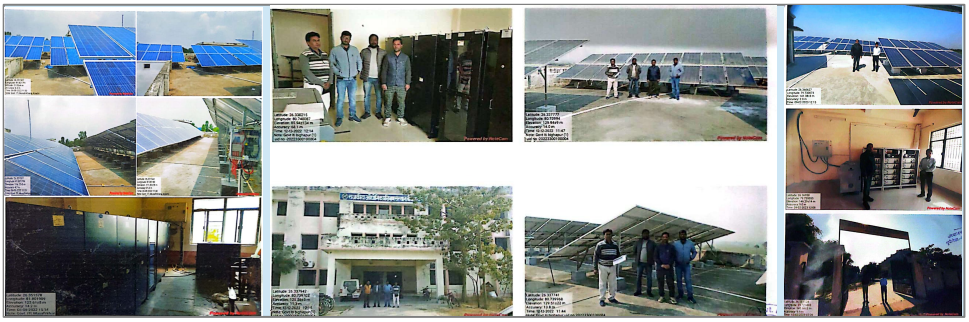
PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT



Title: 107.69 MW bundled Rooftop Solar Project in Uttar Pradesh by UPNEDA

Version 1.1

Date 03/09/2024

First CoU Issuance Period: 08 Years 17 days

Date: 14/08/2016 to 31/08/2024

Project Concept Note (PCN)
CARBON OFFSET UNIT (CoU) PROJECT

BASIC INFORMATION	
Title of the project activity	107.69 MW bundled Rooftop Solar Project in Uttar Pradesh by UPNEDA
Scale of the project activity	Large Scale
Completion date of the PCN	03/09/2024
Project participants	Aggregator: PA Research & Consultants Pvt Ltd
Host Party	INDIA
Applied methodologies and standardized baselines	AM0123-"Renewable energy generation for captive use", v-1.0 Standardized baselines- Not Applicable
Sectoral scopes	01 Energy industries (Renewable/Non-renewable Sources)
Estimated amount of total GHG emission reductions	1,443,410 CoUs (1,443,410 tCO_2eq)

SECTION A. Description of project activity

A.1. Purpose and general description of Carbon offset Unit (CoU) project activity >>

The project is a 107.69 MW bundled rooftop solar project located in 75 districts of Uttar Pradesh state of India.

Purpose of the project activity:

The Project activity includes installation of Solar Photovoltaic Panels on roofs of government buildings/institutions located in various districts of Uttar Pradesh (UP) state of India. The project activity is implemented by Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA). The purpose of the project activity is to transition to a source of clean electricity generation. The rooftop solar projects installed on each building will generate solar power which will be utilized for the energy needs of the building where the modules are installed. In the absence of the project activity the equivalent amount of electricity generated from the project would have been drawn in from the carbon intensive national grid which is also the baseline scenario of the project activity. The project activity will thus reduce the anthropogenic emissions of Green House Gases (GHGs) in to the atmosphere associated with the equivalent amount of electricity generation from the fossil fuel-based grid connected power plant.

The project activity is a bundled project activity which involves installation of rooftop solar projects on 1,333 different government buildings across 75 districts of UP. The installation details of the SPV-modules are provided in Appendix-1 of this PCN.

The start date of the project activity is 14/08/2016 which is the date of installation of the 1st rooftop solar project in the plant. While UPNEDA has installed the project activity and are the legal owners of the credits to be generated, they have authorised Nextgen Infoworld Pvt Ltd to act on their behalf to initiate and process the project to get registered and issue the COUs under UCR. The total energy that will be generated through all the SPV modules combined will be around 160,379.26 MW. The project will lead to overall 144,341 tCO_2e per year emission reductions.

A.2 Do no harm or Impact test of the project activity>>

The project activity is a Greenfield initiative with grid power as its baseline. The power drawn by the project buildings in the baseline will be from Indian grid system which primarily derive their energy from fossil fuel fired thermal power plants. Renewable power generation in the project scenario contributes to the production of emission-free energy.

The Government of India has established specific indicators for sustainable development in the interim approval guidelines for projects aimed at GHG mitigation. It has also been declared by the "Central Pollution Control Board" that such project activity comes under white category industry[1] and won't require any environmental clearance. The Ministry of Environment, Forests & Climate Change has defined economic, social, environmental, and technological well-being as the four key indicators of sustainable development. It is anticipated that the project will contribute to sustainable development in the following ways:

- **Social benefits:**
  - The project will generate various employment opportunities across different districts of Uttar Pradesh throughout various stages, consisting of construction, installation and operation of the solar rooftop projects.
  - The generation of employments will in a way help in alleviating poverty in the surrounding areas
  - The project activity will provide training to its employees on the technical aspects and operation of SPV modules, thereby enhancing the skill set of the local population.

- **Environmental benefits:**

  - The project involves generating electricity using Solar Power, which is a clean and emission-free source. This approach helps reduce GHG emissions and specific pollutants such as SOx, NOx, and SPM that would otherwise be produced by thermal power plants.

  - Project will now generate electricity by rooftop solar projects which will reduce the dependence on fossil fuels for electricity generation; this will result in conservation of natural resources.

- **Economic benefits:**
  - The project is an investment in clean technology, supported by carbon revenue, which indicates a flow of clean energy investments into the host country.
  - The project activity will require both temporary and permanent skilled and semi-skilled labour at the project site, creating additional employment opportunities in the region.

- **Technological benefits:**
  - The project activity will result in generation of electricity from clean and emission free source that is solar power with the help of solar panels installed on the rooftop of the buildings. This has reduced usage of carbon intensive thermal power plants for electricity generation. This reduced usage will promote usage of clean and emission free source for electricity generation, thereby promoting technological well-being. The success of the project activity will also inspire many other entrepreneurs to participate in similar project activities.

[1] https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9MYXRlc3RfMTE4X0ZpbmFsX0RpcmVjdGlvbnMucGRm

The project is expected to contribute 5 SDGs which are SDG 7, 8, 9, 11 and 13.

SDG 7 Energy: The project contributes SDG Target 7.2 “By 2030, increase substantially the share of renewable energy in the global energy mix” by the utilization of solar energy as a renewable energy source.

SDG 8 Economic Growth: The project creates direct and indirect employment opportunities during construction and operation phases, so it contributes to SDG Target 8.5.2 “By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities and equal pay for work of equal value”.

SDG 9 Infrastructure, Industrialization: SDG Target 9.4.1 requires “By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities”. The project helps the Target 9.4.1 by implementing a clean, reliable and environmental-friendly infrastructure for clean energy production / up-to-date industrialization.

SDG 11 Sustainable Cities and Communities: The project helps SDG Target 11.6.2 “By 2030, reduce the adverse per capita environmental impacts of cities, including by paying special attention to air quality and municipal and other waste management.” by decreasing particulate matter caused by fossil fuel emissions in the cities.

SDG 13 Climate Change: The project produces clean renewable energy by diminishing CO_2 emissions. Therefore, it contributes SDG Target 13.2.2 “Total Greenhouse gas emissions per year”.

A.3. Location of project activity >>

Country: India
State: Uttar Pradesh
The project activity involves installation of rooftop solar projects on 1,333 different government buildings across 75 districts of UP. The project area lies between following coordinates:

Points	Coordinates
North	30°24'50"N 77°36'45"E
East	25°45'39"N 84°12'05"E
West	27°29'04"N 77°24'57"E
South	24°57'22"N 80°59'26"E

The map of project area is attached below:

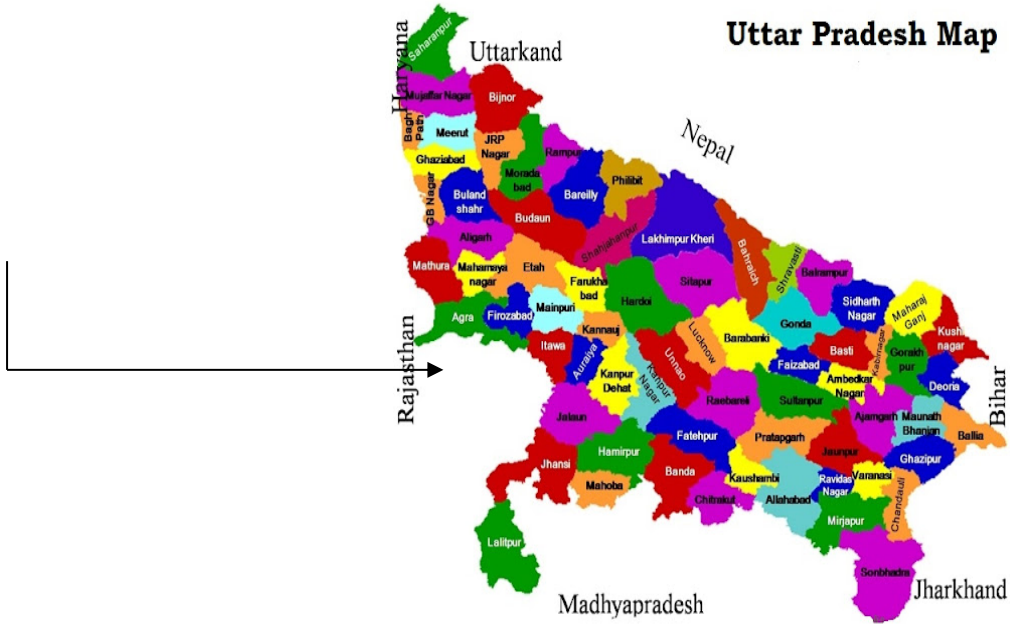


Fig: Project locations

A.4. Technologies/measures >>

The project activity comprises of rooftop solar panels as the technology. The total installed capacity of the bundled project activity is 107.69 MW. These solar panels consist of PV cells. These cells in the panels absorb the energy from the sunlight. This absorbed energy generates electrical charges that move in response to an internal electric field in a cell which causes electricity to flow. The solar modules generate DC power, which is converted to AC with the help of inverters.

Project installs multi-crystalline silicon technology. The key components of a photovoltaic (PV) system include the solar cells, which are the fundamental units that capture sunlight, the modules, which assemble many cells into a single unit, and the inverters, which convert electricity generated in DC form to AC form which is usable in everyday applications.

As the project is a large scale rooftop solar project different types of solar modules have been used in the project activity. Technical details of the components used in some districts in the project are

given below:

Solar Modules

Criteria	Description
Type of SPV modules	Multi- Crystalline
Make of Module	SOVA Solar
Model No:	335 Wp/72Cell
Total Wattage of module installed	5025 Wp
Tilt angle of module to true south	26 degree

Invertor/Power Conditioning Unit

Criteria	Description
Make of PCU	Polycab
Capacity of installed PCU	5 KWp
Input Voltage	1000 VDC, Max.
Output Voltage	400V - 3 Phase

A.5. Parties and project participants >>

Party (Host)	Participants
India	**Project Aggregator:** PA Research & Consultants Pvt Ltd.
India	**Project Owner:** UPNEDA
India	**Project Participant:** Nextgen Infoworld Pvt Ltd

A.6. Baseline Emissions>>

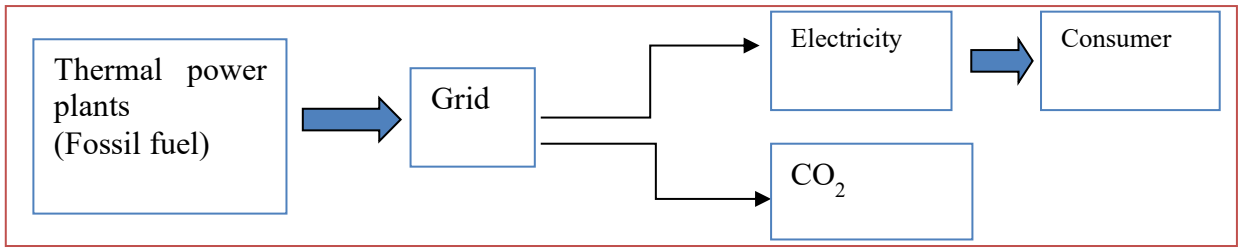
The baseline scenario identified at the PCN stage of the project activity is:

- Indian Grid

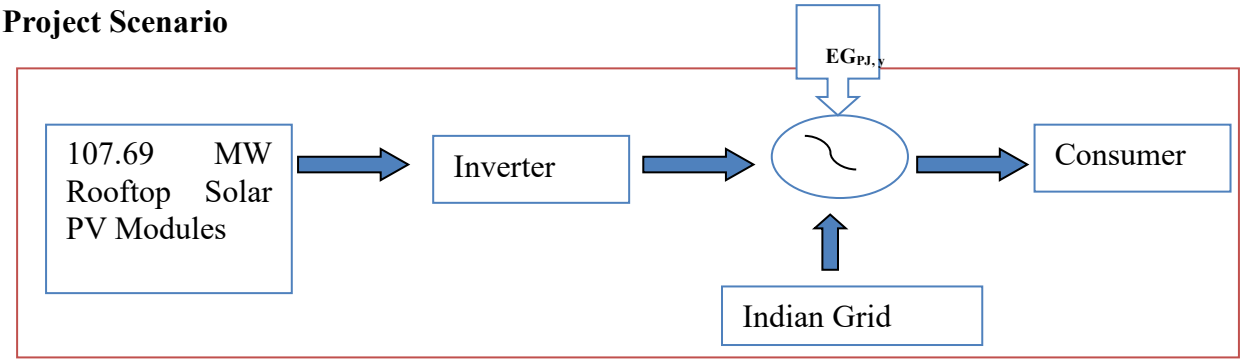
  In the absence of the project activity, the equivalent amount of electricity would have been consumed from the Indian grid, which is carbon-intensive due to its reliance on fossil fuel-based power plants. Therefore, the baseline scenario for the project activity is the grid-

based electricity system, which also represents the pre-project scenario.

Baseline Scenario



Project Scenario



A.7. Debundling>>

The project activity is not a debundled component of a larger project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines >>

SECTORAL SCOPE – 01 - Energy industries (Renewable/Non-renewable sources)
TYPE I - Renewable Energy Projects
CATEGORY- AM0123 (Title: "Renewable energy generation for captive use", version 01.0)

B.2. Applicability of methodologies and standardized baselines >>

Applicability Conditions	Project Activity
This methodology is applicable to renewable energy power generation project activities that install a greenfield power plant supplying electricity to the captive consumer via: (a) A grid interface through a wheeling; or (b) A dedicated electricity transmission and distribution line	The project activity is a greenfield project activity that will install a rooftop solar power generation projects which will supply electricity to captive consumer via dedicated electricity transmission and distribution line. Hence this criterion is applicable.

In case the project activity integrates a BESS, the methodology is applicable only to project activities that integrate greenfield BESS with a greenfield renewable energy power plant.	The project activity does not integrate BESS; hence this criterion is not relevant to the project activity.
The methodology is applicable under the following conditions: (a) In the pre-project scenario, the captive consumer does not source electricity from a renewable energy source; (b) The renewable energy producer and captive consumption facility shall be owned by the same project participant; (c) The project activity may include a renewable energy power plant/unit of one of the following types: solar power plant/unit, wind power plant/unit, and/or hydro power plant/unit with or without a reservoir. (d) The greenfield project power plant should, at the time of the start date of the project activity, be contractually bound to supply electricity to a captive consumer at least for the entire duration of the first crediting period. (e) The project renewable energy plant(s) shall not export more than 10 per cent on a yearly basis of its generation to a grid. This condition shall be met over the crediting period; (f) In case of integration of BESS as per paragraph 4 above, the project participants shall demonstrate that the BESS was an integral part of the design of the project activity (e.g., by referring to feasibility studies or investment decision documents); (g) The BESS should be charged with electricity generated from the project renewable energy power plant(s). Only during exigencies may the BESS be charged with electricity from the grid or a backup generator. In such cases, the corresponding GHG emissions shall be accounted for as project emissions following the requirements under section 5.4.3 below. The charging using the grid or backup generator should not amount to more than 2 per cent of the electricity generated by the project renewable energy plant on an annual basis. During the time periods e.g., days(s), week(s), months(s)) when the BESS consumes more than 2 per cent of the electricity for charging, the project participant, for the concerned periods of the monitoring period, shall consider baseline emissions as zero, however, they shall account the project	a) In pre-project scenario, the consumer imports electricity from the national grid which is carbon-intensive due to its reliance on fossil fuel-based power plants, thus is not sourcing electricity from a renewable source. b) The renewable energy producer and captive consumption facility is owned by the same project participant c) The project activity involves installation of rooftop SPV plants in government buildings of various districts of Uttar Pradesh for generating electricity. d) The project power plants in the bundled project will generate electricity which will be consumed in-house for the whole crediting period. e) The project is a zero export project activity; hence it exports 0% on a yearly basis of its generation to the grid. f) The project activity does not involve integration of BESS; hence this criterion is not relevant to the project activity. g) The project activity does not involve integration of BESS; hence this criterion is not relevant to the project activity.

emissions as per requirements under section 5.4.3. below.	
In case of hydro power plants, one of the following conditions shall apply: 2 (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density, calculated using equation (2), is greater than 4 W/m^2 ; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (2), is greater than 4 W/m^2; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (2), is lower than or equal to 4 W/m^2, all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (3), is greater than 4 W/m^2 (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project	The project activity generates its electricity using rooftop solar projects and not hydro power plant; hence this criterion is not relevant to project activity.
In the case of integrated hydro power projects, project participants shall: (a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or (b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed	The project activity generates its electricity using rooftop solar power projcts and not hydro power plant; hence this criterion is not relevant to project activity.

under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum of five years prior to the implementation of the CDM project activity.	
In addition, the applicability conditions included in the tools referred to below apply	Applicability conditions of the tools has been justified below

Applicability conditions of "Tool to calculate the emission factor for an electricity system", TOOL07, version 7.0	
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The condition is applicable. All the 3 parameters. i.e, OM, BM and CM are estimated using the tool under section B.5.for calculating baseline emissions.
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	The project activity is grid connected. Hence this criterion is applicable and emission factor is calculated accordingly.
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country	The project activity is located in India that is a non-annex 1 country; therefore this criterion is not applicable.
Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	The project activity is a solar power project. Therefore, this criterion is not applicable.

B.3. Applicability of double counting emission reductions >>

There is no risk of double counting emission reductions in the project activity for the following reasons:

- The project has an exclusive commissioning certificate and a defined connection point.
- The project is linked to energy meters that are solely assigned to the project's consumption point.

B.4. Project boundary, sources and greenhouse gases (GHGs)>>

As per para 18 of methodology AM0123, the spatial extent of the project boundary includes the project power plant/unit and or all power plants/units connected physically to the electricity system that the project power plant is connected to, the captive consumer that receives electricity generated by the project activity via wheeling, or through a dedicated electricity transmission and distribution line.

Thus, the project boundary consists of all the rooftop solar PV projects which are installed at different government buildings in various districts that are connected to the Indian grid. Hence the Indian grid and all the rooftop solar PV projects in the project activity are considered as project boundary for this project activity.

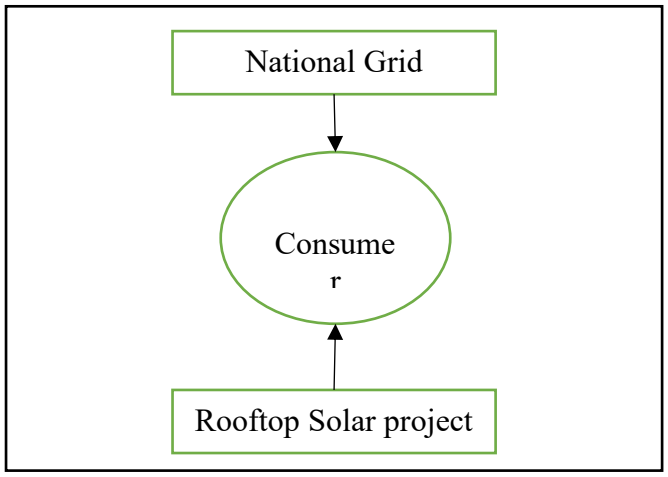


Fig: Project boundary

	Source	GHG	Included?	Justification/Explanation
Baseline	Grid connected electricity generation	CO_2	Included	Major source of emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Greenfield rooftop solar PV bundled project activity	CO_2	Excluded	As the project activity is sourcing its electricity from rooftop solar PV modules which is an emission free source, hence it does not emit CO_2.

		CH_4	Excluded	Project activity does not emit CH_4
		N_2O	Excluded	N_2O is not emitted by the project activity.

B.5. Establishment and description of baseline scenario (UCR Standard or Methodology) >>

The details regarding emission displacement rates/ coefficients/ factors established by the applicable methodology selected for the project is provided in this section.

The methodology selected for the project is AM0123 version 1 that is used for the projects that generates renewable energy for captive utilization. As per this methodology if the project activity is renewable energy generation from rooftop solar panels for captive utilization, the baseline scenario is the following:
The baseline scenario would be the electricity generation by new or existing power plants connected to the Indian grid system, which mostly relies on fossil fuels.

The project activity involves installation of solar rooftop projects in government buildings located across 75 districts of Uttar Pradesh India. The electricity generated by these solar rooftop projects will be captively utilized in the government buildings. This electricity generated will be harnessed by the solar energy which is emission free. In the absence of the project activity same amount of electricity would have been supplied by the Indian grid which is fed mainly by fossil fuel fired plants. Hence, the baseline scenario for the project activity is electricity generation by the Indian grid.

Baseline Emissions:

As per the selected methodology AM0123 Version 1, para 39: Baseline emissions include only CO_2 emissions from electricity generation either in grid connected and or captive fossil fuel fired power plants that are displaced due to the project activity. The baseline emissions are to be calculated as follows:

$$\mathbf{BE_y = EG_{PJ,\,y} \times EF_{CO2,y} + EG_{PJsurplus,y} \times EF_{grid,y}}$$

Where

BE_y	Baseline emissions in year y (t CO_2/yr)
$EG_{PJ,\,y}$	Quantity of net electricity generation that is produced and supplied to a captive consumer as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EG_{PJsurplus,\,y}$	Quantity of the surplus electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{CO2,\,y}$	The electricity emission factor (t CO_2/MWh) of the baseline electricity source
$EF_{grid,\,y}$	The emission factor of the grid (t CO_2/MWh) following the procedures described in TOOL07

The $EG_{PJ,\,y}$ that is quantity of net electricity generation that is produced and supplied to captive consumer is estimated as follows:

$$\mathbf{EG_{PJ,\,y} = EG_{facility,\,y}}$$

Where:

$EG_{PJ,\,y}$	Quantity of net electricity generation that is produced and supplied to a captive consumer as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EG_{facility,\,y}$	Quantity of net electricity generation supplied by the project plant/unit to the captive consumer in year y (MWh/yr)

$EG_{PJsurplus,\,y}$ will be estimated as 0 MWh/yr as the project activity will not export any amount of electricity to the Indian grid.

As per the para 40 of methodology AM0123: In case of calculation of the electricity emission factor the following guidance is applicable:

a) In cases where the baseline is use of electricity from the grid (baseline scenario S1), follow the procedures described in TOOL07 to calculate the electricity emission factor;
b) In cases where the baseline is use of electricity from an existing and/or new captive power plants using fossil fuels or other plausible and credible alternatives (baseline scenario S2, S3 or S5), follow the procedures described in TOOL05 to calculate the electricity emission factor. The project participant shall calculate compare the electricity emission factor calculated using TOOL05 with the grid electricity emission factor calculated using TOOL07 as described above and use the lower value among it.

The baseline scenario for our project activity as described above is use of electricity from the grid; hence we will follow the guidance mentioned in point (a). According to which we will follow the procedures described in TOOL07 to calculate the $EF_{CO2,\,y.}$

As per the TOOL 07 i.e. Tool to calculate the emission factor for an electricity system (Version7.0, EB 100, Annex 4), following steps will be followed:

Step 1: Identify the relevant electricity systems;
Step 2: Choose whether to include off-grid power plants in the project electricity system (optional);
Step 3: Select a method to determine the operating margin (OM);
Step 4: Calculate the operating margin emission factor according to the selected method;
Step 5: Calculate the build margin (BM) emission factor;
Step 6: Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity systems

This step specifies that for determining the electricity emission factors, the project participants shall identify the relevant project electricity systems.

It states that project participants must delineate the project electricity system using any of the following options:

Option-1. A delineation of the project electricity system and connected electricity systems published by the DNA or the group of the DNAs of the host country(ies), In case a delineation is provided by a group of DNAs, the same delineation should be used by all the project participants applying the tool in these countries;

Option-2. A delineation of the project electricity system defined by the dispatch area of the dispatch centre responsible for scheduling and dispatching electricity generated by the project activity. Where the dispatch area is controlled by more than one dispatch centre, i.e. layered dispatch area, the higher level area shall be used as a delineation of the project electricity system (e.g. where regional dispatch centres are required to comply with dispatch orders of the national dispatch centre then area controlled by the national dispatch centre shall be used);

Option 3. A delineation of the project electricity system defined by more than one independent dispatch areas, e.g. multi-national power pools.

Keeping Option1 consideration, the Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into five regional grids viz. Northern, Eastern, Western, North-eastern and Southern.

However, since August 2006, however, all regional grids except the Southern Grid had been integrated and were operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids were treated as a single grid named as Indian grid from FY 2007-08 onwards for the purpose of this CO_2 Baseline Database. As of 31 December 2013, the Southern grid has also been synchronised with the Indian grid; hence forming one unified

INDIAN GRID				
Northern	**Eastern**	**Western**	**North-Eastern**	**Southern**
Chandigarh Delhi Haryana Himachal Pradesh Jammu and Kashmir Punjab Rajasthan Uttarakhand	Bihar Jharkhand Orissa West Bengal Sikkim Andaman Nicobar	Chhattisgarh Gujarat Daman & Diu Dadar & Nagar Haveli Madhya Pradesh Maharashtra Goa	Arunachal Pradesh Assam Manipur Meghalaya Mizoram Nagaland Tripura	Andhra Pradesh Karnataka Kerala Tamil Nadu Puducherry Lakshadweep Telangana

Indian Grid. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation

The project participant has chosen only grid power plants in the calculation.

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 one of the following methods, which are described under Step 4:
(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

PP has chosen Option (a) i.e. simple OM, to determine the operating margin. Other available options in the tool were ruled out considering the fact that data required to calculate simple adjusted OM or dispatch data analysis is not available publicly. As per the tool, low cost/must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Data for the same, as published by Central Electricity Authority, has been presented below which illustrates that low cost/must run resources constitute less than 50% of total Indian grid generation, hence, the average OM method could not have been used.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)

	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
India	14.6%	14.3%	14.5%	17.0%	16.5%	15.8%	15.33%

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of three most recent years) for the INDIAN grid is less than 50 % of the total generation. Thus the average emission rate method cannot be applied, as low cost/must run resources constitute less than 50% of total grid generation.

The "Simple operating margin" has been calculated as per the weighted average emissions (in tCO_2/MWh) of all generating sources serving the system, excluding hydro, geo-thermal, wind, low□cost biomass, nuclear and solar generation;
As per tool to calculate emission factor for an electricity system (v7.0), The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. Since the low cost/must run resources constitute less than 50% of total grid generation as seen from the average of five most recent years, the Simple OM method can be used to calculate the Operating Margin Emission factor.

PP has chosen ex ante option, thus, no monitoring and recalculation of the emissions factor during the crediting period is required. PP has considered a data vintage of 3-year generation-weighted average, based on the most recent data available at the time of submission of the PSF to the DOE for validation.

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

The simple OM may be calculated:
Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

The Central Electricity Authority, Ministry of Power, Government of India has published a database of Carbon Dioxide Emission from the power sector in India based on detailed authenticated information obtained from all operating power stations in the country. This database i.e. The CO_2 Baseline Database provides information about the Combined Margin Emission Factors of all the regional electricity grids in India. The Combined Margin in the CEA database is calculated ex ante using the guidelines provided by the UNFCCC in the "Tool to calculate the emission factor for an electricity system, v7.0". We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

As per „Tool to calculate the emission factor for an electricity system", Option A ("Based on the net electricity generation and a CO_2 emission factor of each power unit") is used to calculate simple OM emission factor. Where Option A is used, the simple OM emission factor is calculated based on the electricity generation of each power unit and an emission factor for each power unit, as follows:

$$\mathbf{EF_{grid,OMsimple,y}} = \mathbf{\Sigma\ (EG_{m,y} * EF_{EL,m,y})/\ \Sigma\ EG_{m}}$$

Where

$EF_{grid,\ OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,\ y\ Net}$	quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,\ m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
	y the relevant year as per the data vintage chosen in STEP 3

The CO_2 emission factor ($EF_{EL,\ m,\ y}$) data for simple OM, available under the CEA database (v19.0) for the last three years is as follows

	2020-2021	2021-2022	2022-2023
Simple OM, tCO_2/MWh(incl.Imports)	0.94	0.960	0.971
Net Generation, GWh	9,58,218.2696	10,35,672.7914	11,17,845.66
Weighted Average Simple OM, tCO_2/MWh	0.958		

Step 5: Calculate the build margin (BM) emission factor, $EF'_{grid',\ BM,\ y}$

The build margin emissions factor is the generation-weighted average emission factor of all power units m during the most recent year y for which power generation data is available, calculated as

follows:

$$\mathbf{EF}_{\mathbf{grid BM,y}} = \mathbf{\Sigma}(\mathbf{EG}_{\mathbf{m,y}} * \mathbf{EF}_{\mathbf{EL,m,y}})/\mathbf{\Sigma}\ \mathbf{EG}_{\mathbf{m,y}}$$

Where:

$EF_{grid, BM, y}$	Build margin CO_2 emission factor in year y (t CO_2e/MWh)
$EG_{m, y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL, m, y}$	CO_2 emission factor of power unit m in year y (t CO_2 e/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the procedures given in step 4 (a) for the simple OM, using options A1B1 using for y the most recent historical year for which power generation data is available, and using form the power units included in the build margin.

CEA's "CO_2 Baseline Database for the Indian Power Sector" v19.0,

Build Margin (tCO_2/MWh) (not adjusted for imports)	
	2022-23
Indian Grid	0.867

Step 6: Calculate the combined margin (CM) emissions factor
The combined margin is the weighted average of the simple operating Margin and the build margin. In particular, for intermittent and non-dispatchable generation types such as solar photovoltaic, the 'Tool to calculate the emission factor for an electricity system (v7.0)', allows to weigh the operating margin and Build margin at 75% and 25%, respectively

$$\mathbf{EF}_{\mathbf{grid,y}} = (\mathbf{EF}_{\mathbf{Om,y}} * \mathbf{W}_{\mathbf{OM}}) + (\mathbf{EF}_{\mathbf{BM,y}} * \mathbf{W}_{\mathbf{BM}})$$
$$\mathbf{EF}_{\mathbf{grid,y}} = (\mathbf{EF}_{\mathbf{OM,y}} * \mathbf{75\%}) + (\mathbf{EF}_{\mathbf{BM,y}} * \mathbf{25\%})$$

Electronic spreadsheet showing calculation of all these parameters is being submitted separately and the final values are presented below:

Parameter	Value	Units
Operating Margin : $EF_{OM,y}$	0.9580	tCO_2e/MWh
Build Margin : $EF_{BM,y}$	0.867	
Combined Margin : $EF_{grid,y}$	0.9352	

As per the section 'Emission Factors' in the UCR STANDARD version 7.0, "*The UCR recommends an emission factor of 0.9 tCO_2/MWh for the 2013-2020 years as a fairly conservative estimate for Indian projects not previously verified under any GHG program.*"
0.9 tCO_2/MWh has been adopted for emission reduction calculations considering a conservative approach which is appropriate.

Project Emissions
This will estimate the emissions from the project activity. As the electricity generated in the project activity is sourced from solar panels which is a clean and emission free source. Hence, the project emissions will be null.

Thus, $PE_y = 0$

Leakage Emissions
As per para 42 of methodology AM0123 v7.0, no leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g., extraction, processing, transport etc.) are neglected.

Hence, $LE_y = 0$

Net GHG Emission Reductions and Removals:

Net GHG Emission Reductions and Removals are calculated as follows:

$$\mathbf{ER_y = BE_y - PE_y - LE_y}$$

Where:

ER_y	Emission reductions in year y (tCO_2/y)
BE_y	Baseline Emissions in year y ($t CO_2/y$)
PE_y	Project emissions in year y (tCO_2/y)
LE_y	Leakage emissions in year y (tCO_2/y)

The estimated emission reduction for the project activity is as follows:

$\mathbf{BE_y} = EG_{facility, y} * EF_{CO2,y}$
=107.69 x 0.17 [2]x 0.9
=160,379.26 x 0.9 (An Emission factor of 0.9 has been considered as per UCR standard)
= 144,341 tCO_2e (ROUNDED DOWN)
$\mathbf{PE_y} = 0$
$\mathbf{LE_y} = 0$
$ER_y = BE_y - PE_y - LE_y$
= 144,341-0-0
$\mathbf{ER_y}$ = **144,341 tCO_2e**

B.6. Prior History>>

The project activity has not applied to any other GHG program for generation or issuance of carbon offsets or credits.

B.7. Changes to start date of crediting period >>

There is no change in the start date of crediting period.

[2] Value of Plant Load Factor (PLF) is taken as 17% that is 0.17. The value is obtained by taking the average of the PLFs recorded in the project location for the period of 4 years that is from 2012-2015 obtained from public sources.

B.8. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

Not Applicable

B.9. Monitoring period number and duration>>

First Issuance Period: 8years 17days– 14/08/2016- 31/08/2024

B.8. Monitoring plan>>

Data and Parameters available at validation (ex-ante values):

Data/Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2e /MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year y
Source of data	CEA's "Baseline Carbon Dioxide Emission Database, v19.0" https://cea.nic.in/wpcontent/uploads/baseline/2024/04/User_Guide__Version_19.0.pdf
Value(s) applied	0.958
Measurement methods and procedures	This value is calculated
Purpose of data	Calculation of combined margin emission factor

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2e /MWh
Description	Build margin CO_2 emission factor for the project electricity system in year y
Source of data	CEA's "Baseline Carbon Dioxide Emission Database, v19.0" https://cea.nic.in/wpcontent/uploads/baseline/2024/04/User_Guide__Version_19.0.pdf
Value(s) applied	0.867
Measurement methods and procedures	This value is calculated
Purpose of data	Calculation of combined margin emission factor

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e /MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year y
Source of data	Combined Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with "Tool to calculate

	the emission factor for an electricity system", v7.0
Value(s) applied	As per EF Calculation - 0.935 tCO_2e/MWh However, the UCR default value of 0.9 tCO_2e/MWh has been considered as grid emission factor for emission reduction calculations
Measurement methods and procedures	This value is calculated
Purpose of data	Calculation of baseline emission.

Data and Parameters to be monitored (ex-post monitoring values):

Data / Parameter:	$EG_{facility, y}$
Data unit:	MWh
Description:	Electricity generated by solar rooftops installed in various districts of Uttar Pradesh which is used for captive consumption.
Source of data:	Energy Meter records and/or monthly generation statement
Measurement procedures (if any):	Data Type: Measured Monitoring Equipment: Energy meters are used for monitoring Calibration frequency: Once in 5 years (as per CEA India provision). The Net Electricity that is being generated by solar rooftops installed in various districts of Uttar Pradesh which is used for captive consumption will be calculated. Thus **EG** $EG_{facility, y} = EG_{generated\ by\ solar\ rooftops}$
Monitoring frequency:	Monthly
QA/QC procedures:	Not required
Any comment:	-

Appendix-1

Table-1- PV Modules location and capacity

District	No. of Systems	Capacity in KW
Agra	35	1087.70
Aligarh	25	3330
Ambedkar Nagar	8	40
Ayodhya	79	1298
Amethi	17	2019
Amroha	11	150
Auraiya	6	5781
Azamgarh	13	281
Badaun	16	80
Bagpat	9	45
Bahraich	13	65
Ballia	8	40
Balrampur	6	30
Banda	26	777
Barabanki	19	264
Bareilly	57	1749.86
Basti	10	270
Bijnor	18	180
Bulandshahr	13	821
Chandauli	8	1510
Chitrakoot	14	78
Deoria	4	140
Etah	15	325
Etawah	16	138
Farrukhabad	6	75
Fatehpur	16	235
Firozabad	8	85
Gautam Buddha Nagar	9	12950.80
Ghaziabad	17	4396
Ghazipur	12	66
Gonda	6	30
Gorakhpur	15	1972
Hamirpur	15	170
Hapur	9	255
Hardoi	16	155
Hathras	8	40
Jalaun	10	105
Jaunpur	8	415
Jhansi	28	5858
Kannauj	6	227
Kanpur Dehat	2	255
Kanpur Nagar	37	4740.69
Kasganj	5	220
Kaushambi	6	165
Kushinagar	2	10

Lakhimpur Kheri	27	176
Lalitpur	8	104
Lucknow	91	22420.90
Maharajganj	8	50
Mahoba	13	114
Mainpuri	7	35
Mathura	26	649.29
Mau	2	10
Meerut	22	1915.80
Mirzapur	14	125
Moradabad	21	1820.80
Muzaffarnagar	22	637
Pilibhit	17	370
Pratapgarh	26	605
Prayagraj	31	5311.59
Rae Bareli	57	276
Rampur	27	138
Saharanpur	32	421
Sant Kabir Nagar	3	15
Bhadohi	19	95
Sambhal	2	10
Shahjahanpur	26	160
Shamli	5	25
Shravasti	2	10
Siddharthnagar	10	105
Sitapur	32	230
Sonbhadra	17	85
Sultanpur	15	480
Unnao	17	130
Varanasi	47	18245.48