

RENEWABLE SOLAR POWER PROJECT BY MAHINDRA RENEWABLES PRIVATE LIMITED



Mahindra Renewables Private Limited is the Project Proponent



Document Prepared By EKI Energy Services Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The proposed project activity is a step towards supporting the implementation and installation of grid connected renewable solar energy power plants in India. The implementation of project activity ensures energy security, diversification of the grid generation mix and sustainable growth of the electricity generation sector in India. The main goal of project activity is to implement renewable energy projects in the country and the significant importance of revenues from sale of Verified Carbon Units (VCUs) to achieve this goal forms the basis of the implementation of this project activity. The project proponent for this Project activity is M/s Mahindra Renewables Private Limited. There are no mandatory laws or regulations existing in India requiring PP or any other party to develop a programme for renewable generation plants.

The project activity will support the development of new grid-connected renewable energy power plants in India and will cover the solar energy technologies. It seeks to enable investment in large scale grid connected plants that export their generated output to the regional / national electricity grid in India. This project activity follows methodology ACM0002 version 19.0¹.

The electricity generated by renewable technology (solar) installed as part of the project activity will be supplied either to the regional grid and/or will be supplied to the identified facility via regional grid through a contractual wheeling agreement for captive consumption there by displacing the consumption of electricity from the regional grid electricity distribution system. As of 31 December 2013, the Southern grid has also been synchronised with the NEWNE grid, hence forming one unified Indian Grid. Thus for this Project activity Indian Grid is applicable. The objective of the project activity is to develop a platform for reducing VCS Registration timelines and process costs for registration of individual projects under VCS.

The details of the project and the state of installation are mentioned in the table:-

Project Investor	Capacity in MW	Connection with Grid	State	Usage of Electricity
Mahindra Renewables Private Limited	250 MW	Indian Grid	Madhya Pradesh	Sale to third Party
Total	250 MW			

The total capacity of the project activity is 250 MW and the power produced displaces an equivalent amount of power from the grid, which is fed mainly by fossil fuel fired power plants. Hence, it results in reduction of GHG emissions. Average GHG emission reductions from the project activity will be 389,911 tonnes of CO₂e per year and total GHG emission reductions for the chosen 10 year crediting period will be 3,899,117 tonnes of CO₂e.

Total emission reductions achieved in this monitoring period:

During the Current Monitoring Period from 06/07/2018 to 30/11/2019 (First and last date included) the project activity has contributed 226,244 tCO₂e GHG reductions.

1.2 Sectoral Scope and Project Type

The project activity falls under the following Sectoral scope and Project Type:

Sectoral Scope : 01 - Energy industries (renewable / non-renewable sources)
Project Type : I - Renewable Energy Projects
Methodology : ACM0002: Grid-connected electricity generation from renewable sources - Version 19.0¹

The project is not a grouped project activity.

1.3 Project Proponent

Organization name	M/s Mahindra Renewables Private Limited.
Contact person	Mr. Rakesh Khaitan
Title	CEO
Address	Mahindra towers, Dr. G.M. Bhosle Marg P.K. Kurne Chowk, Worli-Mumbai-400018, Maharastra, India.
Telephone	+91-99306 74683
Email	khaitan.rakesh@mahindra.com

1.4 Other Entities Involved in the Project

Organization name	M/s EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Mr. Manish Dabkara
Title	MD & CEO
Address	Enking Embassy, Office no. 201, Plot 48, Scheme 78 Part-2, Vijay Nagar, Indore-452010, Madhya Pradesh, India
Telephone	+91 99075 34900
Email	manish@enkingint.org

1.5 Project Start Date

06/07/2018² which is the date of commissioning of first phase of the Project. Hence the project start date is 06/07/2018.

¹ <http://cdm.unfccc.int/UserManagement/FileStorage/58IAGB7SZUDEO2VN6LYM30K41HFPRQ>

² As per the commissioning certificate.

The commission details are mentioned in Section 1.8.

1.6 Project Crediting Period

Crediting Period Start date: 06-July-2018

Crediting Period End date: 05-July-2028

The project activity adopts renewable crediting period of 10 years period which can be renewed for maximum 2 times.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	✓

As per section 3.9.1 of VCS standard Version 3.7, the projects are classified as follows:

- 1) Projects: Less than or equal to 300,000 tonnes of CO₂e per year
- 2) Large projects: Greater than 300,000 tonnes of CO₂e per year

As the estimated annual average GHG emission reductions or removal per year is 389,911 tCO₂e which is more than 300,000 tonnes of CO₂e per year, thus the project falls in the category of Large Project.

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
06-07-2018 to 05-07-2019	389,802
06-07-2019 to 05-07-2020	390,635
06-07-2020 to 05-07-2021	389,568
06-07-2021 to 05-07-2022	389,568
06-07-2022 to 05-07-2023	389,568
06-07-2023 to 05-07-2024	390,635
06-07-2024 to 05-07-2025	389,568
06-07-2025 to 05-07-2026	389,568
06-07-2026 to 05-07-2027	389,568
06-07-2027 to 05-07-2028	390,635
Total estimated ERs	3,899,117
Total number of crediting years	10
Average annual ERs	389,911

1.8 Description of the Project Activity

The proposed project activity involves the installation of Solar Power Projects. The total capacity of the project is 250 MW. The project is promoted by **Mahindra Renewables Private Limited**. The project activity would use solar energy to generate direct current from photovoltaic modules that will be converted into alternating current by inverters. The project activity will install a new power plant (i.e. solar PV) at a site where no renewable power plant was operating prior to the implementation of the project activity (green-field plant). The generated electricity will be supplied to grid. The project activity follows ACM0002 Version 19.0.

Baseline Scenario:

As per the applicable methodology, a Greenfield power plant is defined as “a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity”.

As the project activity falls under the definition of a Greenfield power plant, the baseline scenario as per applied methodology is the following:

The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid. Hence, pre-project scenario and baseline scenario are the same. The estimated lifetime of the project activity is considered as 25 years for solar technology. This may increase depending on the operation & maintenance of the plant. The Project activity is a new facility (Greenfield) and the electricity generated by the Project will be exported to the Indian Grid. The Project will therefore displace an equivalent amount of electricity which would have otherwise been generated by fossil fuel dominant electricity grid. The Project Proponent plans to avail the VCS benefits for the Project.

Emission Reductions from anthropogenic sources:

The solar power generated from the Project will be displacing the electricity generated from thermal power stations feeding into Indian grid and will be replacing the usage of diesel generators for meeting the power demand during shortage periods. Since, the solar power is Green House Gas (GHG) emissions free, the power generated will prevent the anthropogenic GHG emissions generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas. The estimation of GHG reductions by this project is limited to carbon dioxide (CO₂) only.

The commissioning details of the project are as follows:

Project Investor	Capacity (MW)	Commissioning Dates
M/s Mahindra Renewables Private Limited	5.1	06-07-2018
	35.7	07-09-2018
	100	05-04-2019
	94.2	10-07-2019
	15	Yet to be Commission
Total	250	

All project activity is a photovoltaic (PV) plant/unit thus, would use solar energy to generate direct current from photo voltaic modules that will be converted into alternating current by inverters. There were no major breakdown observed during current monitoring period.

The technical specifications of 5.1 MW of 250 MW of Solar PV Power plant is provided below:

Solar PV Modules	
Make and Model	1. Longi Solar. LR6-72HV-340M 2. Longi Solar.LR6-72HV-345M
PV Module Technology	Monocrystalline
Total number of modules	19964 (340W-10044 Nos., 345W-9920Nos.)
Inverter/Power Conditioner	
Inverter Make and Model	Tmeic-PVH-L2550E
Number of Inverters	2 numbers
Continuous AC power at 50°C	2550 kWAc per Inverter
Mounting Structure	
Type of Structure	Fixed
Manufacturer and Model of Mounting Structure	Mahindra Susten
Tilt	14°
Pitch	5.8 M

The technical specifications of 35.7 MW of 250 MW of Solar PV Power plant is provided below:

Solar PV Modules	
Make and Model	3. Longi Solar. LR6-72HV-340M 4. Longi Solar.LR6-72HV-345M
PV Module Technology	Monocrystalline
Total number of modules	132122 (340W-66092 Nos., 345W-66030 Nos.)
Inverter/Power Conditioner	
Inverter Make and Model	Tmeic-PVH-L2550E
Number of Inverters	14 numbers
Continuous AC power at 50°C	2550 kWAc per Inverter
Mounting Structure	
Type of Structure	Fixed
Manufacturer and Model of Mounting Structure	Mahindra Susten
Tilt	14°
Pitch	5.8 M

The technical specifications of 94.2 MW of 250 MW of Solar PV Power plant is provided below:

Solar PV Modules	
Make and Model	1. Longi Solar. LR6-72HV-340W

	2. Longi Solar. LR6-72HV-345W 3. Trina Solar. TSM-DE14A(II)-340W 4. Trina Solar. TSM-DE14A(II)-345W 5. Canadian Solar. CSU-320W 6. Canadian Solar. CSU-325W 7. Canadian Solar. CSU-330W
PV Module Technology	Monocrystalline/Polycrystalline
Total number of modules	1. Longi Solar. LR6-72HV-340W:27746 Nos. 2. Longi Solar. LR6-72HV-345W:24546 Nos. 3. TRINA. TSM-DE14A(II)-340W:87326 Nos. 4. TRINA. TSM-DE14A(II)-345W:27286 Nos. 5. Canadian Solar. CS6U-320W:6944 Nos. 6. Canadian Solar. CS6U-325W:49724 Nos. 7. Canadian Solar.CS6U-330W:156984 Nos.
Inverter/Power Conditioner	
Inverter Make and Model	1. ABB:PVS980-58-2000 KVA 2. TMEIC:PVH-L2550E
Number of Inverters	1. ABB-42 Nos. 2. TMEIC-4 Nos.
Continuous AC power at 50°C	1. ABB-2000 kWAc 2. TMEIC-2550 kWAc
Mounting Structure	
Type of Structure	Fixed
Manufacturer and Model of Mounting Structure	Mahindra Susten
Tilt	14°
Pitch	5.8 M

The technical specifications of 100 MW of 250 MW of Solar PV Power plant is provided below:

Solar PV Modules	
Make and Model	1. Canadian Solar-CS6U-325W 2. Canadiun Solar-CS6U-330W 3. TRINA-TSM-DEI14A(II)-340W 4. TRINA-TSM-DEI14A(II)-345W
PV Module Technology	Monocrystalline/Polycrystalline
Total number of modules	410192 (CS: 325Wp-166160 Nos., 330Wp-212784 Nos.), (Trina:340 Wp-15624 Nos., 345 Wp-15624 Nos.)
Inverter/Power Conditioner	
Inverter Make and Model	ABB-PVS980-58-2000 KVA
Number of Inverters	50Nos.
Continuous AC power at 50°C	2000 kWAc per Inverter
Mounting Structure	
Type of Structure	Fixed

Manufacturer and Model of Mounting Structure	Mahindra Susten
Tilt	14°
Pitch	5.8 M

The 15 MW is yet to be commissioned, the actual technical specification would be updated after the verification of the project.

1.9 Project Location

Project Investor	Village	Tehsil	District	State	Latitude	Longitude
M/s Mahindra Renewables Private Limited	Badwar	Gurh	Rewa	Madhya Pradesh	24°28'35.3"N	81°32'56.0"E
	Barsaita Pahad	Gurh	Rewa	Madhya Pradesh	24°28'53.3"N	81°34'31.9"E
	Barsaita Desh	Gurh	Rewa	Madhya Pradesh	24°28'53.2"N	81°34'31.4"E
	Itar Pahad	Gurh	Rewa	Madhya Pradesh	24°28'49.7"N	81°36'35.0"E
	Ramnagar Pahad	Gurh	Rewa	Madhya Pradesh	24°28'51.0"N	81°35'17.2"E

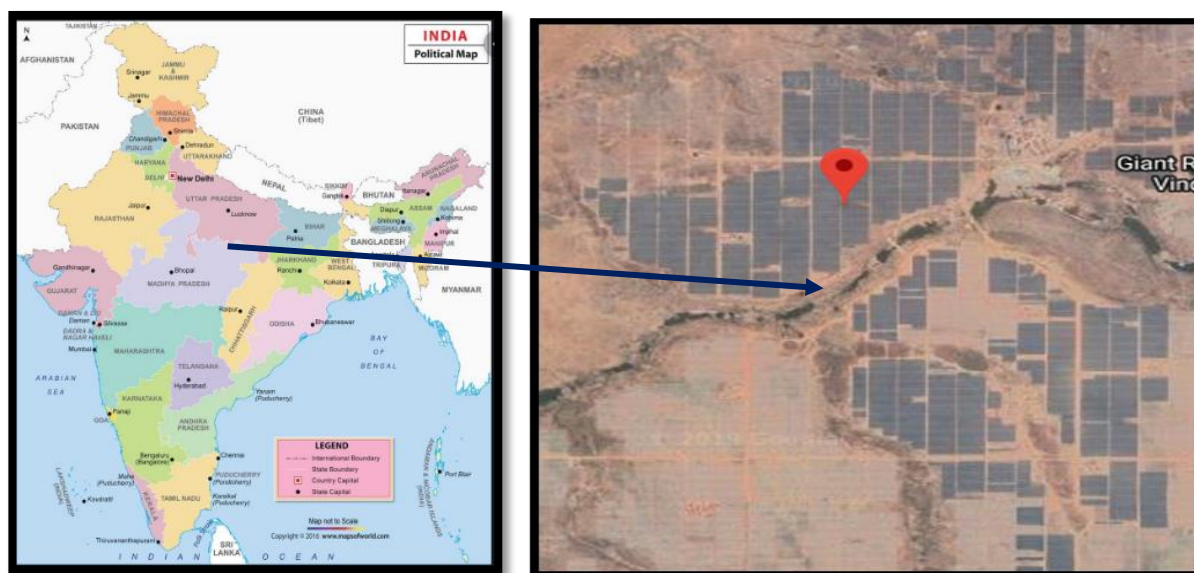


Figure 1. Project Location

1.10 Conditions Prior to Project Initiation

The project is a Greenfield solar power project and does not involve generation of GHG emissions for the purpose of their subsequent reduction, removal or destruction. Prior to the initiation of the project activity, the equivalent amount of electricity would have been drawn from grid connected or new power plants, in Indian Grid. The grid is predominantly coal based and therefore is a major source of carbon dioxide emissions in India. The main emission in the pre project scenario is the

power plants connected to the Indian Grid, and main GHG involved is CO₂. The baseline identified in section 2.4 is same as the pre-project scenario.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project has received necessary approvals for development and commissioning for each PV Plant from the state Nodal agencies and is in compliance to the local laws and regulations.

The relevant national laws and regulations pertaining to generation of energy in India are:

- Electricity Act 2003
- National Electricity Policy 2005
- Tariff Policy 2006

The Project activity conforms to all the applicable laws and regulations in India:

- Power generation using solar energy is not a legal requirement or a mandatory option.
- There are state and sectoral policies, framed primarily to encourage solar power projects. These policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments.
- The Indian Electricity Act, 2003 (May 2007 Amendment) does not influence the choice of fuel used for power generation.
- There is no legal requirement on the choice of a particular technology for power generation.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

As per VCS Program Definitions version 3.7, the project ownership is the legal right to control and operate the project activities.

Mahindra Renewables Private Limited is the project proponent (PP) of project activity.

The project ownership has been demonstrated through below supporting documents:

1. **Commissioning certificates** – The letter from respective State Nodal Agency to the Mahindra Renewables Private Limited for registration of commissioning of generation facility indicates that PP have the legal right to control and operate the project activities.
2. **Contract with EPC contractor** – The purchase order in the name of Mahindra Renewables Private Limited Projects indicate that PP have the legal right to control and operate the project activities.

Based on above evidences, the project ownership is with **Mahindra Renewables Private Limited**.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project activity under consideration is not participating in any other Emission trading programme and other binding limits.

The project activity is not participating at moment in any other emission trading programme and other binding limits. The GHG emission reductions generated during the current monitoring period have not been used for compliance of other mechanism

1.12.3 Other Forms of Environmental Credit

The proposed project activity neither has nor intends to generate any other form of GHG related environmental credit for GHG emission reductions or removals claimed under the VCS Program. The initial project activity is neither has nor intends to generate any other form of GHG related environmental credit for GHG emission reductions or removals claimed under the VCS Program.

1.12.4 Participation under Other GHG Programs

The proposed project activity has not been registered and is not seeking registration at moment under any other GHG programs.

This project activity is not participating in any other GHG program.

1.12.5 Projects Rejected by Other GHG Programs

The proposed project activity is not participating in other Environmental credits, other GHG programs and has not been rejected by other GHG programs.

This project activity is not participating in other Environmental credits, other GHG programs and have not been rejected by other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The proposed project activity is not a grouped project activity.

Leakage Management

This project activity is renewable energy project based on solar technology, no leakage emissions are considered.

Thus leakage management plan and implementation of leakage and risk mitigation measures are not applicable for this project activity.

Commercially Sensitive Information

Not applicable. No any commercially sensitive information has been excluded from the public version of the project description. There is no commercially sensitive information.

Sustainable Development

Contribution to sustainable development:

Apart from generation of renewable electricity, the project activity would contribute to the sustainable development of the region - socially, environmentally and economically. Ministry of Environment and Forests, has stipulated economic, social, environment and technological well-being as the four indicators of sustainable development. The project contributes to sustainable development using the following ways.

- **Social well-being:** The project would help in generating employment opportunities during the construction and operation phases. The project activity will lead to development in infrastructure in the region like development of roads and also may promote business with improved power generation.
- **Economic well-being:** The project is a clean technology investment in the region, which would not have been taken place in the absence of the VCS benefits the project activity will also help to reduce the demand supply gap in the state. The project activity creates local employment generation which helps economic well-being of local people.
- **Technological well-being:** The successful operation of project activity would lead to promotion of solar based power generation and would encourage other entrepreneurs to participate in similar projects
- **Environmental well-being:** Solar being a renewable source of energy, it reduces the dependence on fossil fuels and conserves natural resources which are on the verge of depletion. Due to its zero emission the Project activity also helps in avoiding significant amount of GHG emissions.

Further Information

Not Applicable.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The methodology for the project activity is approved methodology for large-scale CDM project activities. The details of the methodology are as follows:

Methodology: ACM0002

Project Type: Type-I: Renewable Energy Projects

Title: Grid-connected electricity generation from renewable sources

Version No.: Version 19.0;

Reference: CDM Methodology³

The methodology refers to following CDM Tools:

³ <http://cdm.unfccc.int/UserManagement/FileStorage/58IAGB7SZUDEO2VN6LYM30K41HFPRQ>

- Tool for the demonstration and assessment of additionality⁴ (Version 07.0.0, EB 70, Annex 8)
- Tool to calculate the emission factor for an electricity system⁵ - (Version 07.0 EB 100, Annex 04)

2.2 Applicability of Methodology

The project activity under the project activity will meets the applicability conditions of the approved consolidated baseline and monitoring methodology ACM0002, Version 19.0, Sectoral Scope 1, as described below:

Applicability Criterion	Project Case
This methodology is applicable to grid-connected renewable power generation project activities that: • install a Greenfield power plant; • involve a capacity addition to (an) existing plant(s); • involve a retrofit of (an) existing operating plants/units; • involve a rehabilitation of (an) existing plant(s)/unit(s) or • involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a Renewable Energy Project i.e. Solar Power Project which falls under applicability criteria option 1 (a) i.e., "Install a Greenfield power plant". Hence the project activity meets the given applicability criterion.
The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;	The proposed project activity are installation of a new grid connected solar renewable energy power plant and hence this condition is met.
In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;	The proposed project activity does not involve any capacity additions, retrofits or replacements and therefore this condition is not applicable.
In case of hydro power plants, one of the following conditions shall apply: • The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or • 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 (3), is greater than 4 W/m²; or	The proposed project activity under project activity is a grid connected solar renewable energy power project. This condition is applicable only for hydro power plants and not applicable for solar projects. Hence this criteria is not applicable.

⁴ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf>

⁵ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>

The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m².	
The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m², all of the following conditions shall apply: - The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m²; - Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; - Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m² shall be; ✓ Lower than or equal to 15 MW; and ✓ Less than 10 per cent of the total installed capacity of integrated hydro power project.	The proposed project activity under project activity is a grid connected solar renewable energy power project. This condition is applicable only for hydro power plants and not applicable for solar projects.
In the case of integrated hydro power projects, project proponent shall: - 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 - 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 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 five years prior to implementation of CDM project activity.	The proposed project activity is a grid connected solar renewable energy power project. This condition is applicable only for hydro power plants and not applicable for solar projects.
Methodology is not applicable to the following - Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; - Biomass fired power plants/units	The proposed project activity is the installation of a new grid connected solar renewable energy power project and does not involve switching from fossil fuel to renewable energy and hence this criterion is not relevant to the project activity. This project activity does not involve any biomass based power plants and hence this criterion is not applicable to the project activity.
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation	The proposed project activity is a new grid connected solar renewable energy power plant and not a retrofits, replacement or capacity additions and therefore this criterion is not applicable to the project activity.

equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	
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Tool to calculate the emission factor for an electricity system⁶ - Version 07.0 (EB 100, Annex 04)

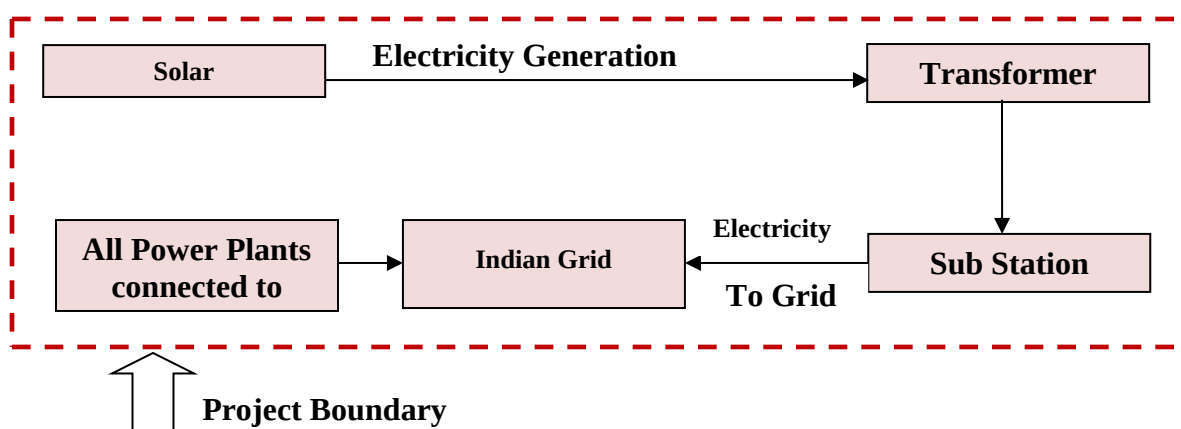
Applicability Criterion	Project Case
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The project is a grid connected Greenfield solar power project and thus the tool is applicable.
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 2: 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.	Steps involved in calculation of Emission Factor is included in section 3.1 of the Joint PD MR as per the requirement of the tool
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.	Project is located in non-Annex I country and hence the tool is applicable
Under this tool, the value applied to the CO ₂ emission factor of biofuels is zero.	The project is a solar project and there is no involvement of biofuels.

2.3 Project Boundary

As per ACM0002 version 19.0 - "The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to".

The project boundary includes the solar project, sub-stations, grid and all power plants connected to grid. The proposed project activity will evacuate power to the Indian grid. Therefore the entire Indian grid and all connected power plants have been considered in the project boundary for the proposed VCS project activity.

⁶ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>



Source		Gas	Included?	Justification/Explanation
Baseline	Grid connected electricity generation	CO ₂	Yes	Main emission source
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
		Other	No	No CO ₂ emissions are emitted from the project
Project	Greenfield Solar Power Project Activity.	CO ₂	No	No CO ₂ emissions are emitted from the project
		CH ₄	No	Project activity does not emit CH ₄
		N ₂ O	No	Project activity does not emit N ₂ O
		Other	No	Project activity does not emit other forms of GHG emissions

2.4 Baseline Scenario

As per the applicable methodology, a Greenfield power plant is defined as “a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity”.

As per ACM0002 version 19.0; “Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

Hence, the baseline for the project activity is the equivalent amount of power from the INDIAN grid.

The combined margin ($EF_{grid,y}$) is the result of a weighted average of two emission factor pertaining to the electricity system: the operating margin (OM) (having weightage 75%) and build margin (BM) (having weightage 25%). Calculations for this combined margin must be based on data from an official source of CEA database (where available) and made publically available.

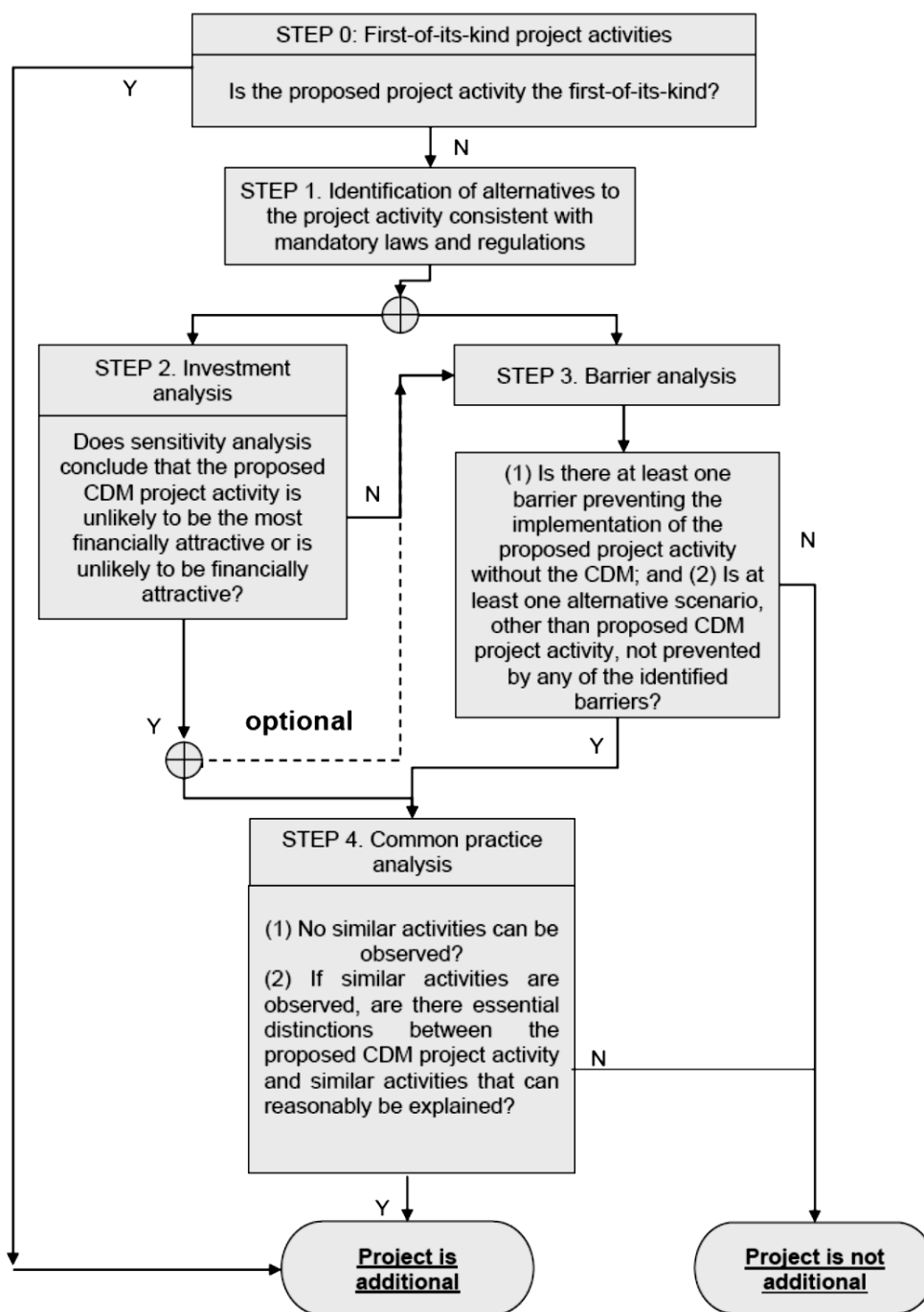
The combined margin of the INDIAN National Grid used for the project activity is as follows:

Parameter	Value	Nomenclature	Source
$EF_{grid,CMy}$	0.9368 tCO ₂ /MWh	Combined margin CO ₂ emission factor for the project electricity system in year y	Calculated as the weighted average of the operating margin (0.75) & build margin (0.25) values, sourced from Baseline CO ₂ Emission Database, Version 14.0, December 2018 published by Central Electricity Authority (CEA), Government of India
$EF_{grid,OM,y}$	0.9610 tCO ₂ /MWh	Operating margin CO ₂ emission factor for the project electricity system in year y	Calculated as the last 3 year (2015-16, 2016-17, 2017-18) generation-weighted average, sourced from Baseline CO ₂ Emission Database, Version 14.0, December 2018 published by Central Electricity Authority (CEA), Government of India
$EF_{grid,BM,y}$	0.8644 tCO ₂ /MWh	Build margin CO ₂ emission factor for the project electricity system in year y	Baseline CO ₂ Emission Database, Version 14.0, December 2018 published by Central Electricity Authority (CEA), Government of India

2.5 Additionality

Additionality Assessment for large scale project activities

The present VCS project generates power using solar energy which is a renewable, zero emission source of energy. Baseline considerations for the project are based on approved consolidated baseline methodology ACM0002 (Version 19.0). The methodology requires the project investor to determine the additionality based on “Methodological Tool- Tool for the demonstration and assessment of additionality”, Version 7.0.0. The step-wise approach to establish additionality of the project activity has been followed, details of which are provided in the following paragraphs:



In line with VCS Standard version 3.7, the additionality of the Project activity is ascertained in line with the applicable guidance from the UNFCCC. The demonstration of additionality for the proposed Project activity is being carried out in accordance with the additionality tool provided by the UNFCCC i.e. “Tool for demonstration and assessment of Additionality” Version 07.0.0,. The tool provides a step-wise approach to demonstrate additionality which is displayed below:

Step 0: Demonstration whether the proposed project activity is the first-of-its-kind

The proposed project activity is not the first-of-its-kind. Hence not applicable.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity:

Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed VCS project activity.

The purpose of the project activity is to generate electrical power using solar energy and feed the electricity generated to the grid. Hence, the following alternatives are considered:

Alternative 1: The proposed project activity not undertaken as a VCS project activity.

The PP could proceed with the implementation of the project without Carbon credit benefits. The electricity produced from the renewable energy project would have been sold to the grid. This is in compliance with all applicable legal and regulatory requirements and can be a part of the baseline. However, the Project activity is not feasible without revenues from sale of Carbon Credits. This argument has been discussed in step 2 of the Additionality section.

Alternative 2: No proposed project activity and equivalent amount of energy would have been produced by the grid electricity system through its currently running power plants and by new capacity addition to the grid i.e. Continuation of the present situation.

The PP would have continued without investment in Project activity with usual business activities. The grid would continue with the fossil fuel based power projects and this would result in GHG emissions. Hence, the new capacity add-on from a fossil fuel based power plant is appropriate, realistic & credible baseline alternative for the project activity.

Outcome of Sub-step 1a: All the realistic alternatives for the project activity have been enlisted above.

Thus though two alternatives are mentioned above as per step of additionality tool, the first alternative is not possible as project activity is not viable without carbon credit benefits and second alternative is the baseline scenario for the project activity as per methodology as mentioned in section 2.4 of joint VCS PD & MR.

It is to be noted that being the green field project activity, “the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

Sub-step 1b: Consistency with mandatory laws and regulations:

The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air

pollution. (This sub-step does not consider national and local policies that do not have legally-binding status.).

The relevant national laws and regulations pertaining to generation of energy in India are:

- Electricity Act 2003
- National Electricity Policy 2005
- Tariff Policy 2006

The Project activity conforms to all the applicable laws and regulations in India:

- Power generation using solar energy is not a legal requirement or a mandatory option.
- There are state and sectoral policies, framed primarily to encourage solar power projects. These policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments.
- The Indian Electricity Act, 2003 (May 2007 Amendment) does not influence the choice of fuel used for power generation.
- There is no legal requirement on the choice of a particular technology for power generation.

Outcome of Sub-step 1b: Hence, both the alternatives enlisted above are found to comply with the mandatory laws and regulations taking into account the enforcement of the legislations in the region or country and EB decisions on national and/or sectoral policies and regulations. However, Alternative 2 has been selected as the appropriate baseline alternative for this project activity.

Step 2: Investment analysis

Determine whether the proposed project activity is economically or financially less attractive than at least one other alternative, identified in step 1, without the revenue from the sale of emission reductions credits. To conduct the investment analysis, use the following sub-steps:

Sub-step 2a: Determine appropriate analysis method

The Project activity envisages to export the power to Indian grid and the revenues from the sale would be generated in accordance with the terms and tariffs established in the Power Purchase Agreement (PPA). Thus, simple cost analysis (Option I) cannot be used as the analysis method as the sale of the units of generated electricity shall result in a revenue stream during the operations of the Project activity.

In the absence of the project activity grid electricity would have been the obvious choice for the Project which requires no investment. Hence investment comparison analysis (Option II) is also not appropriate for the project activity.

After eliminating Option I and Option II, the use of Benchmark analysis (Option III) is the method of analysis that has been selected as the most suitable method. This method determines the attractiveness of the project activity for the investors, as well as provides a measure of the viability of the investment to generate revenues during its operation, as compared with other avenues and investment options. Hence, the Benchmark analysis method is to be employed for analysis of the said project.

Sub-step 2b (Option III): Apply benchmark analysis

The investment analysis using Benchmark analysis approach (Option III) has been chosen. Further, this method illustrates the evaluation of the Project by the PP before the decision to undertake the project was taken and management approval granted.

Choice of Financial Indicator:

According to the "Tool for demonstration and assessment of Additionality", *the financial indicator can be based either on (1) project IRR or (2) equity IRR. There is no general preference between the approaches (1) or (2). The benchmark chosen for analysis shall be fully consistent with the choice of approach.* Therefore in accordance with the guidance, the relevant financial indicator for project activity has been chosen as post tax equity IRR.

Choice of Benchmark:

As per Investment Analysis tool, Required/expected returns on equity are appropriate benchmarks for an equity IRR. The Equity IRR is considered as the financial indicator and the benchmarks used is cost of equity. Hence the benchmarks used are applicable to the project activity and the type of IRR calculation presented

At the time of decision made of project activity, version 09 of methodological tool "Investment Analysis" was the latest available tool for respective calculations, hence PP has considered the same tool for default value of return on equity. The default value of Return on Equity for Group-1 projects in India is 9.79%.

As per paragraph 7 of Appendix A of the above mentioned document, "In situations where an investment analysis is carried out in nominal terms, project participants can convert the real term values provided in the table below to nominal values by adding the inflation rate. The inflation rate shall be obtained from the inflation forecast of the central bank of the host country for the duration of the crediting period. If this information is not available, the target inflation rate of the central bank shall be used. If this information is also not available, then the average forecasted inflation rate for the host country published by the IMF (International Monetary Fund World Economic Outlook) or the World Bank for the next five years after the start of the project activity shall be used".

Default Value Benchmark:

The investment analysis has been carried out in Nominal terms. Accordingly, Default value has been adjusted by adding suitable forecasted inflation rate taken from RBI (Central Bank, India). PP has calculated Benchmark based on WPI mean inflation rate. As per Para 17 of Appendix of EB101, Annex 11, the inflation forecast should be for the duration of the crediting period. However, since RBI provides forecast inflation only for 5 & 10 years, the project investor has calculated benchmark using 10 years durations and the same is considered as Benchmark for the project activity.

The benchmark has been computed in the following manner:

$$\text{Nominal Benchmark}^7 = \{(1 + \text{Real Benchmark}) * (1 + \text{Inflation rate})\} - 1$$

⁷As per Pg. 320 of Corporate Finance, Second Edition of Aswath Damodaran

Where,

Real Benchmark = 9.79% (as per Appendix of EB 101, Annex 11)

Inflation rate = Projected Inflation Rate for India in next 10 years (RBI Forecast)

Benchmark estimation:

Appendix in EB 101, Annex 11 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = **9.79 %**

Inflation Forecast for India as per RBI website⁸:

Benchmark Calculations	Value	Document Date	Decision date
Default Value for India as per UNFCCC guidelines ⁹	9.79%	29-11-2018	13-03-2017
Inflation forecast (WPI Mean) as per RBI for 10yrs ¹⁰	3.90%	08-02-2017	
Benchmark (with 10yrs Forecast)	14.07%		

Thus benchmark of **14.07 %** has been selected for this project activity.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

The Post tax Equity IRR is evaluated for the entire lifetime of the project activity, i.e. 25 years. It is calculated based on the cash outflows from and cash inflows into the project activity.

The IRR and Benchmark analysis are calculated in excel spreadsheet and same will be submitted to DOE during validation of project activity.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

The Post tax Equity IRR is evaluated for the entire lifetime of the project activity, i.e. 25 years. It is calculated based on the cash outflows from and cash inflows into the project activity.

The IRR and Benchmark analysis are calculated in excel spreadsheet and same will be submitted to DOE during validation of project activity.

Based on result of IRR excel spreadsheets, equity IRR (4.38%) is less than 14.07%. The input assumption is mentioned in section Appendix 1: Input **Parameters for Additionality Assessment for Respective Project Activities**

This substantiates that the investment is not financially attractive (Equity IRR for the project activity is less than the Benchmark). Thus it can be easily concluded that project activity is additional & is not business as usual scenario.

⁸ <https://rbi.org.in/Scripts/PublicationsView.aspx?id=17433>

⁹ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v9.0.pdf>

¹⁰ <https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=18712>

Sub-step 2d: Sensitivity Analysis

Addressing Guidance of EB 101, Annex 11, following factors has been subjected to sensitivity analysis:

1. PLF
2. O&M Cost
3. Project Cost
4. Tariff

The rationale of sensitivity is, "The ultimate objective of the sensitivity analysis is to determine the likelihood of the occurrence of a scenario other than the scenario presented, in order to provide a cross-check on the suitability of the assumptions used in the development of the investment analysis."

The results of sensitivity analysis show that even with a variation of +10% & -10% in project cost, O&M cost, PLF and Tariff Rate Equity IRR is significantly lower than the benchmark. And it is evident from the results given above; the project remains additional even under the most favourable conditions.

Probability to breach the benchmark:
Sensitivity Parameter 1 : PLF
PLF considered in financials for is as per Third Party PLF report in line with "Guidelines for the reporting and validation of Plant load factors" stated in EB48 Annex11 option 3(b).
Hence, variation in PLF of more than 10% is unlikely to happen as the PLF has been reported as per the Third Party Report based on long term data.
Sensitivity Parameter 2 : O&M
The sensitivity analysis reveals that O&M will breach the benchmark at negative values and is hypothetical case. Since the O&M cost is subject to escalation (as evidence by the O&M agreement) and also subject to inflationary pressure, any reduction in the O&M costs is highly unlikely. Hence, the reduction in the O&M cost is highly unlikely.
Sensitivity Parameter 3 : Project Cost
Project Cost for financial analysis is considered from DPR of the project activity, being available at the time of investment making decision to go ahead with the project activity. The actual project cost is lower than the DPR cost. Since the Purchase Order cost is firm, there is no possibility of project cost going below this level. However, Sensitivity is carried out for threshold level below which benchmark is not breached.
Sensitivity Parameter 4 : Tariff Rate
The tariff is determined by PPA which is fixed for entire lifetime of the project activity. Hence, there is no probability to get variation for the same. However, Sensitivity is carried out for +/-10% even then the benchmark is not breached.

Outcome of Step 2:

This substantiates that the investment is not financially attractive (Equity IRR for the project activity is less than the Benchmark Equity IRR) for any of the investor. Thus it can be easily concluded that project activity is additional & is not business as usual scenario.

Step 3: Barrier analysis

Barrier analysis has not been used.

Step 4: Common practice analysis

For the concerned project activity, the Common Practice Analysis has been carried out.

Mahindra Renewables Private Limited is the project proponent. Thus common practise analysis has been carried out for the total capacity of the project activity.

The project activity involves generation of electricity from solar energy. The project activity is located in the state of Madhya Pradesh in India and the policy applicable for the solar power projects is regulated by State Electricity regulation Commission (SERC) of the respective state. The policies/tariff for each state is regulated by State Electricity Regulatory Commissions of respective states and they differ for respective states. The project implemented in different states are claimed as different since the policies and regulations differ in each state. Hence Madhya Pradesh state is considered as Geographical area for the project activity.

Stepwise approach for common practice analysis has been carried out as per Methodological tool "Common Practice", version 03.1 EB84, Annex 7:

Step (1): Calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.

Range	Capacity	Unit
+50%	375	MW
Capacity of the proposed project activity	250	MW
-50%	125	MW

Step (2): Identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

- (a) The projects are located in the applicable geographical area;
- (b) The projects apply the same measure as the proposed project activity;
- (c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
- (d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
- (e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
- (f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

Identification of the similar projects (CDM and non-CDM) is carried out as per sub-steps of Step (2) as follows:

- a) As the projects are located in *Madhya Pradesh* state of India, therefore, projects in the geographical area *Madhya Pradesh* have been chosen for analysis. The project activity involves generation of electricity from solar energy. The project activity is located in the different states in India and the policy applicable for the solar projects is regulated by respective state policy. The policies/tariff for each state is regulated by State Electricity Regulatory Commissions of respective

states and they differ for respective states. The project implemented in different states are claimed as different since the policies and regulations differ in each state. Each state have different policies regarding renewable energy, hence *Madhya Pradesh* is considered as geographical region for common practise analysis.

b) The project activity is a green-field solar power project and uses measure (b) “Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies”. Therefore, projects applying same measure (b) are candidates for similar projects.

c) The energy source used by the project activity is solar energy. Hence, only solar PV projects have been considered for analysis.

d) The project activity produces electricity; therefore, all power plants that produce electricity are candidates for similar projects.

e) The capacity range of the projects is within the applicable capacity range from 125 MW to 375 MW.

f) The start date of the large scale project activity is 06-07-2018. Therefore projects, which have started commercial operation before 06-07-2018, have been considered for analysis.

Numbers of Similar projects identified, which fulfil above-mentioned condition are

N_{Solar} = 1

The project identified is given below:-

Sl. No.	Project Investor	Project Name	State	Capacity (MW)	Reference Weblinks
1.	Welspun Solar Madhya Pradesh Pvt. Ltd.	Welspun Renewable Energy Program	Madhya Pradesh	130	https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/4ZK9SWCUA8MTHPYENG2VBQO5F3XJI7/view

Above conclusion are based on publically available data by Ministry of New & Renewable Energy, Government of India for State wise commissioning status of grid connected Solar PV Power Projects is as on 06/07/2018 and for the project activity, the start date is before 06/07/2018¹¹ and this is a conservative approach. The start date of respective project activity is mentioned in CPA analysis excel sheet.

Step (3): Within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

CDM project activities, which have got registered or are under validation have been excluded in this step. The list of the Solar PV projects identified is provided to the DOE.

N_{all} = 0

¹¹<http://mnre.gov.in/file-manager/UserFiles/state-wise-commissioned-grid-connected-solar-power-projects.htm>

Step (4): Within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff} .

As per the tool on Common Practice, the project activities have been separated from the different technologies on the basis two criteria:

1. Size of Installation – Since project activity is large scale project, small and micro scale projects are considered as different technology project. Based on this criteria, there are no any different technology project out of similar identified projects.
2. Investment climate on the date of the investment decision – For proposed project activity, there are no any different technology project considered out of similar identified projects.

Hence, projects where either of the conditions is satisfied those projects are counted for calculating N_{diff} projects.

$N_{diff} = 0$

Step (5): Calculate factor $F = 1 - N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

Calculate $F = 1 - N_{diff}/N_{all}$
 $F = 1 - (0/0) = 1$

As per methodological tool “common practise” version 03.1, the proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all} - N_{diff}$ is greater than 3.

Thus if both conditions are fulfilled, then project activity will be a common practise otherwise, the project activity is treated as not a common practise.

Outcome of Common Practise analysis:

As,

- i. $F = 1$, which is greater than 0.2
- ii. $N_{all} - N_{diff} = 0$; is not greater than 3

The project activity does not satisfy the (ii). Hence, project activity is not a common practice.

2.6 Methodology Deviations

Not Applicable

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

As per the approved consolidated Methodology ACM0002 version 19.0 the Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the

addition of new grid- connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \text{ (para 42, ACM0002 V19)}$$

Being as a green field plant, $EG_{PJ,y} = EG_{facility,y}$ (para 44, ACM0002 V19)

Therefore,

$$BE_y = EG_{facility,y} \times EF_{grid,CM,y}$$

Where:

BE_y = Baseline emissions in year y (tCO₂/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid 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 grid in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO₂/MWh)

As per methodology, combined grid emission factor as per the "Tool to calculate the emission factor for an electricity system" version 07 is calculated as below.

CO₂ Baseline Database for the Indian Power Sector, Version 14¹² published in December 2018 by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

As per the "Tool to calculate the emission factor for an electricity system" Version 07.0, EB 100, Annex 4, the following steps have been 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

As described in tool "For determining the electricity emission factors, identify the relevant project electricity system. Similarly, identify any connected electricity systems". It also states that "If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used". Keeping this into 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 NEWNE grid from FY 2007-08 onwards for the purpose of this CO₂ Baseline Database. As of 31

¹² http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

December 2013, the Southern grid has also been synchronised with the NEWNE grid, hence forming one unified 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.

Table: Geographical Scope of Indian Electricity Grid

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

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.

The data required to calculate Simple adjusted OM and Dispatch data analysis OM is not possible due to lack of availability of data to project developers. The choice of other two options for calculating operating margin emission factor depends on generation of electricity from low-cost/must-run sources. In the context of the methodology low cost/must run resources typically include hydro, geothermal, wind, low cost biomass, nuclear and solar generation.

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

	2013-14	2014-15	2015-16	2016-17	2017-18
India	18.6%	16.8%	15.1%	14.6%	14.3%

Data Source: Central Electricity Authority (CEA) database Version 14, December 2018¹³

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

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

- (a) **Ex-ante option:** if the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

OR

- (b) **Ex-post option:** 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.

PP has chosen ex-ante option for calculation of Simple OM emission factor using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation.

OM determined at validation stage will be the same throughout the crediting period. There will be no requirement to monitor & recalculate the emission factor during the crediting period.

Step 4: Calculate the operating margin emission factor (EF_{grid,OMSimple,y}) according to the selected method

The operating margin emission factor has been calculated using a 3 year data vintage:

Net Generation in Operating Margin (GWh) (incl. Imports)			
	2015-16	2016-17	2017-18
INDIAN Grid	871,753	916,278	960,693

Simple Operating Margin (tCO ₂ /MWh) (incl. Imports)			
	2015-16	2016-17	2017-18
INDIAN Grid	0.9655	0.9636	0.9543

Weighted Generation Operating Margin			
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¹³ http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

INDIAN Grid	0.9610
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STEP 5: Calculate the build margin emission factor ($EF_{BM,y}$)

Option 1 as described above is chosen to calculate the build margin emission factor for the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PDD and is fixed for the entire crediting period.

Build Margin (tCO ₂ /MWh) (not adjusted for imports)	
	2017-18
INDIAN Grid	0.8644

STEP 6: Calculate the combined margin (CM) emissions factor

Combined Margin – 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 wind and solar photovoltaic, the Tool to calculate the emission factor for an electricity system, Version 07.0.0, EB 100, Annex 4, allows to weigh the operating margin and Build margin at 75% and 25%, respectively for wind and solar projects and 50% and 50%, respectively for hydro and biomass projects.

The baseline emission factor is calculated using the combined margin approach as described in the following steps:

Calculation of Baseline Emission Factor EF_y

The baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$$

Where,

w_{OM}	75% weight for Solar energy projects
w_{BM}	25% weight for Solar energy projects
$EF_{OM,y}$	calculated as described in Steps 3&4 above (tCO ₂ /MWh)
$EF_{BM,y}$	calculated as described in Steps 5 above (tCO ₂ /MWh)

$$\begin{aligned} \text{Baseline Emission factor (INDIAN Grid)} &= 0.75 * 0.9610 + 0.25 * 0.8644 \\ &= 0.9368 \text{ tCO}_2/\text{MWh} \end{aligned}$$

The baseline emission factor is ex-ante parameter and will remain constant throughout the crediting period.

$$BE_y = 416215.8 \times 0.9368 = 389,911 \text{ tCO}_2$$

3.2 Project Emissions

As per the approved consolidated Methodology ACM0002 (Version 19.0) para 36: “For most renewable energy power generation project activities, $PE_y = 0$. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

PE_y = Project emissions in year y (t CO₂e/yr)

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (t CO₂/yr)

$PE_{GP,y}$ = Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO₂e/yr)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (t CO₂e/yr)

As the project activity involves installation of Solar Power plant and does not involve any project emissions from fossil fuel, operation of dry, flash steam or binary geothermal power plants, and from water reservoirs of hydro power plants. Therefore $PE_{FF,y}$, $PE_{GP,y}$, $PE_{HP,y}$ are equal to zero and thus, $PE_y = 0$.

3.3 Leakage

No other 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.

3.4 Estimated Net GHG Emission Reductions and Removals

Reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year y (t CO₂e/yr)

BE_y = Baseline emissions in year y (t CO₂/yr)

PE_y = Project emissions in year y (t CO₂e/yr)

Therefore, Net GHG Emission Reductions and Removals are calculated as follows:

$$ER_y = BE_y - PE_y$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)

06-07-2018 to 05-07-2019	389,802	0	0	389,802
06-07-2019 to 05-07-2020	390,635	0	0	390,635
06-07-2020 to 05-07-2021	389,568	0	0	389,568
06-07-2021 to 05-07-2022	389,568	0	0	389,568
06-07-2022 to 05-07-2023	389,568	0	0	389,568
06-07-2023 to 05-07-2024	390,635	0	0	390,635
06-07-2024 to 05-07-2025	389,568	0	0	389,568
06-07-2025 to 05-07-2026	389,568	0	0	389,568
06-07-2026 to 05-07-2027	389,568	0	0	389,568
06-07-2027 to 05-07-2028	390,635	0	0	390,635
Total	3,899,117	0	0	3,899,117

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	EF _{grid,OM,y}
Data unit	tCO ₂ /MWh
Description	Operating Margin CO ₂ emission factor in year y
Source of data	Calculated from CEA database, Version 14, December 2018 ¹⁴
Value applied	0.9610
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per “Tool to calculate the emission factor for an electricity system, version 07” as 3-year generation weighted average using data for the years 2015-2016, 2016-2017 & 2017-2018. The data are obtained from “CO ₂ Baseline Database for Indian Power Sector” version 14, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

Data / Parameter	EF _{grid,BM,y}
Data unit	tCO ₂ /MWh

¹⁴ http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

Description	Build Margin CO ₂ emission factor in year y
Source of data	Calculated from CEA database, Version 14, December 2018 ¹⁴
Value applied	0.8644
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per “Tool to calculate the emission factor for an electricity system, version 07” as per the latest data available for the most recent year 2018. The data is obtained from “CO ₂ Baseline Database for Indian Power Sector” version 14, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO ₂ /MWh
Description	Combined Margin CO ₂ emission factor in year y
Source of data	Calculated from CEA database, Version 14, December 2018 ¹⁴
Value applied	0.9368
Justification of choice of data or description of measurement methods and procedures applied	The combined margin emissions factor is calculated as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$ Where: $EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh) $EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/MWh) W_{OM} = Weighting of operating margin emissions factor (%) = 75% W_{BM} = Weighting of build margin emissions factor (%) = 25% Calculated as per “Tool to calculate the emission factor for an electricity system, version 07.0.0”. The data is obtained from “CO₂ Baseline Database for Indian Power Sector” Version 14, December 2018, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project (Solar) plant/unit to the grid during the monitoring period

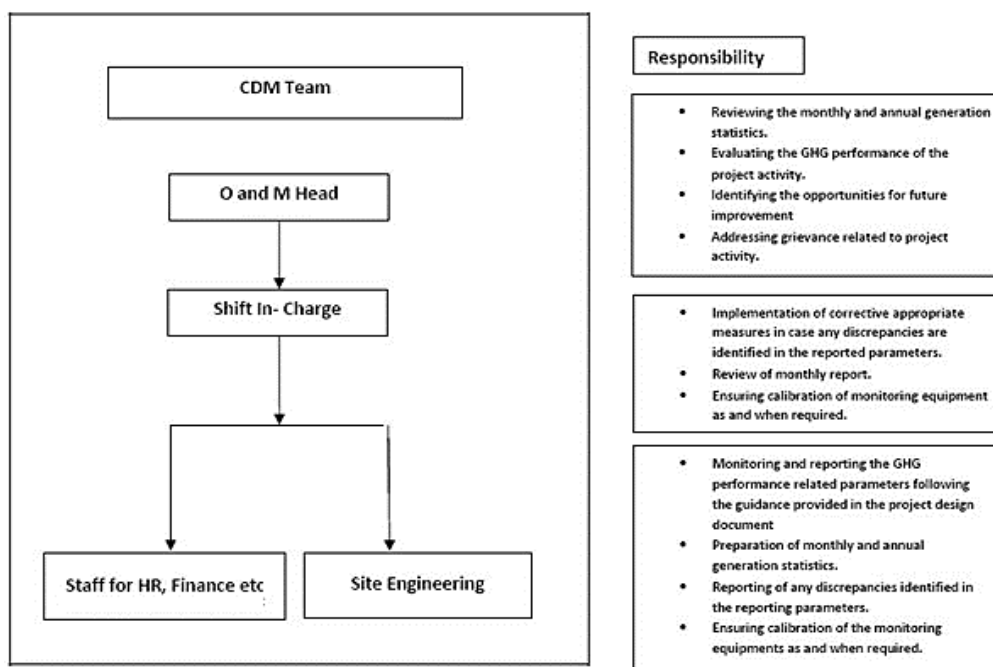
Source of data	Regional Energy Account statement issued by WRPC
Description of measurement methods and procedures applied	Data Type: Measured Monitoring equipment: Energy Meters are used for monitoring. Recording Frequency: Continuous monitoring and Monthly recording from Energy Meters, Summarized Annually Archiving Policy: Paper & Electronic Class of meter: 0.2s. Calibration frequency: One in five years¹⁵ Electricity exported by the project to the grid at project site switch yard is the actual generation recorded and monitored by the metering system installed at the project site switch yard. The metering system comprises of three individual special energy meters (SEMs) (acts as standby meters) installed at the power station, for each generating units. These are connected via four transmission lines of 220 kV, each having its own SEM meter (main meter and check meter). In case, anyone transmission line is not in service than complete load will be shifted to other transmission line which is in operation. The energy meters are special energy meters which are installed and sealed by the Power Grid Corporation of India Limited in the presence of the representatives of the power producer. The check meter shall be used during the period the main metering system is not in service. Further in case of failure of both main meter and check meter, sum of the net electricity generation recorded by three individual special energy meters (SEMs) and individual auxiliary meters shall be used for accounting and billing purpose.
Frequency of monitoring/recording	Continuous monitoring and monthly recording
Value applied:	416215.8
Monitoring equipment	Special Energy Meters (SEMs) of 0.2s accuracy class
QA/QC procedures applied	Energy meters will be calibrated once in a five year and faulty meters will be duly replaced immediately. This data may be cross checked with the Monthly Generation Reports
Purpose of data	Calculation of Baseline emissions
Calculation method	N/A
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

¹⁵ http://www.aegcl.co.in/Metering_Regulations_Of_CEA_17_03_2006.pdf

4.3 Monitoring Plan

The monitoring plan is developed in accordance with the modalities and procedures for CDM project activities and is proposed for solar energy power project. The monitoring plan, which will be implemented by the project participant describes about the monitoring organisation, parameters to be monitored, monitoring practices, quality assurance, quality control procedures, data storage and archiving.

The authority and responsibility for registration, monitoring, measurement, reporting and reviewing of the data rests with the project participant. PP proposed the following structure for data monitoring, collection, data archiving and calibration of equipments for this project activity. The team comprises of the following members:



Data Measurement

The electricity supplied or transmitted is sourced from the “Regional Energy Account” and the same can be cross checked from the Invoices raised by the PP. The “Regional Energy Account” is a publically available document which is issued by the ‘Western Regional Power Committee¹⁶. The “Regional Energy Account” statement are available on monthly basis and based upon this, the invoices are raised by the PP.

Data collection and archiving

The records are checked periodically by the Plant Manager and discussed thoroughly with the plant supervisor. The period of storage of the monitored data will be 2 years after the end of crediting period or till the last issuance of VERs for the project activity whichever occurs later.

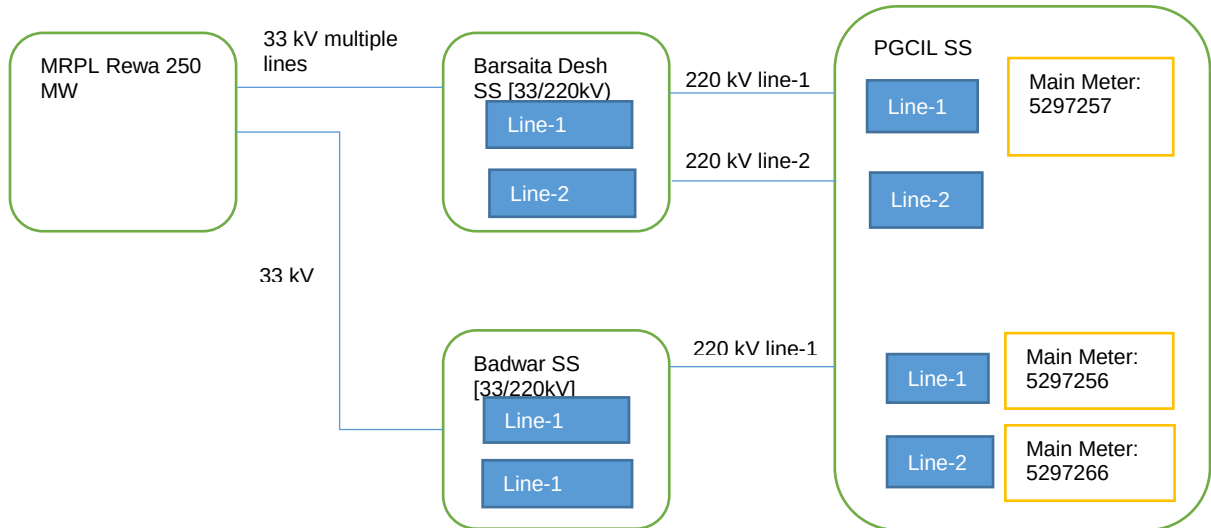
Emergency preparedness

¹⁶ http://www.wrpc.gov.in/Commercial_REA.asp?ln=e

The project activity will not result in any unidentified activity that can result in substantial emissions from the project activity. No need for emergency preparedness in data monitoring is visualized.

Personnel training

In order to ensure a proper functioning of the project activity and a properly monitoring of emission reductions, the staff will be trained. The plant helpers will be trained in equipment operation, data recording, reports writing, operation and maintenance and emergency procedures in compliance with the monitoring plan.



The energy meter line diagram is illustrated above, the billing energy meter are connected to the PGCIL substation.

5 SAFEGUARDS

5.1 No Net Harm

The project activity does not involve any major construction activity. The report on “Developmental Impacts and Sustainable Governance Aspects of Renewable Energy Projects” prepared by MNRE dated September 2013. This report clearly mentioned that solar project activity operations do not result in direct air pollution, noise pollution. Please refer below web link for the same¹⁷.

Thus there are no any significant impacts due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

5.2 Environmental Impact

The guidelines on Environmental Impact Assessment have been published by Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India (GOI) under

¹⁷ <http://mnre.gov.in/file-manager/UserFiles/report-on-developmental-impacts-of-RE.pdf>

Environmental Impact Assessment notification 14/09/2006¹⁸. Further amendments to the notification have been done on 14/07/2018¹⁹. As per the notification:

“The following projects or activities shall require prior environmental clearance from the concerned regulatory authority, which shall hereinafter referred to be as the Central Government in the Ministry of Environment and Forests for matters falling under Category ‘A’ in the Schedule and at State level the State Environment Impact Assessment Authority (SEIAA) for matters falling under Category ‘B’ in the said Schedule, before any construction work, or preparation of land by the project management except for securing the land, is started on the project or activity:

- (i) All new projects or activities listed in the Schedule to this notification;
- (ii) Expansion and modernization of existing projects or activities listed in the Schedule to this notification with addition of capacity beyond the limits specified for the concerned sector, that is, projects or activities which cross the threshold limits given in the Schedule, after expansion or modernization;
- (iii) Any change in product - mix in an existing manufacturing unit included in Schedule beyond the specified range.”

As the Solar power generation projects are not listed in any of the categories of the schedule, So, the project is considered environmentally safe and as per Host party- India no EIA is required

5.3 Local Stakeholder Consultation

The details of the Stakeholder Meetings are as follows:

For Renewable Solar Power Project by Mahindra Renewables Private Limited

Date of invitation – 10/04/2017

Date of Meeting – 14/04/2017

Location of Meeting - Project site, Gurh, Madhya Pradesh

In the introductory speech, the representative of Mahindra Renewables Private Limited (Project Investor), welcomed the gathering and given a brief about the climate mitigation project activity. Subsequent to the introductory speech, stakeholders were explained about the electricity generation from solar project is an environmental friendly power generation technology contributing to reduction in GHG emissions. They were also explained about the benefits of the Solar power projects like, increasing energy availability and improving quality of power and its assistance to the local population by providing employment opportunities to both skilled & unskilled labours.

Regular stakeholder engagement is one the key focus at the site. Some of the pictures of stakeholder consultation are depicted below:-

¹⁸ EIA Notification 2006: <http://envfor.nic.in/legis/eia/so1533.pdf>

¹⁹ EIA Notification 2018: <http://www.egcipl.com/Doc/Gazette%20Notification.pdf>



Figure 2. Consultation with the Villagers



Figure 3. Interaction with Harijan Basti family



Figure 4. Focus group discussion with Women's group



Figure 5. Interaction with the children regarding education facilities



Figure 6. Consultation with the Village men

The question raised by the villagers are summarised below:

Q: Will there be employment generation due to the project activity for youth from the adjoining areas?

A: Responding about the increased possibilities for employment of local youth due to the project activity, it was pointed out that preference would be given for locals in the employment opportunities.

Q: Will there be any facility for proper drainage system because we already have send application to Tehsil but have not received any response yet?

A: Yes, we will look in to this matter once the project is fully commissioned and assure you all to find a solution for the drainage problem.

Q: The Villagers told that the there is a problem of power supply and asked that will there be free supply of power to the local people?

A: The generated power will be fed in the grid. Project promoter can't supply directly power to the local people. They have to get authorized connection from Govt. body. But due to the project activity the supply of power in the area will increase.

Project representatives explained the project benefits and how project would help to fight against climate change and no any negative comments received during the local stakeholder round. The questions raised during the local stakeholder consultation are addressed satisfactorily. Villagers were totally in support for setting up of these kinds of projects in the region.

5.4 Public Comments

As a part of continuous feedback from stakeholders, there were no other major comments or protest raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region. The project is also open for GCS comments from 26th November to 26th December. https://www.vcsprojectdatabase.org/#!/pipeline_details/PL2059

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	EG _{facility,y}
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project (Solar) plant/unit to the grid
Values applied:	241508.09
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

6.2 Baseline Emissions

$$BE_y = EG_{PJ, y} * EF_{grid, CM, y}$$

Where:

- BE_y : Baseline emissions in year y (tCO₂e/yr)
- EG_{PJ, y} : Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the VCS project activity in year y (MWh/yr)
- EF_{grid,CM,y} : Combined margin CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO₂e/MWh)

Parameter	Unit	Value
EG _{PJ, y}	MWh	241508.09
EF _{grid,CM,y}	tCO ₂ e	0.9368
BE _y	=	241508.09* 0.9368
	=	226,244 (Round down value)

6.3 Project Emissions

As per methodology ACM0002 Version 19.0, for renewable energy projects, there is no any project emissions occurred.

Hence, PE_y= 0

6.4 Leakage

As per methodology ACM0002 Version 19.0, for renewable energy projects, there is no any leakage emissions occurred.

Hence, LE_y= 0

6.5 Net GHG Emission Reductions and Removals.

The net emission reduction would be:

$$ER_y = BE_y - PE_y - LE_y$$

$$= 226,244-0-0$$

$$=226,244 \text{ tCO}_2\text{e}$$

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
06/07/2018 to 31/12/2018	23196	0	0	23196

01/01/2019 to 30/11/2019	196997	0	0	203049
Total	226,244	0	0	226,244

The actual emission reduction is lower than 8.22% from the estimated emission reduction. The generation of electricity depends upon many other climatic conditions, and not within the control of the project participant. The lower generation during the current verification period is hence due to certain natural conditions and hence acceptable.

Appendix 1: Input Parameters for Additionality Assessment for Respective Project Activities

Assumptions and Values considered for Financial and Sensitivity Analysis of Mahindra Renewables Private Limited are as follows:

Project Investor – Mahindra Renewables Private Limited	Equity IRR without CDM	Benchmark (Equity IRR)
	4.38%	14.07%

Assumption and financial of Project

Details of the project		Source
State where the project is situated	Madhya Pradesh	As per DPR
Total Capacity (MW)	250.00	As per DPR
Expected Date of Commissioning	01-06-18	As per DPR
Life of the plant (Yrs.)	25	MPERC order, pg 13 ²⁰
Generation of electricity		
PLF (%)	19.00%	MPERC order, pg 10 ²¹
Annual generation (kWh)	416,100,000	Calculated Value
Annual Degradation per year	0.60%	CERC order ²²
Tariff rate (INR/kWh)	2.979	As per PPA
Escalation in tariff rate		As per Schedule 1 of PPA
Transmission & Wheeling Losses (%)	0.00%	
Operation and maintenance cost and Insurance		
O & M Expenses (INR Mn.)	87.50	As per DPR
O & M free for (Yr.)	-	

²⁰ <http://www.mperc.in/080816-SMP-25-16-solar.pdf>

²¹ <http://www.mperc.in/080816-SMP-25-16-solar.pdf>

²² <http://www.cercind.gov.in/2015/orders/SO4.pdf>

Escalation in the operational expenses (%)	5.72%	MPERC order, pg 13 ²³
Insurance (INR Mn.)	240.00	CERC order ²⁴
Financial parameters		
TOTAL COST (INR Mn.)	12,000.00	As Per DPR
Loan Amount (INR Mn.)	8,400.00	As Per DPR
Equity Investment (INR Mn.)	3,600.00	As Per DPR
Term loan		
Loan Amount (INR Mn.)	8,400.00	As Per DPR
Interest rate (%)	10.50%	As Per DPR
Loan Tenure (Qtr.)	52	As Per DPR
Moratorium Period (Qtr.)	-	Assumption
Repayment Period (Qtr.)	52	Calculated Value
Repayment instalments value (INR Mn.)	161.538	Calculated Value
1st instalment from (Qtr. end)	30-Sep-18	Considered from the next Quarter End

Sensitivity Analysis:

Sensitivity Analysis	Equity IRR			
Variation %	-10%	Normal	10%	Breaching Value
PLF	2.69%	4.38%	6.11%	59.40%
O&M	4.60%	4.38%	4.16%	-551.97%
Project Cost	6.05%	4.38%	3.02%	-45.28%
Tariff Rate	4.20%	4.38%	4.57%	395.99%

Appendix 2: Meter Details at 220 kV_PGCIL End

Meter Serial No.	Make	Type	Accuracy class	Meter Calibration date	Due date of meter calibration
5297256	Elster	ABT	0.2S	25/11/2015	24/11/2020
5297266	Elster	ABT	0.2S	25/11/2015	24/11/2020
5297257	Elster	ABT	0.2S	25/11/2015	24/11/2020

²³ <http://www.mperc.in/080816-SMP-25-16-solar.pdf>

²⁴ <http://www.cercind.gov.in/2016/orders/SO17.pdf>