks
Solar DC system output rating	200	W	As per technical specification
Annual hours	8760	h	As per AMS III BL, ver 1.0
Default solar availability factor as per meth	20.24%	%	As per manufacture/supplier
Electricity delivered by the solar DC home system per year (Electricity consumed)	355	KWh	As per 54 and as per foot note 11 of AMS III BL,ver 1.0.
Total number of consumer or Households (Ny)	40595	numbers	As per project database
ECT1,x,y	0.355	MWh	Calculated
Emission factor for type I consumer(EF CO2, T1-upto 0.055 MWh/year)	6.8	tCO2/MWh	Default emission factor as per AMS III BL, ver 1.0
Emission factor for type I consumer(EF CO2, T1-Between 0.055 to 0.250 MWh/year)	1.3	tCO2/MWh	Default emission factor as per AMS III BL, ver 1.0
Emission factor for type I consumer(EF CO2, T1-greater then 0.250 MWh/year)	1	tCO2/MWh	Default emission factor as per AMS III BL, ver 1.0
BE T1 upto 0.055MWh/year	0.374	tCO2/year	Calculated
BE T1 between 0.055 to 0.250MWh/year	0.2535	tCO2/year	Calculated
BE T1 greater than0.250MWh/year	0.1046	tCO2/year	Calculated
Proportion of operational systems and connections	1.0	fraction	sample survey
Total Baseline emission, BET1,y	29719	tCO2/year	Calculated

Since,

$$BE_y = BE_{T1,y}$$

Therefore baseline emissions during the monitoring period is = 29,719 tCO₂/y

SDG 3: For 'Improvement in health and decrease in illness' the baseline situation is poor due to usage of fossil fuel which generates smoke and leads to health problems pertaining to smoke.

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SDG 7: For 'access to affordable and clean energy services' the baseline scenario can be described as poor due to that fact that fossil fuel based home lighting practice leads to generation of smoke as well as harmful CO₂ in the atmosphere.

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

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SDG Indicator 13:

Project emissions: As per the PDD and applied methodology project emissions from the project activity is zero.

SDG 3: For 'Improvement in health and decrease in illness' a qualitative assessment was done through survey and results from end users response shows that health problems related to smoke is reduced.

SDG 7: For 'access to affordable and clean energy services' the survey result shows that all surveyed plants are in operation which justifies that all project plants are in operation during the monitoring period. This means that the project leads to clean energy services to the users.

E.3. Calculation of net benefits as difference of baseline and project values or direct calculation for each SDG outcome

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SDG 13:

In line with the applied methodology and PDD, PEy & Leakage are 0. Therefore, the net benefit is

The emission reductions from the project are:

= BEy

= 29,719

= 29,719 tCO₂/y

SDG 3: For 'Improvement in health and decrease in illness' a qualitative assessment was done through survey and results from end users response shows that health problems related to smoke is reduced.

SDG 7: For 'access to affordable and clean energy services' the survey result shows that all surveyed plants are in operation which justifies that all project plants are in operation during the monitoring period. This means that the project leads to clean energy services to the users.

E.4. Summary of ex-post values of each SDG outcome for the current monitoring period

Item	Baseline estimate	Project estimate	Net benefit
SDG 13	36,605	0	29,719
SDG 3	100% users are not connected to the regional or nation grid and are using fossil fuel for home electricity which is leading to problem in smoke related health issues	No user confirmed problem	100% users responded positively.
SDG 7	100% users were accessed to traditional fossil fuel based home lighting system which is not a clean form of energy	No user continued traditional fossil fuel based home lighting system during the monitoring period	100% users are accessed to clean and affordable energy sources

Year-wise emission reductions:

Period	Baseline Emissions	Project Emissions	Leakage Emissions	Net Emission reductions
21/03/2018 to 31/12/2018	23287	0	0	23287
01/01/2019 to 20/03/2019	6432	0	0	6432

E.5. Comparison of actual value of outcomes with estimates in approved PDD

Item	Values estimated in ex ante calculation of approved PDD	Actual values achieved during this monitoring period
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SDG 13	36,605	29,719
SDG 3	100% users are not connected to the regional or nation grid and are using fossil fuel for home electricity which is leading to problem in smoke related health issues	100% users responded positively.
SDG 7	100% users were accessed to traditional fossil fuel based home lighting system which is not a clean form of energy	100% users are accessed to clean and affordable energy sources

E.6. Remarks on difference from estimated value in approved PDD

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The difference is due to the reason of decrease in the number of beneficiary as estimated in the PDD.

SECTION F. Stakeholder inputs and legal disputes

F.1. List all inputs/grievances which have been received for the project during the monitoring period together with their respective answers/actions

>> No grievance received during the monitoring period.

F.2. List all inputs/grievances from previous monitoring period where follow up action is to be verified in this monitoring period

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

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

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

