BUNDLED SOLAR POWER PROJECT BY D. J. MALPANI AND GIRIRAJ ENTERPRISES

ENKING INTERNATIONAL

Document Prepared By EKI Energy Services Limited

Project Title	Bundled Solar Power Project by D.J. Malpani and Giriraj Enterprises
Version	2
Date of Issue	27-March-2017
Monitoring Period	31-March-2015 to 25-Feb-2017 (both days included)
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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The purpose of the bundled project activity is to generate power using renewable energy source (solar energy) and sell the power generated to the state grid. The project activity generates electricity using solar energy. The generated electricity is exported to the regional grid system which is under the purview of the INDIAN electricity grid of India.

The proposed project activity will support development of renewable energy generation plants based on Solar PV technology in India and delivering electricity to the grid.

The proposed project activity is a voluntary action being undertaken project investors. Since, the solar power is Green House Gas (GHG) emissions free, the power generated will replace anthropogenic emissions of greenhouse gases estimated to be approximately 93,022 tCO2e per year, thereon displacing 95,145 MWh/year amount of electricity from the generation-mix of power plants connected to the INDIAN GRID, which is mainly dominated by thermal/ fossil fuel based power plant.

The total installed capacity of the current project activity is 56.25 MW; which involves operation of solar power plants in the states of Tamil Nadu and Telangana in India. The project is promoted by following project investors which are as follows:

Project Investors	Project Type	Project Capacity in AC	Date of Commissioning	Project Location	State
M/s. D. J. Malpani	Solar	16.25 MW	31-03-2015	Village- Hoti Tehsil- Zaheerabad Mandal, District- Medak	Telangana
Giriraj Enterprises	Solar	40 MW	23-09-2015	Village- Sengottai, Tehsil- Virudhunagar, District- Virudhunagar,	Tamilnadu

The bundled project activity is a new facility (Greenfield) and the purpose of the bundled project activity is to generate energy electricity by the utilization of renewable solar PV technology and further selling the generated energy to the Indian Grid. In this process there is no consumption of any fossil fuel and hence the project does not lead to any greenhouse gas emissions. Thus, electricity would be generated through sustainable means without causing any negative impact on the environment.

In the Pre- project scenario the entire electricity, delivered to the grid by the bundled project activity, would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

For current monitoring period, the actual emission reductions achieved are 145,393 tCO2.

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 17.0[1]
The proposed project activity is not a grouped project activity.

1.3 Project Proponent

Organization name	M/s. D.J. Malpani
Contact person	Mr. Prafulla Khinvasara
Title	CEO- Renewable Power Projects
Address	Malpani House, New Nagar Road, Tal- Sangamner, Dist – Ahmednagar, Maharashta, India
Telephone	-
Email	-

Organization name	Giriraj Enterprises
Contact person	Mr. Prafulla Khinvasara
Title	CEO- Renewable Power Projects
Address	Malpani House, New Nagar Road, Tal- Sangamner, Dist – Ahmednagar, Maharashta, India
Telephone	-
Email	-

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Mr. Manish Dabkara
Title	MD & CEO
Address	Office No. 201, EnKing Embassy, Plot No. 48, Scheme No. 78, Part II, Vijay Nagar INDORE – 452010, India.
Telephone	+91-731-4289086
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[1] http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

1.5 Project Start Date

The first project activity of the bundled project under consideration was commissioned and power generation started on 31-March-2015 at Hoti, Zaheerabad Mandal in District Medak, in the state of Telangana in India. Hence the project start date is defined as follows:

Project Start Date: 31-Mar-2015

The project start date is the date on which first Solar PV plant was commissioned under the bundled project activity.

Project Owner	Capacity	DOC[2]	Village	Taluka	District	State
M/s. D. J. Malpani	16.25	31-03-2015	Hoti	Zaheerabad Mandal	Medak	Telangana
Giriraj Enterprises	40	23-09-2015	Sengottai	Virudhunagar	Virudhunagar	Tamilnadu

1.6 Project Crediting Period

Crediting Period Start date: 31-Mar-2015

Crediting Period End date: 30-Mar-2025

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

The project involves setting up of 56.25 MW of solar power project.

Project Scale	
Project	✓
Large project	

EX- ANTE EMISSION REDUCTION CALCULATIONS OF PROPOSED PROJECT ACTIVITY

Investor Name	Capacity (MW)	PLF	Net Generation	Baseline Emission factor	Baseline emissions	Project emissions	Leakage Emissions	Emission reductions
			(MWh/year)	(tCO_2/MWh)	(tCO_2e/year)	(tCO_2e/year)	(tCO_2e/year)	(tCO_2e/year)
D.J. Malpani	16.25	18.10%	25,765	0.9777	25,190	0	0	25,190

[2] Date Of commissioning

Giriraj Enterprises	40	19.80%	69,379	0.9777	67,832	0	0	67,832
Total	**56.25**		**95,145**		**93,022**	**0**	**0**	**93,022**
In Ten Years								**9,30,220**

As the Estimated GHG emission reductions or removals per year considering total project activity capacity is 93,022 (tCO_2e) which is less than 300,000 tonnes of CO_2e per year, thus the project falls in the category of Project

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	93,022
Year 2	93,022
Year 3	93,022
Year 4	93,022
Year 5	93,022
Year 6	93,022
Year 7	93,022
Year 8	93,022
Year 9	93,022
Year 10	93,022
Total estimated ERs	930,220
Total number of crediting years	10
Average annual ERs	93,022

1.8 Description of the Project Activity

The proposed bundled project activity involves the installation of Solar Power Projects in different states of India i.e. Tamil Nadu and Telengana. The total installed capacity of the project is 56.25 MW.

The bundled project activity is a new facility (Greenfield) and the electricity generated by the Project will be exported to the INDIAN GRID electricity 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 Proponents plan to avail the VCS benefits for the Project.

In the Pre- project scenario the entire electricity, delivered to the grid by the project activity, would have otherwise been generated by the operation of grid-connected power plants which is mainly dominated by fossil fuels or by the addition of new generation sources.

The project shall result in replacing anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 93,022 tCO2e per year, thereon displacing 95,145 MWh/year amount of electricity from the gird.

Solar Power Project Technology Details –

The bundled project activity aims to harness solar energy through installation of PV with total installed capacity of 56.25 MW. Solar energy is a pollution-free, infinitely sustainable form of energy. It does not use fossil fuel. It does not produce greenhouse gases, and it does not produce toxic or radioactive waste. Therefore the technology used for the project activity is environmentally safe and sound.

The proposed bundled project activity will generate power using solar energy, which is a renewable source of energy. The solar PV system mainly consists of PV modules, module mounting structures, junction boxes, Inverters, regulators, monitoring devices etc. The solar PV cells convert solar radiation into DC current. The solar panels are installed in arrays. The modules in the each array are connected in parallel and/or series in order to get the preferred current & voltage which match with the rated input parameters of the inverter. The Inverter connected in each array converts the DC current to AC current. The electricity collected from all the inverters is stepped up to 11 kV through a 415V/11kV transformer. The 11 kV electricity is further stepped up to 66 kV and then supplied to Indian grid. The operational life time of the project activity is 25 years. The commissioning of the project activity has been completed and details are mentioned in section 1.5.

There is no technology transfer involved in this project activity.

The technical Specifications for 16.25 MW project activity is as below

CSUN 255-60P- Polycrystalline Solar PV modules

Capacity DC – 17.92854 (70308 No of Nodules, 255 Watt capacity)

Inverter – ABB make, PVS800-57-1000KW-C

The technical Specifications for 40 MW project activity is as below

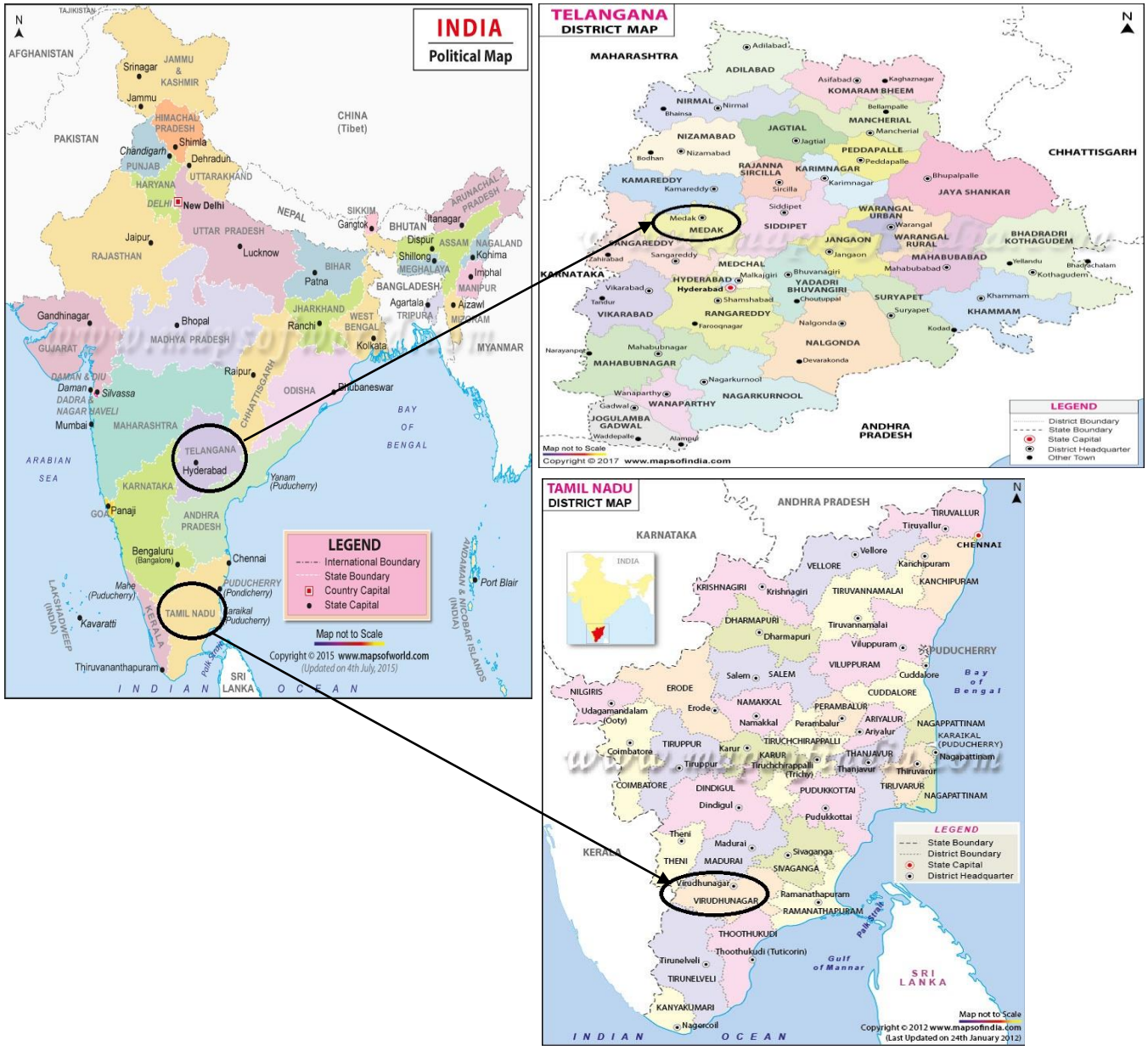
Canadian Solar PV Modules, 315 Wp (CS6X-315P),

Capacity DC – 49.565280 (Total Modules (87024+72864=159,888) of 315 Watt capacity)

AC output capacity – 40 MW

1.9 Project Location

The location of the project activity has been highlighted in the map shown below



The details of the Geo-Coordinates of the project location is given below

Project Owner	Village	Taluka	District	State	Latitude (D° M' Sec")	Longitude (D° M' Sec")
M/s. D. J. Malpani	Hoti	Zaheerabad Mandal	Medak	Telangana	17°39'21.08" N	77°33'24.55" E
Giriraj Enterprises	Sengottai	Virudhunagar	Virudhunagar	Tamil Nadu	9°38'8.03"N	77°51'16.17" E

1.10 Conditions Prior to Project Initiation

The project activity instances as part of the proposed bundled project activity are Greenfield renewable power generation projects. These will be installed at locations where there was no power generation activity at the site. In the absence of the project activity instances as part of the proposed bundled project activity, the equivalent amount of electricity would have been generated from the existing/new power plants connected to the grid. Therein, the main emission source in the pre-project scenario are the grid connected power plants and the primary GHG involved is CO_2. For this project activity, the baseline scenario is the same as conditions existing prior to project initiation. Please refer section 2.4 of joint VCS PD and MR for baseline scenario for the project activity.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project has received necessary approvals for development and commissioning for each plants from the state Nodal agencies and is in compliance to the local laws and regulations.
The PPA, Commissioning Certificates are the project ownership documents which are executed only when the project activity compliance laws and regulatory requirements. Land procurement was initiated only after obtaining the required approvals for the project activity.

Apart from above, as per Central pollution Control Board directions No. B-29012/ESS (CPA) /2015-16 dated 07/03/2016, the wind/solar projects having capacity less than 25 MW, the category of industries has been changes from Green to White. As per this re-categorisation exercise," There shall be no necessity of obtaining the Consent to Operate'' for White category of industries. An intimation to concerned SPCB / PCC shall suffice". As per this rule, No necessity of consent for non-polluting industries.
http://cpcb.nic.in/upload/Latest/Latest_118_Final_Directions.pdf

1.12 Ownership and Other Programs

1.12.1 Project Ownership

The Project is owned by Individual investors hence it possess right of use of ER credits. The Ownership is demonstrated through the following documents.

1) Commissioning certificates for solar plant in the name of Project Owner issued by respective state electricity board.

2) Power Purchase Agreement with respective State Electricity Board for sale of electricity by the PP

1.12.2 Emissions Trading Programs and Other Binding Limits

Net GHG emission reductions or removals generated by the bundled project activity under consideration will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions in any Emission Trading program or other binding limits.

1.12.3 Other Forms of Environmental Credit

The Project has no intend to generate any other form of GHG-related environmental credit for GHG emission reductions or removals other than CDM or VCS. It is going to be registered under VCS program to avail pre CDM credits. If any PP is availing REC benefits, the PP will claim either VCU or REC and there will not be any double accounting for the same monitoring period.

1.12.4 Participation under Other GHG Programs

The Project is not registered in other GHG programs. For current monitoring period, there is no any claim of GHG emission reductions with other GHG program.

1.12.5 Projects Rejected by Other GHG Programs

The Project is not rejected by other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

This is not a grouped project activity. Thus, this section is not applicable for this project.

Leakage Management

Not applicable to the project activity.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Sustainable Development

Contribution to sustainable development:

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 will generate power using zero emissions solar based power generation which helps to reduce GHG emissions and specific pollutants like SOx, NOx, and SPM associated with the conventional thermal power generation facilities.

- **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

Till now no legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and/or temporal information that may have a bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission reductions or removals.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Methodology: ACM0002: Grid-connected electricity generation from renewable sources --- Version 17.0, Sectoral Scope: 01,
https://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

The project activity also takes reference from following Tools from the tools prescribed by applied methodology:

1. Tool for the demonstration and assessment of additionality --- Version 07.0.0, EB 70, Annex 8 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

2. Tool to calculate the emission factor for an electricity system --- Version 05.0, EB 87, Annex 09 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf

2.2 Applicability of Methodology

The following steps will show the applicability of the project under this methodology.

Applicability Criterion	Project Case
1. This methodology is applicable to grid-connected renewable energy power generation project activities that: a. Install a Greenfield power plant; b. Involve a capacity addition to (an) existing plant(s); c. Involve a retrofit of (an) existing operating plants/units; d. Involve a rehabilitation of (an) existing plant(s)/unit(s);or	The project activity is installation of a new grid connected solar power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant) and hence this criterion is applicable.

e. Involve a replacement of (an) existing plant(s)/unit(s).	
2. 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 is an installation of a new grid connected solar power plant. Hence this condition is met.
3. 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 is the installation of a Greenfield solar power plant/unit. Therefore, the said criteria is not applicable
4. In case of hydro power plants, one of the following conditions shall apply: 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 (3), is greater than 4 W/m2; or c. The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m2; 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 (3),is lower than or equal to 4 W/m2, all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (4),is greater than 4 W/m2; (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/m2 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 proposed project activity is the installation of a Greenfield solar power plant/unit. Therefore, the said criteria is not applicable
5. 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	The proposed project activity is the installation of a Greenfield solar power plant/unit. Therefore, the said criteria is not applicable

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.	
6. The methodology is not applicable to: • 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 Greenfield solar power plant/unit. Therefore, the said criteria is not applicable
7. 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 equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The project activity involves a new grid connected solar power plant and not a retrofits, replacement or capacity additions and therefore this criterion is not applicable to the project activity.
8. In addition, the applicability conditions included in the tools referred to below apply.	The project applies the following tools and is in compliance to the same; • "Tool to calculate the emission factor for an electricity system"; • "Tool for the demonstration and assessment of additionality";

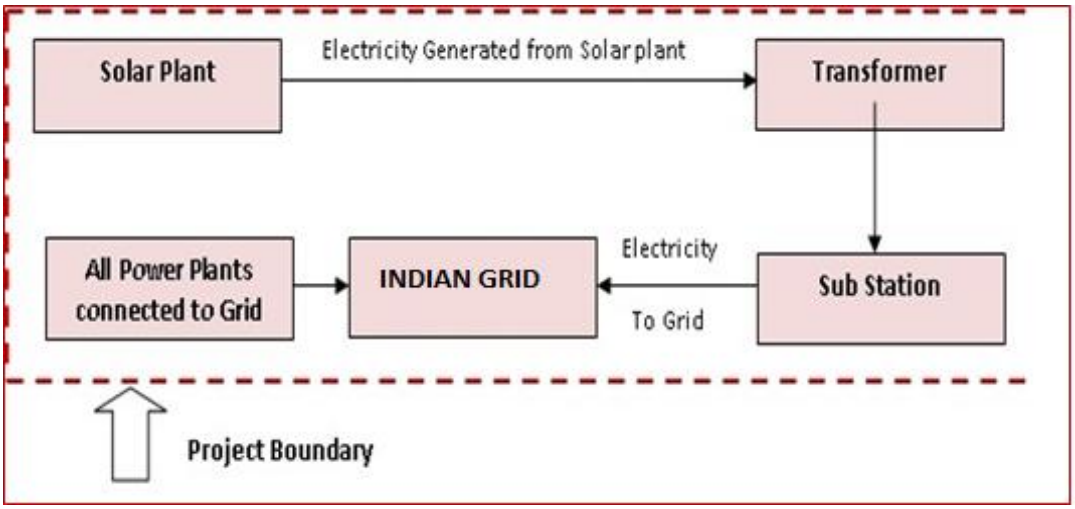
2.3 Project Boundary

As per the para 20 of the applicable methodology ACM0002 (Version 17.0.0) "*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*".

Therefore, the project boundary includes solar power plant along with the other solar power plant connected to the sub-station, which is further connected to the network of the Indian grid, i.e. the project boundary also includes the Indian grid. Thus, the project boundary further includes all the power plants physically connected to the Indian grid.

Source		GHGs	Included?	Justification/Explanation
Baseline Scenario	Grid-connected electricity generation	CO_2	Yes	Major emission sources.
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
Project Scenario	Greenfield solar energy generation system	CO_2	No	The project activity does not emit any emissions.
		CH_4	No	No methane generation is expected to be emitted.
		N_2O	No	No nitrous oxide generation is expected to be emitted.

Project Boundary Diagram:



2.4 Baseline Scenario

As per para 23 of ACM0002 version 17.0; If the project activity is the installation of a Greenfield power plant

"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 25%) and build margin (BM)

(having weightage 75%). 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
$EF_{grid,y}$	0.9777 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 11.0 published by Central Electricity Authority (CEA), Government of India.
$EF_{grid,OM,y}$	0.9941 tCO_2/MWh	Operating margin CO_2 emission factor for the project electricity system in year y	Calculated as per "Tool to calculate the emission factor for an electricity system, version 05.0.0" as 3-year generation weighted average using data for the years 2012-2013, 2013-2014 & 2014-2015. The data are obtained from "CO_2 Baseline Database for Indian Power Sector" version 11.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
$EF_{grid,BM,y}$	0.9285 tCO_2/MWh	Build margin CO_2 emission factor for the project electricity system in year y	Calculated as per "Tool to calculate the emission factor for an electricity system, version 05.0.0" 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. The data is obtained from "CO_2 Baseline Database for Indian Power Sector" version 11.0, published by the Central Electricity Authority, Ministry of Power, Government of India.

2.5 Additionality

In line with VCS Standard version 3.6, 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;

No, this project activity is not first-of-its-kind project. The additionality of the project activity has demonstrated by using the investment barrier and the same has been discussed in the following steps.

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.

As per methodology, the baseline scenario is fixed i.e *"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*

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: The baseline scenario is the alternative to the project activity.

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, Baseline Scenario 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 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.

After eliminating Option I, 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 para 9 of methodological Tool "Investment Analysis" Version 07 (EB92 Annex 5), the value for cost of equity is selected from Appendix, however as per para 11 of tool, the default value is considered from Appendix, However Appendix A of Annex 05 of EB 62 was available to PP at the time of decision made. The default value of Return on Equity for Group-1 projects in India is 11.75%. This default value was available to PP at the time of decision made, hence this default value is taken for Benchmark analysis.

As per paragraph 7 of Appendix A of Annex 05 of EB 62 and para 17 of EB92 Annex 5 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 Calculations:

As mentioned in Appendix A in EB62 Annex 5 and latest Clarification from UNFCCC in EB 73 (Applicability of the "Guidelines on the assessment of investment analysis" version 01.0), default value benchmark is presented below:

Appendix A in EB62 Annex 5 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = 11.75%
The Required return on equity (benchmark) was computed in the following manner:

Nominal Benchmark[3] = {(1+Real Benchmark)*(1+Inflation rate)} - 1

Where:
- Default value for Real Benchmark = 11.75% (as per Appendix of Annex 5, EB 62)
- Inflation Rate forecast by Reserve Bank of India (RBI) (i.e. Central Bank of India) for India

Decision date for the project activity

Project Activity	Decision Date	Start Date of project activity
D J Malpani_16.25 MW	05/06/2014	15/10/2014
Girriraj Enterprises_40 MW	05/06/2015	08/06/2015

Benchmark for D J Malpani_16.25 MW project activity

Default Value

As per EB62, Annex 05 Dated: 15 July 2011

Equity IRR Calculation as per Default Value in EB 62 Annex 5	
Benchmark	**17.45%**

Benchmark Calculations	**Value**	**Sources Link**	**Document Date**
Default Value for India as per UNFCCC guidelines	**11.75%**	As per EB 62 Annex 5	15-07-2011
Inflation forecast (WPI Mean) as per RBI for 10yrs	**5.10%**	https://rbi.org.in/Scripts/PublicationsView.aspx?id=15761	03-06-2014
Benchmark (with 10yrs Forecast)	**17.45%**	Calculated	
Benchmark	**17.45%**	Calculated	

Benchmark for Girriraj Enterprises_40 MW project activity

Default Value

As per EB62, Annex 05 Dated: 15 July 2011

Equity IRR Calculation as per Default Value in EB 62 Annex 5

[3] As per Pg. 320 of Corporate Finance, Second Edition of Aswath Damodaran

Benchmark	**16.00%**

Benchmark Calculations	Value	Sources Link	Document Date
Default Value for India as per UNFCCC guidelines	**11.75%**	As per EB 62 Annex 5	15-07-2011
Inflation forecast (WPI Mean) as per RBI for 10yrs	**3.80%**	https://rbi.org.in/Scripts/PublicationsView.aspx?id=16402	03-06-2015
Benchmark (with 10yrs Forecast)	**16.00%**	Calculated	
Benchmark	**16.00%**	Calculated	

For input assumptions and IRR calculations, the IRR spreadsheets are shared to the DOE.

Input values considered for Giriraj Enterprises are as follows:

Cost of the Project Activity

SPV Name	**Giriraj Enterprises**

Project Location	Senkottai Village, Virudhnagar
State	Tamil Nadu
Project Capacity (MW)	40
Expected Date of Commissioning	23-Sep-2015
Life of Plant in years	25

	DPR & Offer letter		
	1-Apr-15		
			in INR MN
Items	Cost	Tax	Cost + Tax
Total Project Cost	3,000.00	**370.80**	3,370.80
Total	3,000.00	370.80	3,370.80
Land	36.40	**4.50**	40.90
O&M Expenses	**32.00**	**3.96**	**35.96**
	5% Escalation, starting from 2nd Yr.		

Input values and assumptions are considered are as follows:

Details of the project	Source

State where the project is situated	Tamil Nadu	DPR
Total Capacity (MW)	40.00	DPR
Expected Date of Commissioning	23-Sep-15	Assumption
Life of the plant (Yrs.)	25	DPR (page 12 of 65)
Generation of electricity		
PLF (%)	19.80%	Third Party DPR
Annual generation (kWh)	69379200	Calculated Value
Annual Degradation per year	0.30%	Assumption
Tariff rate at the decision making (INR/kWh)	6.28[4]	DPR (page 58 of 65)
Escalation in tariff rate	0.0%	DPR (page 58 of 65)
Transmission & Wheeling Losses (%)	0.00%	
GBI Benefit (INR/kWh) if applicable	-	As per MNRE scheme dt. 04.09.2013[5]
Operation and maintenance cost and Insurance		
O & M Expenses (INR Mn.)	35.96	
O & M free for (Yr.)	-	
Escalation in the operational expenses (%)	5.00%	
Administrative expenses (INR MN)	10.00	Administration and Miscellaneous expenses
Escalation in Administrative expenses	5.00%	Escalation for Admin Expenses
Insurance (INR Mn.)	16.85	As per TAC order 2001, Sheet No. 31[6]
Financial parameters		
TOTAL COST (INR Mn.)	3,370.80	Offer letter
Loan Amount (INR Mn.)	2,359.56	Assumption
Equity Investment (INR Mn.)	1,011.24	Calculated Value
Term loan		
Loan Amount (INR Mn.)	2,359.56	assumption 70% loan and 30% equity
Interest rate (%)	14.50%	Bank of Baroda PLR

[4] http://www.solarguidelines.co.in/index.php/tamil-nadu/

[5] http://www.ireda.gov.in/forms/contentpage.aspx?lid=743

[6] http://www.cercind.gov.in/2016/orders/SO17.pdf

Loan Tenure (Qtr.)	**28**	Assumption
Moratorium Period (Qtr.)	**2**	Assumption
Repayment Period (Qtr.)	**26**	Calculated Value
Repayment instalments value (INR Mn.)	**90.752**	Calculated Value
1st instalment from (Qtr. end)	**31-Mar-16**	Considered from the next Quarter End
Book Depreciation (SLM Method)		
Land	40.90	
Gross Depreciable Value (INR Mn.)	3,329.90	Calculated Value
Salvage Value (%)	10.00%	
Salvage value (INR Mn.)	332.99	Calculated Value
Net Depreciable Value (INR Mn.)	2,996.91	Calculated Value
Residual Value (INR Mn.)	373.89	Calculated Value
IT Depreciation		
IT Depreciation (%)	80%	As per IT act
Income Tax		
Financial Year	FY 2015-16	
Income tax rate (%)	30.00%	As Per Income Tax Rule, Pg 30 Para E(I)[7]
MAT (%)	18.50%	As Per IT rule Pg 4[8]
Service Tax (%)	12.00%	As Per Income Tax Rule[9]
Surcharge (%)	10.00%	As Per Income Tax Rule, Pg 30[10]
Education cess (%)	3.00%	As Per Income Tax Rule, Pg 5, 11 and 12[11]
Final Tax rates		
Income tax rate (%)	33.99%	Calculated Value
MAT (%)	20.96%	Calculated Value
Service Tax (%)	12.36%	Calculated Value

[7] http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html

[8] http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html

[9] http://taxguru.in/service-tax/service-tax-rate-increased-1236-14-subsuming-ec-shec-effective-01062015.html

[10] http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html

[11] http://taxguru.in/income-tax/income-tax-rates-fy-201314-ay-201415.html

Input values considered for M/s. D. J. Malpani are as follows:

Cost of the Project Activity	
SPV Name	**D J Malpani**

Project Location	Zaheerabad
State	Telangana
Project Capacity (MW)	16.25
Expected Date of Commissioning	31-Mar-2015
Life of Plant in years	25

	DPR & Offer letter		
	12-Apr-14		
			in INR MN
Items	Cost	Tax	Cost + Tax
Total Project Cost	1,137.50	**140.60**	1,278.10
Total	1,137.50	140.60	1,278.10
Land	13.00	**1.61**	14.61
O&M Expenses	**13.00**	**1.61**	**14.61**
	5% Escalation, starting from 2nd Yr.		

Input values and assumptions are considered are as follows:

Details of the project		Source
State where the project is situated	Telangana	DPR
Total Capacity (MW)	16.25	DPR
Expected Date of Commissioning	31-Mar-15	Assumption
Life of the plant (Yrs.)	25	DPR (page 12 of 65)
Generation of electricity		
PLF (%)	18.10%	Third Party DPR
Annual generation (kWh)	25765350	Calculated Value
Annual Degradation per year	0.30%	Assumption
Tariff rate at the decision making (INR/kWh) (fixed for first 20 years)	6.49	DPR (page 58 of 65)

Tariff rate after 20th year	6.49	Assumption
Escalation in tariff rate	0.0%	DPR (page 58 of 65)
Transmission & Wheeling Losses (%)	0.00%	
GBI Benefit (INR/kWh) if applicable	-	As per MNRE scheme dt. 04.09.2013[5]
Operation and maintenance cost and Insurance		
O & M Expenses (INR Mn.)	14.61	
O & M free for (Yr.)	-	
Escalation in the operational expenses (%)	5.00%	
Administrative expenses (INR MN)	4.06	Administration and Miscellaneous expenses
Escalation in Administrative expenses	5.00%	Escalation for Admin Expenses
Insurance (INR Mn.)	6.39	As per TAC order 2001, Sheet No. 31[6]
Financial parameters		
TOTAL COST (INR Mn.)	1,278.10	Offer letter
Loan Amount (INR Mn.)	894.67	Assumption
Equity Investment (INR Mn.)	383.43	Calculated Value
Term loan		
Loan Amount (INR Mn.)	894.67	assumption 70% loan and 30% equity
Interest rate (%)	14.50%	Bank of Baroda PLR
Loan Tenure (Qtr.)	**28**	Assumption
Moratorium Period (Qtr.)	**2**	Assumption
Repayment Period (Qtr.)	**26**	Calculated Value
Repayment instalments value (INR Mn.)	**34.410**	Calculated Value
1st instalment from (Qtr. end)	**30-Sep-15**	Considered from the next Quarter End
Book Depreciation (SLM Method)		
Land	14.61	
Gross Depreciable Value (INR Mn.)	1,263.49	Calculated Value
Salvage Value (%)	10.00%	Standard Accounting Practise
Salvage value (INR Mn.)	126.35	Calculated Value
Net Depreciable Value (INR Mn.)	1,137.14	Calculated Value
Residual Value (INR Mn.)	140.96	Calculated Value
IT Depreciation		

IT Depreciation (%)	80%	As per IT act
Income Tax		
Financial Year	FY 2014-15	
Income tax rate (%)	30.00%	As Per Income Tax Rule[7]
MAT (%)	18.50%	As Per IT rule[8]
Service Tax (%)	12.00%	As Per Income Tax Rule[9]
Surcharge (%)	10.00%	As Per Income Tax Rule,[10]
Education cess (%)	3.00%	As Per Income Tax Rule,[11]
Final Tax rates		
Income tax rate (%)	33.99%	Calculated Value
MAT (%)	20.96%	Calculated Value
Service Tax (%)	12.36%	Calculated Value

Considering the input values, equity IRRs for all projects are given below:

Project Promoters' Name	Equity IRR without CDM	Benchmark (Equity IRR)
Giriraj Enterprises	9.39%	16.00%
M/s. D. J. Malpani	9.30%	17.45%

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.

Sub-step 2c: Sensitivity Analysis:

As per methodological Tool "Investment Analysis" Version 07 (EB92 Annex 5), only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation and the results of this variation should be presented in the PDD and be reproducible in the associated spreadsheets. Guidance also states, "All parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude". The Annex also states, as a general point of departure, variations in the sensitivity analysis should at least cover a range of +10% and –10%, unless this is not deemed appropriate in the context of the specific project circumstances.

Since the project cost is already firmed up, the cost is not variable. The tariff is determined by PPA which is fixed for years mentioned as per the tariff order and hence it need not be subjected to variation. All other expenses are much less than 20% of the total cost. Hence, only PLF needs to be subjected to reasonable variation. Nevertheless, following factors have been subjected to sensitivity analysis:

(a) PLF

(b) O&M Cost
(c) Project Cost
(d) Tariff Rate

The results for Giriraj Enterprises are as follows:

Variation %	-10%	Normal Equity IRR	10%	Breaching Value
PLF	**6.69%**	**9.39%**	**12.11%**	**23.33%**
O&M	**9.70%**	**9.39%**	**9.03%**	**-203.60%**
Project Cost	**11.91%**	**9.39%**	**7.31%**	**-21.70%**
Tariff Rate	**6.69%**	**9.39%**	**12.11%**	**23.33%**

The results for M/s. D.J. Malpani are as follows:

Variation %	-10%	Normal Equity IRR	10%	Breaching Value
PLF	**6.56%**	**9.30%**	**12.17%**	**28.30%**
O&M	**9.69%**	**9.30%**	**8.93%**	**-237.00%**
Project Cost	**11.95%**	**9.30%**	**7.30%**	**-25.39%**
Tariff Rate	**6.56%**	**9.30%**	**12.17%**	**28.30%**

It can be observed from above tables that in various scenarios wherein there are changes in tariff, O&M cost, net saleable units and project's capital cost, the Equity IRR does not cross the benchmark. Thus, it can be concluded that revenue from sale of VCUs is important to alleviate this gap and hence the project has been considered to be additional.

	Probability to breach the benchmark
PLF	Not possible as the actual PLF has been less than threshold limit considered in sensitivity calculations and hence a PLF fluctuation of more than threshold limit is unlikely to happen.
O&M	With the country experiencing 6.50% inflation on an average, the question of O&M coming down is ruled out. Moreover, the purchase orders provide for a 5% escalation in the cost every year.
Project Cost	Since the project cost is firm, there is no possibility of project cost going below this level. With actual project cost, IRR is not crossing the benchmark. The actual project cost is within the threshold limit mentioned in sensitivity analysis..
Tariff Rate	The tariff is determined by PPA which is fixed for 25 years mentioned as per the State Electricity Board's tariff order. Hence, there is no probability to get variation for the same.

Step 3: Barrier analysis

Barrier analysis has not been used.

Step 4: Common practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed Project activity:

Common practice analysis has been carried out as per methodological tool "Common Practice, version 03.1 ". In the context of the project activity, the following parameters are defined as per **Part I. Definitions** of the Guidelines on Common Practice:

1. Applicable Geographical Area (Para 1): The host country, i.e. India has been considered as the applicable geographical area for this project.

2. Measure (Para 2): The project activity reduces greenhouse gas emissions by generating electricity using renewable energy source-solar. Therefore, the project activity falls under the following measure:
   (b) Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies

.

3. Output (Para 3): The project activity produces electricity. Therefore, electricity is considered as output of the project activity.

4. Different Technologies (Para 4): The project activity uses solar energy for producing electricity and hence as per Para 4(a), the technologies which use energy source/ fuel other than solar will be considered as the different technologies for the project activity

For Giriraj Enterprises (40 MW in Tamilnadu state):

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%	60	MW
Capacity of the proposed project activity	40	MW
-50%	20	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) Project is located at Tamilnadu state in India. The policies/tariff for each state is regulated by the State Electricity Regulatory Commission of the respective states. The geographical scope of project activity is India. Therefore, the policies and tariff are different in different states. Therefore, Tamilnadu state has been considered as Geographical Region has been chosen for analysis.

(b) The project activity is a green-field solar power project (renewable energy 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, all projects applying same measure (b) as the proposed project activity are candidates for similar projects.

(c) The energy source used by the project activity is solar. Hence, only solar energy 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 20 MW to 60 MW.

(f) The start date of the project activity is 08/06/2015. Therefore projects, which had started commercial operation before 08/06/2015 have been identified.

Numbers of Similar projects (CDM and non-CDM) identified, which fulfil above-mentioned conditioned are:

Particulars	No. of Projects	Source
N_{Solar}	2[12]	Publically available data MNRE, GOI[13]

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}.*
All the projects identified in step-2 are either registered or project activities submitted for registration, or project activities undergoing validation.

Thus N_{all} = 2

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}.*

From the projects identified above, those projects which employ "**different technologies**" have been excluded and the number of such projects has been identified as N_{diff}.

There are no any different technology project from selected all projects, thus the value of Ndiff is considered as zero.

[12] Name of the Investor/Project State/Province Capacity, MW
a) Welspun Solar Tech Pvt Ltd Tamil Nadu 50
b) Welspun Solar Tech Pvt Ltd Tamil Nadu 50

[13] http://mnre.gov.in/file-manager/UserFiles/state-wise-commissioned-grid-connected-solar-power-projects.htm

As N_{all} = 2; thus 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 $F=1-N_{diff}/N_{all} = 1$

As N_{all} =2 thus and N_{all}-N_{diff} = 2;

Outcome of Step 5:

As,

i. F = 1;
ii. N_{all}-N_{diff} = 2 which is less than 3

Thus, the proposed project activity is not a "common practice" within a sector in the applicable geographical area.

For M/s. D.J. Malpani (16.25 MW in Telangana):

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%	24.38	MW
Capacity of the proposed project activity	16.25	MW
-50%	8.13	MW

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

(g) The projects are located in the applicable geographical area;
(h) The projects apply the same measure as the proposed project activity;
(i) 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;
(j) 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;
(k) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
(l) 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:

(g) Project is located at Telangana state in India. The policies/tariff for each state is regulated by the State Electricity Regulatory Commission of the respective states. The geographical scope of project activity is India. Therefore, the policies and tariff are different in different states. Therefore, Telangana state has been chosen for analysis.

(h) 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, all projects applying same measure (b) as the proposed project activity are candidates for similar projects.

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

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

(k) The capacity range of the projects is within the applicable capacity range from 8.13 MW to 24.28 MW.

(l) The start date of the project activity is 15/10/2014.Therefore projects, which had started commercial operation before 15/10/2014 have been identified.

Numbers of Similar projects (CDM and non-CDM) identified, which fulfil above-mentioned conditioned are:

Particulars	No. of Projects	Source
N_{Solar}	1[14]	Publically available data MNRE, GOI[15]

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}.*
All the projects identified in step-2 are either registered or project activities submitted for registration, or project activities undergoing validation.

Thus N_{all} = 1

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}.*

From the projects identified above, those projects which employ "**different technologies**" have been excluded and the number of such projects has been identified as N_{diff}.

There are no any different technology project from selected all projects, thus the value of Ndiff is considered as zero.
As N_{all} = 1; thus N_{diff} = 0

[14] Name of the Investor/Project State/Province Capacity, MW
a) Emmvee Energy Pvt Ltd Telangana 10

[15] http://mnre.gov.in/file-manager/UserFiles/state-wise-commissioned-grid-connected-solar-power-projects.htm

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 $F=1-N_{diff}/N_{all} = 1$

As N_{all} =1 thus and $N_{all}-N_{diff} = 1$;

Outcome of Step 5:

As,

iii. F = 1;

iv. $N_{all}-N_{diff} = 1$ which is less than 3

Thus, the proposed project activity is not a "common practice" within a sector in the applicable geographical area.

2.6 Methodology Deviations

There is no methodology deviation

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

As per para 44 of ACM0002 version 17.0, Baseline emissions include only CO_2 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:

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

Where:

BEy	=	Baseline emissions in year *y* (t CO_2/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 CO_2 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" (t CO_2/MWh)

Calculation of $EG_{PJ,y}$

The methodology ACM 0002 (Version 17.0) has procedures for calculation of $EG_{PJ,y}$ for the following cases:

(a) Greenfield plants,
(b) Retrofits and replacements, and

(c) Capacity additions.

As the proposed project activity is Greenfield plant, option (a) as provided in the methodology ACM 0002 (Version 17.0) shall be applicable and is described below:

"If the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

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

Where:

$EG_{PJ,y}$: 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)

Calculation of $EF_{grid,CM,y}$

The methodology ACM0002 (Version 17.0) requires that the combined margin for the grid be calculated in accordance with the procedure provided in the latest version of *"Tool to calculate the emission factor for an electricity system".*

CO_2 Baseline Database for the Indian Power Sector, Version 11.0, April 2016[16], published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission factor. This version is the latest available CEA database for the emission factor.

As per the "Tool to calculate the emission factor for an electricity system[17]" Version 05.0, EB 87, Annex 9, 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 power systems

The tool defines that "*for determining the electricity emission factors, identify the relevant 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.

[16] http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver11.pdf

[17] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf

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 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: Grid Classification

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

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

Project participants have the option of choosing 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) method

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 or Dispatch data analysis is not possible due to lack of availability of this activity data to the project developers. The choice of other two options for calculating the operating margin emission factor depends on the 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)

	2010-11	2011-12	2012-13	2013-14	2014-15
INDIAN	18.4%	19.6%	16.9%	18.6%	16.8%

Data Source: Central Electricity Authority (CEA) database Version 11, April'2016

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 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;

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:

- **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

- **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 the calculation of OM with 3 years generation weighted average of the most recent years available at the time of submission of CDM-PDD 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 first crediting period.

STEP 4: Calculate the operating margin emission factor 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) (excl. Imports)			
	2012-13	2013-14	2014-15
INDIAN Grid	7,01,976	7,25,037	8,10,011

Simple Operating Margin (tCO_2/MWh) (incl. Imports)			
	2012-13	2013-14	2014-15
INDIAN Grid	0.9922	1.0002	0.9903

Weighted Generation Operating Margin	
INDIAN Grid	**0.9941**

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)	
	2014-15
INDIAN Grid	**0.9285**

(With sample group constituting most recent capacity additions to the grid comprising 20% of the system generation)

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[18], Version 05.0.0, EB 87, Annex 9, allows to weigh the operating margin and Build margin at 75% and 25%, respectively**.**

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 of operating margin emissions factor (%)
w_{BM}	25% weight of build margin emissions factor (%)
$EF_{OM,y}$	calculated as described in Steps 3&4 above (tCO_2/MWh)
$EF_{BM,y}$	calculated as described in Steps 5 above (tCO_2/MWh)

Baseline Emission factor (INDIAN Grid) = 0.75*0.9941 + 0.25*0.9285
= 0.9777 tCO_2/MWh

Therefore, Baseline Emissions:
For D J Malpani –

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

[18] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf

BE_y **= 25,765 x 0.9777 = 25,190 tCO_2**

For Girirraj Enterprises –

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

BE_y **= 69,379 x 0.9777 = 67,832 tCO_2**

Total Baseline Emissions for both projects:

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

BE_y **= 95,145 x 0.9777 = 93,022 tCO_2**

3.2 Project Emissions

The project emission calculation as per para 35 of ACM0002 version 17,

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

Where:

PE_y	=	Project emissions in year *y* (t CO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (t CO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (t CO_2e/yr)

$PE_{FF,y} = 0$, As per para 37 of ACM0002 version 17, *"For all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected"*

$PE_{GP,y} = 0$, Not applicable for the solar power projects

$PE_{HP,y} = 0$, Not applicable for the solar power projects

Therefore, $\mathbf{PE_y = 0}$

3.3 Leakage

As per para 60 of ACM0002 version 17, No leakage emissions need to considered for the project activity.

3.4 Estimated Net GHG Emission Reductions and Removals

As per para 61 of ACM0002 version17; Emission Reductions are calculated as follows:

$ER_y = BE_y – PE_y$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2/yr)
PE_y	=	Project emissions in year *y* (t CO_2e/yr)

Therefore, Net GHG Emission Reductions and Removals combined for both sites are calculated as follows:
$ER_y = BE_y – PE_y$

ER_y =93,022– 0

= 93,022 **tCO_2**

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
Year 1	93,022	0	0	93,022
Year 2	93,022	0	0	93,022
Year 3	93,022	0	0	93,022
Year 4	93,022	0	0	93,022
Year 5	93,022	0	0	93,022
Year 6	93,022	0	0	93,022
Year 7	93,022	0	0	93,022
Year 8	93,022	0	0	93,022
Year 9	93,022	0	0	93,022
Year 10	93,022	0	0	93,022
Total	930,220	0	0	930,220

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 11, April 2016[19]
Value applied:	0.9941
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 05.0.0" as 3-year generation weighted average using data for the years 2012-2013, 2013-2014 & 2014-2015. The data are obtained from "CO_2 Baseline Database for Indian Power Sector" version 11.0, 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
Description	Build Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 11, April 2016[20]
Value applied:	0.9285
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 05.0.0" BM is calculated ex-ante based on the most recent information available at the time of submission of PD and is fixed for the entire crediting period. The data is obtained from "CO_2 Baseline Database for Indian Power Sector" version 11.0, 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	$EF_{grid,y}$
Data unit	tCO_2/MWh
Description	Combined Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 11, April 2016[21]
Value applied:	0.9777
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 CO_2 emission factor in year *y* (tCO_2/MWh) $EF_{grid,OM,y}$= Operating margin CO_2 emission factor in year *y* (tCO_2/MWh) W_{OM} = Weighting of operating margin emissions factor (%) = 75% W_{BM}= Weighting of build margin emissions factor (%) = 25%
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

[19] http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver11.pdf

[20] http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver11.pdf

[21] http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver11.pdf

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project (Solar) plant/unit to the grid in year y
Source of data	Joint meter readings
Description of measurement methods and procedures to be applied	The value of net electricity generation supplied to the grid as per Joint Meter Reading Report forms the basis for calculation of the emission reductions; which can be cross checked from the invoice raised to DISCOM. Net electricity supplied to grid will be calculated as the difference of the measured values of "export" and "import" of electricity through the dedicated SEB energy meter installed at the delivery point (i.e. the connected substation). Net electricity generated and supplied by the project (Solar) plant/unit to the grid = Electricity Export to the grid - Electricity Import from the grid Monthly meter readings are taken from the main and check meter installed at the substation and certified by the representatives of SEB Officials and the representatives of the project proponent.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value applied:	95,145 MWh
Monitoring equipment	Monitoring: Tri vector meter will be used Data type: Measured Type of meter: Static type meter (Main & Check). Both are Bidirectional meters. Class of meter: 0.2s
QA/QC procedures to be applied	• The energy meter reading are taken on monthly basis • Energy meters will be calibrated once in a five year[22] and faulty meters will be duly replaced immediately. • All the energy meters are under the control of state utility and calibration of energy meters is also under the jurisdiction of state utility. • The Net electricity exported to the grid will be cross checked against the invoice raised by the PP towards the DISCOM
Purpose of data	Calculation of Baseline emissions
Calculation method	-
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

4.3 Monitoring Plan

Aim of monitoring:

[22] As per CEA regulation

The monitoring methodology specified in the methodology requires that the project-monitoring plan to consist of monitoring of quantity of net electricity supplied to the grid in the year y. In order to monitor the mitigation of GHG due to the project activity, the total energy exported needs to be measured. The net energy supplied to grid by the project activity multiplied by emission factor for regional grid, would form the baseline for the project activity.

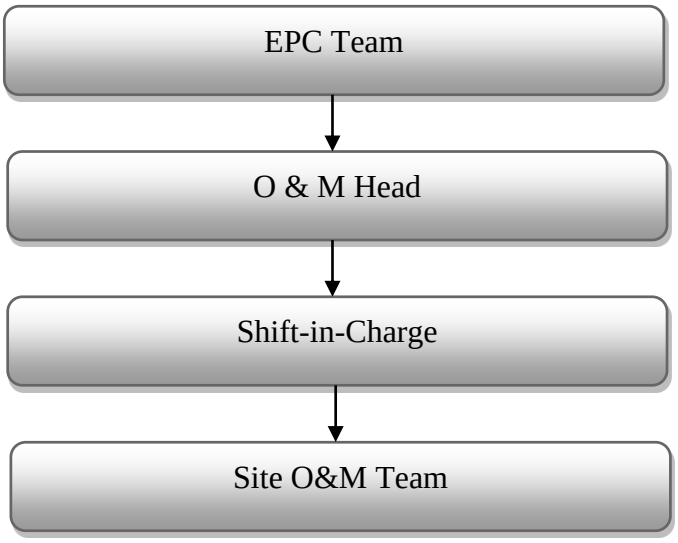
Since the baseline emission factor is based on an ex-ante determination, monitoring of this parameter is not required. The sole parameter for monitoring is the net electricity exported to the grid.

Monitoring roles and responsibilities

The operational and management structure implemented for data monitoring is as follows:

The monitoring plan is developed in accordance with the modalities and procedures for project activities and is proposed for grid-connected solar power project being implemented within India territory. The monitoring plan, which will be implemented by the project proponent 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 proponent. 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:



Responsibilities of O & M Head: Overall functioning and maintenance of the project activity and overall responsibility of compliance with the CDM/VCS Monitoring Plan.

Responsibilities of Plant In-charge: Responsibility for Maintains the data records, ensures completeness of data, and reliability of data. Regularly verifying the monthly energy generation date

with energy sales receipt or installed meters reading for identification of any discrepancies in data collection and taking suitable action to rectify them.

Apportioning –

In case of common metering arrangement, the apportioning will be done by state electricity board and PP is getting break up sheet where the energy supplied by project activity to grid is mentioned. The same break up sheet will be used for invoice purpose. This apportioning process is under control of state electricity board and PP do not have any control on it.

Responsibilities of Shift In-charge: Responsibility for day to day data collection and maintains day to day log book for monitored data. Responsibility for monthly and annual report generation. Quality assurance of the data/reports and preliminary check of data for any discrepancies.

QA/QC procedures:
The energy meters at the feeders are maintained and owned by state electricity board. Neither the project proponent nor the site personnel have any control over it. The records will be cross-checked with the records of sold electricity to state electricity board. The meters are calibrated by state electricity board at-least once in five years.

Data Measurement:
The export and import energy will be measured continuously using above mentioned Main & Check meters. Export & Import readings of Main & Check meters shall be taken on monthly basis by authorized officer of state electricity board in the presence of PP or representative of PP. The meter reading will be taken jointly and signed by the representatives of the state electricity board and project investors. Based on the readings, invoices will be raised by project investors. These invoices can be used for cross checking the meter readings taken for the project activity. It is to be noted though PP or PP representative is available during meter reading, the calculations of net electricity supplied to grid is completely under purview of state electricity board officer and PP do not have any control on it. Also accuracy class of meters and calibration frequency is under purview of state electricity board officer and PP do not have any control on it. PP got the monthly credit report from where net electricity supplied to grid is obtained and used for emission reduction calculations.

Data Archiving:
Monthly data shall be archived electronically and in paper form and stored for the entire crediting period and two years thereafter.

Emergency preparedness:

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.

In the event that the main meter, which is used to record the net electricity exported by the project, is found to be faulty it will be repaired or replaced and the data from the check meter will be used in its place. In the unlikely event that the check meter fails it will also be repaired or replaced.

Training and maintenance requirements:

. Each and every site personnel is provided with proper training to meet the requirements of the Operations and maintenance. This ultimately leads to creativity in problem solving.

Personnel training:
In order to ensure a proper functioning of the project activity and a properly monitoring of emission reductions, the staff (CDM/VCS team) 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.

Apportioning:
In case of mismatch of date between the start date of the billing cycle and the start date of monitoring period the data will be apportioned in line to the daily generation values for the said mismatch period.

5 SAFEGUARDS

5.1 No Net Harm

N/A

5.2 Environmental Impact

The project activity has no significant impact on the environment. Solar PV projects are not included in the Schedule I of the EIA notification S.O.1533 (E) dated 14th September 2006[23] and thus an EIA is not required. Ministry of Environment & forests vide their OM J-11013/41/2006 - IA II (I) dated 13th May 2011[24] has re-affirmed this and exempted Solar PV power plants from EIA and EC requirement.

5.3 Local Stakeholder Consultation

As the Sections 3.17.2-3.17.4 of VCS standard 3.6, the contract for validation is prior to the 19th April 2017, hence the local stake holder consultation is not mandatory.

5.4 Public Comments

NA

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project (Solar) plant/unit to the grid in year y

[23] http://envfor.nic.in/legis/eia/so1533.pdf
[24] http://moef.nic.in/downloads/public-information/OM-SolarPV.pdf

Value applied:	148,710.02
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years. Please refer Appendix 1 for the meter details involved for current monitoring period.

6.2 Baseline Emissions

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

Where:

BE_y: Baseline emissions in year y (tCO_2e/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 CO_2 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" (tCO_2e/MWh)

Parameter	Unit	Value
$EG_{PJ,\ y}$	MWh	148710.02
$EF_{grid,\ CM,\ y}$	tCO_{2e}	0.9777
BE_y:	=	148710* 0.9777
	=	1,45,393 (Rounded down)

6.3 Project Emissions

NA

6.4 Leakage

NA

6.5 Net GHG Emission Reductions and Removals

$ER_y = BE_y – PE_y$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2/yr)
PE_y	=	Project emissions in year *y* (t CO_2e/yr)

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

$ER_y = BE_y – PE_y$

ER_y = 145,393- 0

= 145,393 **tCO_2**

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2015	34,012	0	0	34,012
2016	93,647	0	0	93,647
2017	17,734	0	0	17,734
Total	**145,393**	**0**	**0**	**145,393**

Appendix 1 – Meter details

Meter and Calibration details for current monitoring period:

40 MW Project Activity by Giriraj Enterprises

Meter Type	Meter Serial Number	Make	Accuracy Class	Calibration Date
Main Meter	15196299	L & T	0.2s	10-08-2015
Check Meter	15196298	L & T	0.2s	10-08-2015

16.25 MW Project Activity by D J Malpani

Meter Type	Meter Serial Number at plant site	Make	Accuracy Class	Calibration Date
Main Meter	16351162, 16351134	Elster	0.2s	20/02/2015
Check Meter	16538763 16538748	Elster	0.2s	20/02/2015