

GRID CONNECTED 25 MW PV SOLAR POWER PROJECT AT CHARANKA IN GUJARAT



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1 PROJECT DETAILS

1.1 Summary Description of the Project

The purpose of the 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 NEWNE electricity grid of India. 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 34,462 tCO₂e per year (annual average), thereon displacing 36,330 MWh/year amount of electricity from the generation-mix of power plants connected to the NEWNE grid, which is mainly dominated by thermal/ fossil fuel based power plant. The total estimated emission reductions during the first renewable crediting period of 7 years will be approximately 241,234 tCO₂e. The proposed project activity involves the installation of 25 MW Solar Power PV Project, which involves operation of solar power plant in the state of Gujarat, India.

The Project activity is a new facility (Greenfield) and the purpose of the project activity is to generate 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 project activity, would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources (primarily based upon fossil fuels).

1.2 Sectoral Scope and Project Type

Sectoral Scope: 01, Energy Industries (renewable and non-renewable sources)

Type 1: Renewable energy projects

This is not a grouped project.

1.3 Project Proponent

Organization name	GMR Gujarat Solar Power Pvt. Ltd
Contact person	Shivarama M.S
Title	Mr.

Address	New Shakti Bhawan – Ground Floor Building no 301 Near Terminal 3 IGI Airport New Delhi 110 037
Telephone	+91-7042216999
Email	shivarama.ms@gmrgroup.in

1.4 Other Entities Involved in the Project

Not Applicable

1.5 Project Start Date

Commissioning of Project dated 04/03/2012

1.6 Project Crediting Period

CDM crediting period: Ten years (from 01/01/2013 – 30/08/2019)

VCS crediting period: (04/03/2012 to 31/12/2012)

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

The project falls under large scale category since the emission reductions are less than 300,000 tCO₂ e per annum.

Project Scale	
Project	X
Large project	

Years	Annual estimation of emission reductions in tonnes of CO ₂ e
Year 1	34462
Year 2	34462
Year 3	34462
Year 4	34462
Year 5	34462
Year 6	34462
Year 7	34462

Total estimated ER	241234
Total number of crediting years	7
Annual average ERs	34462

1.8 Description of the Project Activity

The project activity is a solar PV power project which has employed environmentally safe and sound technology and is resulting in abatement of GHG emissions.

The project activity is 25 MW solar PV based power generation. The full power generation capacity of solar PV plant is 25.00 MW under standard conditions of 1000 W/sq.metre sunlight, 25°C temperature and 1.5 air mass. The 25 MW plant consist of fixed mounting structures on which Crystalline silicon modules are installed.

Crystalline Solar Modules:

1. The crystalline solar modules are manufactured using silicon cells
2. The modules comply with International Electrotechnical Commission IEC 61215 standards.
3. Maximum wind load bearing capacity is 2.4 KPa (Kilo Pascals)
4. The modules are designed to have minimum maintenance requirements and high reliability having a minimum design life of 25 years.
5. The PV modules, Canadian solar make SMA's, 500 CP inverters manufactured by SMA are considered for the project activity.

Electrical Power Requirements:

The DC electrical output from the PV modules is fed through solar PV grade cables to string combiner boxes (SCB) and further through D.C switchboard to inverters. The inverters convert the DC electrical output to AC. The cable routes from inverter leads to the MV transformers stepping up voltage to 11kV. In order to achieve system redundancy at MV level, a set of five rings of 5 MW each exists before feeding into HV substation. The 11kV AC voltage is further stepped up to 66kV at the HV substation before feeding into the grid.

The point of interconnection and metering is at solar PV plant.

PV Plant components:

The main components of the PV plant that has been used for the design and energy yield predictions are solar PV modules, inverters, junction boxes, mounting structure, 11kV & 66 kV electrical substation, monitoring and data acquisition system.

PV Modules:

Canadian solar CS6P 235 P & 240P modules with a rated output of 235 Wp & 240 Wp have been selected. The Canadian solar modules are qualified to IEC 61215 and are TUV certified. These module specifications are considered to be suitable for the conditions encountered at the site.

TABLE 1: Technical Specifications

S. No.	Description	Specification
PV Modules		
1.	Photovoltaic Power plant type	Fixed array ground mounted Photovoltaic
2.	Module Technology	Polycrystalline silicon
3.	Module Make	Canadian Solar
4.	Module Name plate peak power	235 Wp / 240Wp
5.	Number of Modules	105,624
Central Inverter		
6.	Make	SMA
7.	Nominal DC power	500 kW
8.	MPP voltage range	430 V to 820 V
9.	Nominal AC voltage	270 V
10.	Operational Temperature Range	-20° C to 50° C
11.	Number of Inverters	45 No's
MV/HV Transformers		
12.	Make	Voltamp Transformers Ltd
13.	Capacity	10/12.5 MVA & 6.3 MVA
14.	Rated voltage HV side	66 kV
15.	Rated voltage MV side	11 kV
16.	Number of Transformers	2 no's of 10/12.5 MVA & 1 No. of 6.3 MVA
17.	Tilt angle	
18.	Tilt angle to horizontal	20 °

Table 2: Temperature Coefficients for PV Modules

Temperature Coefficient	Pmax	-0.43 % /°C
	Voc	-0.34 % /°C
	Isc	0.065 % /°C
Normal Operating Cell Temperature		45 ± 2° C

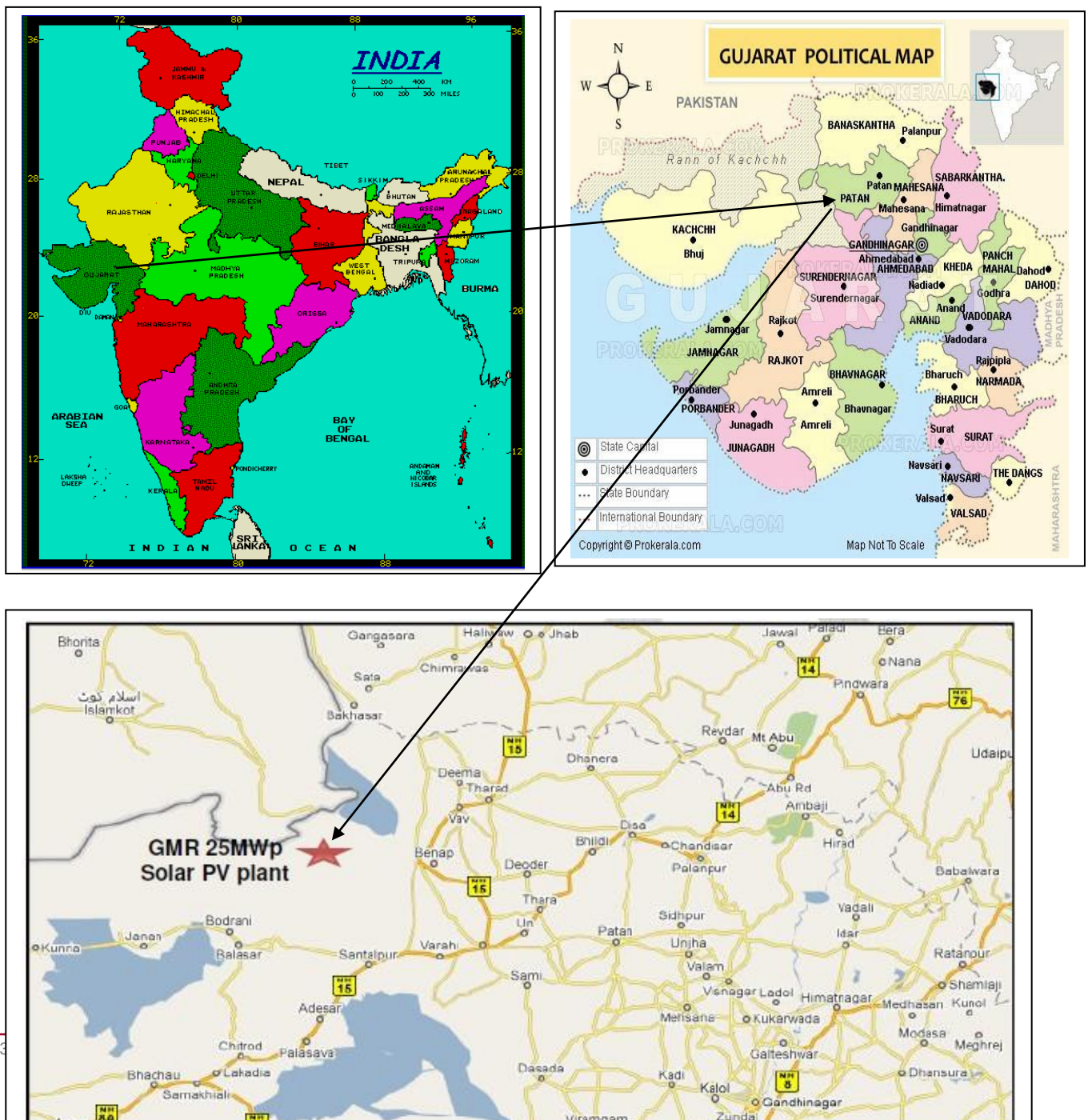
Table 3: NOCT values for PV modules

Parameters	CS6P-235P	CS6P-240P
Nominal Maximum power (Pmax)	170 W	174 W
Optimum Operating Voltage (Vop)	27.2 V	27.3V
Optimum Operating Current (Iop)	6.27 A	6.38A
Open Circuit Voltage (Voc)	33.9 V	34.0 V
Short Circuit Current (Isc)	6.86 A	6.96 A

1.9 Project Location

The project activity is located in the Charanka Village of Patan District of Gujarat State in India at an altitude of approximately 8m above mean sea level. The site is located within the GPCL developed Gujarat Solar Park coming up in this village which is approximately 58km from the Radhanpur and 174km from the city of Ahmedabad, a commercial city in the Indian state of Gujarat. The geographical coordinates of the project activity are between:

Latitude: 23°55' 03.32" N, Longitude: 71°12'53.24" E



1.10 Conditions Prior to Project Initiation

This is a Greenfield project. The project activity replaces the carbon intensive grid electricity. The proposed project activity effectively utilises renewable solar energy to generate electricity which is feed into the coal intensive NEWNE Grid. Thereby the project activity reduces the dependence on fossil fuel based generation units and as there are no associated emissions with this project it contributes to the reduction of greenhouse gases (GHG) emissions.

Please refer section B.4 of the registered PDD. The web link for the same is mentioned below:

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

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 Project has received Letter of Accreditation from RRECL (State Nodal Agency) as well as received Certificate of Registration as an eligible entity by Central Agency of National Load Dispatch Centre for development, commissioning and generation from the 25 MWp Solar PV Plant and hence is in compliance to the local laws and regulations.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

For the ownership details of the project any of the following may be referred to:

1. Power Purchase Agreement between the project promoters and State Utility
2. Commissioning certificates
3. Purchase order of WTGs

1.12.2 Emissions Trading Programs and Other Binding Limits

The project is registered under CDM and UNFCCC (Registration ID -7128)¹. The project is also approved by the DNA and a copy of the approval is also submitted to the DOE. Project Proponent has submitted undertaking that PP not claim same GHG emission reductions of the project from CDM and VCS. PP would not use net GHG emission reductions by the projects for compliance with emission trading program to meet binding limits on GHG emissions.

¹<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

1.12.3 Other Forms of Environmental Credit

Project has been registration with UNFCCC under Clean Development Mechanism program. Registration reference number is 7128. Project Proponent has submitted undertaking for not availing other forms of environmental credit for the same crediting period under consideration.

1.12.4 Participation under Other GHG Programs

Project has been registration with UNFCCC under Clean Development Mechanism program, Registration reference number is 7128. PP hereby confirms that and also gives undertaking that for Project neither has not intends to generate any form of GHG related environmental credit for GHG emission reductions or removals claimed under the VCS 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

The project does not fall under AFOLU category, hence not applicable.

Leakage Management

Project does not involve any leakage emissions as this is solar power project, Hence Leakage Management Plan and risk mitigation measures are not required.

Commercially Sensitive Information

There is no commercially sensitive information accounted for the determination of baseline, net GHG removals and for demonstration of additionality for the present project activity.

Sustainable Development

The project contributes to host country sustainable development criteria.

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 has led 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 is generating power using zero emissions solar based power generation which helps to reduce GHG emissions and specific pollutants like SO_x, NO_x, 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.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

Further Information

There are no information or incidents that will have 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

Title: "Consolidated Baseline Methodology for grid connected electricity generation from renewable sources".

Reference:

ACM0002, Version 12.3.06 (EB 66), Sectoral scope: 1

This selected approved methodology also draws references to the following tools and guidance:

- "Combined tool to identify the baseline scenario and demonstrate additionality"; EB 60 Ver. 3.0.1
- "Tool for demonstration and assessment of additionality"; EB 65 Ver. 06.0.0
- "Guidance on the Assessment of Investment Analysis"; EB 62 Ver. 05.0
- "Tool to calculate the emission factor for an electricity system"; EB 63 Ver. 02.2.1

2.2 Applicability of Methodology

The methodology applied for the project activity is ACM0002, Version 12.3.06 (EB 66) and the applicability conditions specified in the methodology have been evaluated with respect to the project activity. These are presented in the table below:

Conditions in the methodology	Project Status	Conclusion
This methodology is applicable to grid-connected renewable power generation project activities that, (a) Install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The project activity is setting-up of new grid connected 25 MW Solar power plant at a site where no renewable power plant was operated prior to the implementation of the project activity.	Meets this applicability criterion.
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project activity is setting-up of new grid connected 25 MW Solar power plant.	Meets this applicability criterion
In the case of capacity additions, retrofits or replacements: the existing plant 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 or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;	The project activity is not a case of capacity addition, retrofit or replacement, but a new Greenfield Solar power plant and hence this applicability condition need not be considered for this project activity.	This criterion is not applicable to the project activity.
In case of hydro power plants: - The project activity is implemented in an existing reservoir, with no change in the volume of reservoir. - The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section is greater than 4 W/m^2. - The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	The proposed project activity is not a Hydro power plant, but a new Greenfield Solar power plant and hence this need not be considered for this project activity.	This criterion is not applicable to the project activity

In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m ² after the implementation of the project activity all of the following conditions must apply:	The proposed project activity is not a Hydro power plant, but a new Greenfield Solar power plant and hence this need.	This criterion is not applicable to the project activity
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Applicability Criteria for the Tool to calculate the emission factor for an electricity system is included as below:

The above methodological tool determines the CO₂ emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the combined margin emission factor (CM) of the electricity system. The tool is applied to estimate the OM, BM and/or CM when calculating baseline emissions for the project activity since it substitutes grid electricity, i.e. where a project activity supplies electricity to a grid.

2.3 Project Boundary

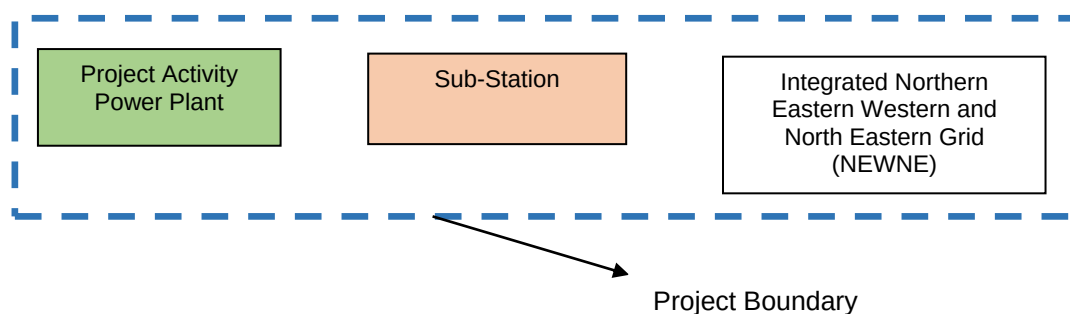
The project activity consists of the utilization of the solar radiation as input source of energy.

This solar radiation is converted to direct current (DC) through Photovoltaic cell modules and further converted to alternate current (AC) through inverters and fed into the regional grid. There are no sources of gas generation or involvement of gas either as fuel or as exhaust.

The “Tool to calculate the emission factor for an electricity system” states that Grid/project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

In line with the above the project boundary includes the power plant of 25 MW capacity that includes the Solar PV modules, Inverters and Metering at switchyard, transformers and the connected grid system. This project will export power to the NEWNE grid.

The spatial extent of the project boundary includes the proposed project activity power plant and all the other power plants connected physically to the electricity systems, to the project activity is connected to. A diagrammatic representation of the project boundary of the project activity is provided:



As per the selected methodology for the project activity a set of greenhouse gases and emission sources are given below.

Table: Summary of emission sources included in or excluded from the project boundary				
	Source	Gas	Included?	Justification / Explanation
Baseline	CO ₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO ₂	Yes	Main emission source.
		CH ₄	No	Minor emission source.
		N ₂ O	No	Minor emission source.
Project Activity	For geothermal power plants, fugitive emissions of CH ₄ and CO ₂ from non-condensable gases contained in geothermal steam	CO ₂	No	Not applicable, as the project activity is a Solar PV power plants.
		CH ₄	No	
		N ₂ O	No	
	CO ₂ emissions from combustion of fossil fuels for	CO ₂	No	Not applicable, as the project activity is a Solar PV power plants.

Table: Summary of emission sources included in or excluded from the project boundary				
	Source	Gas	Included?	Justification / Explanation
	For hydro power plants, emissions of CH ₄ from the reservoir	CH ₄	No	Not applicable, as the project activity is a Solar PV power plants.
		N ₂ O	No	
		CO ₂	No	
		CH ₄	No	
		N ₂ O	No	

For the proposed project activity, the emission sources excluded from the project boundary are as follows:

- CO₂ emissions from geothermal power plants from non-condensable gases contained in geothermal steam

Since the project activity is a Solar PV power plant, this category of CO₂ emissions have not been considered for project emissions.
- CH₄ emissions from geothermal power plants from non-condensable gases contained in geothermal steam

Since the project activity is a Solar PV power plant, this category of CH₄ emissions have not been considered for project emissions.
- CO₂ emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants.

Since the project activity is a Solar PV power plant but not associated with thermal unit, this category of CO₂ emissions have not been considered for project emissions.

4. For hydro power plants, emissions of CH₄ from the reservoir.

Since the project activity is a Solar PV power plant, this category of CH₄ emissions have not been.

2.4 Baseline Scenario

As the project activity is the installation of a new grid-connected solar power plant (renewable power plant) the baseline scenario as defined in the selected methodology is as follows:

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”.

As mentioned before, the electricity generated by the project activity is delivered to the NEWNE grid. The same electricity would have been generated by the addition of new generation sources as reflected in the combined margin (CM) calculations described in ‘Tool to calculate the emission factor for an electricity system’. The CM calculations are derived through the Operating Margin (OM) and Build Margin (BM) emission factors as published by the Central Electricity Authority (CEA), Ministry of Power, Govt. of India. These OM & BM emission factors were in turn computed according to the procedures prescribed in the ‘Tool to calculate the emission factor for an electricity system’. Thus CO₂ Baseline Database for the Indian Power Sector –Version 6.0 is used for baseline emission factor calculations.

Further, since the project activity is allotted by Government of Gujarat to set-up new solar power plant, and thus not neither a capacity addition to existing grid-connected renewable power plant/unit nor the retrofit or replacement of existing grid-connected renewable power plant/unit(s) at the project site. Hence, PP has not considered the related criteria for evaluation of the baseline scenario as it is not applicable to the project activity.

2.5 Additionality

As per the applicable methodology;

The additionality of the project activity shall be demonstrated and assessed using the latest version of the “Tool for the demonstration and assessment of additionality” agreed by the Board, which is available on the UNFCCC CDM website.

As per the “Tool for the demonstration and assessment of additionality”;

Project activities that apply this tool in context of approved consolidated methodology ACM0002, only need to identify that there is at least one credible and feasible alternative that would be more attractive than the proposed project activity.

Accordingly, the step-wise approach to establish additionality of the project activity as per the additionality tool is as follows;

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

This is to define realistic and credible alternatives to the project activity through the following sub-steps:

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

For the project, the possible alternative scenarios that provide outputs or services comparable to the project should be as follows:

Alternative (a) - *The proposed project activity is undertaken without being registered as a CDM project activity.*

Under this alternative, the PP would have implemented the project activity to generate electricity using solar energy and export the same to the NEWNE grid thereby displacing equivalent units of power generated by the contributing power plants of NEWNE grid. There would be no emissions of greenhouse gases from this alternative and may be a part of the baseline scenario. However, in absence of CDM revenue it would have been difficult for the PP to implement the project activity according to the analysis conducted. (Refer to *Step 2: Investment Analysis* and *Step 3: Barrier Analysis* in this section). Hence it cannot be a part of the baseline scenario.

Alternative (b): *Continuation of the current situation with no project activity*

Under this alternative, a "no-project" scenario will imply that electricity output equivalent to that of the project activity would be fulfilled either by the existing capacity of the fossil fuel dominated NEWNE grid or by capacity enhancement of the existing grid. This alternative represents the most likely baseline scenario.

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

Both the above mentioned alternatives are in consistency with the mandatory laws and regulations.

Step 2: Investment Analysis

This step is to determine whether the proposed project activity is not:

- (a) The most economically or financially attractive;
or
- (b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

Sub-step 2a. Determine appropriate analysis method

This is to determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis.

As per the additionality tool, Simple Cost analysis (Option-I) cannot be applied in this case as the electricity generated from the project activity will be sold and will generate financial benefits. Investment comparison analysis (Option-II) also cannot be used since the alternative to the project activity selected is “no-project activity” scenario; this does not involve any investment on the part of the project proponent.

Hence, benchmark analysis (Option-III) has been selected to assess the additionality.

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

Project IRR has been chosen as the financial indicator for the assessment. Project IRR has been calculated for the life of the project i.e. 25 years. This is compared with benchmark. The benchmark chosen is Weighted Average Cost of Capital (WACC). The WACC is calculated as per EB62 guidelines taking market value of 70:30 ratio (as per GERC order) of ‘return on equity’ and ‘cost of debt’. The details of analysis are given in *Sub-step 2c*.

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

The Project IRR for the proposed project activity without CDM revenues is computed based on the date of decision taken by the Board to sign the PPA, on 19/10/2010.

The salient input parameters for Project IRR calculations are given below:

Parameter	Unit	Value	Reference/ Remark
Capacity of the project	MW	25	Allotment Letter from Energy & Petrochemicals Department, Government of Gujarat
Project Cost per MW	INR Million/MW	165.00	Investment Decision
Total Project cost	INR Million	4125	Investment Decision
Debt – Equity Ratio	Ratio	70:30	GERC order ^o
Interest Rate	%	12.25	Investment Decision

Parameter	Unit	Value	Reference/ Remark
No. of Installments	Months	40	GERC order
Asset to be Depreciated as per Companies Act	%	90	GERC order
Depreciation as per Income tax Act	%	80	Income Tax Act
Salvage Value	%	10	GERC order
Income tax rate	%	33.22	Host Country Tax Rate (http://en.wikipedia.org/wiki/Income_tax_in_India#Corporate_Income_tax)
MAT rate	%	19.93	Host Country Tax Rate (http://www.cbec.gov.in/budget1011/bh1.pdf)
Initial PLF	%	18.255	DPR page 43
PLF degradation- 15 months	%	1.50	DPR page 42
PLF degradation- henceforth	%	0.70	DPR page 42
Tariff - First 12 years	INR / Unit	15	GERC order
Tariff - 2nd 13 years	INR / Unit	5	GERC order
Working Capital			
Receivables	Months	1	GERC order
O & M expenditure	Months	1	GERC order
Working capital Finance	%	100	GERC order
Interest rate on working capital	%	12.50	GERC order
O & M charges	% of project cost	0.5	Investment Decision
O & M escalation	% p.a	5	Investment Decision
Insurance charges	% of net asset p.a	0.35	Investment Decision

The Project IRR thus obtained is;

Indicator	Unit	Value
Project IRR	%	7.75

Selection of Benchmark as mentioned above, WACC as 70:30 ratio of 'return on equity' and 'cost on debt'.

The Weighted Average Cost of Capital (WACC) was considered as an appropriate benchmark for the project activity. This benchmark is considered appropriate for comparison against project IRR since beta is used in computation of the same.

In general, if a project is financed by debt and equity, WACC is the average of the costs of these sources of financing, each of which is weighted by its respective use in the given project. Therefore, WACC is the overall required return on the project as a whole and is often used to determine its economic feasibility.

$$WACC = \frac{E}{V} * R_E + \frac{D}{V} * R_D * (1 - T)$$

Where,	
<i>WACC</i>	= <i>Weighted Average Cost of Capital</i>
<i>R_E</i>	= <i>Cost of Equity</i>
<i>R_D</i>	= <i>Cost of Debt</i>
<i>E</i>	= <i>Value of Equity</i>
<i>D</i>	= <i>Value of Debt</i>
<i>V</i>	= <i>Value of Equity + Value of Debt</i>
<i>E/V</i>	= <i>Percentage of financing that is equity</i>
<i>D/V</i>	= <i>Percentage of financing that is debt</i>
<i>T</i>	= <i>Tax Rate</i>

The benchmark has been calculated using the Capital Asset Pricing Model (CAPM). As per CAPM, the required return on investment is the return of a risk-free security (government bond rates) plus beta times the difference between the market return and the risk-free return. The weighted average yield of Government of India Securities has been taken to represent the risk free return. Well diversified Stock market index has been used to represent the market return.

As per the model, Required Return on equity can be estimated as

$$\text{Required rate of return} = R_F + \beta \times (R_M - R_F)$$

Where:

R_F = Risk Free Rate

β = Beta (Which shows risks)

R_M = Market Return

Risk Free Return:

The risk free return is a benchmark figure against which all the investments in an economy should be measured. Reserve Bank of India provides information on Yield on Market Loans, which is actually risk free return and the value was 8.38 %.

Market Return and Risk Premium:

The market risk premium, as measured and applied in practice is the premium above the risk free rate of return that investors expect to earn on a portfolio of equities. Equity indices are indicator of expected market return. With a view of eliminating the unsystematic risk associated with the projects totally, index containing 500 companies has been taken to represent the market return. A period starting from the start of the market base year i.e. February, 1999 to decision making date i.e. September, 2010 has been considered to remove the impact of short term volatility. Selection of BSE 500 represent a more robust and efficient face of the market. Based on this, market return is estimated by Compound

Annual Growth Rate (CAGR) and its estimate value is 19.33 %

BSE-500 Index is a Broad-Based Index constituting 500 companies across 20 sectors listed at the Exchange, representing approximately 90% of the total BSE Market Capitalization and around 92% of the average turnover at the Exchange. Hence PP has selected BSE -500 as a well-diversified portfolio to calculate Beta and Market return.

Power Company Portfolio

PP has considered the companies involved in power generation and are listed with BSE with a trading history of at least five years (at the time of decision making) for beta calculation. Accordingly, the companies considered by PPs are Gujarat Industries Power Company Ltd (GIPCL), BF Utilities Ltd., TATA Power Co. Ltd., CESC Ltd., Neyveli Lignite Corporation Ltd.(NLC), NTPC Ltd., and Torrents Power Ltd.

Beta

Project participants estimated equity beta values for power companies in India. Equity Beta measures the systematic risk of a stock, i.e. the risk that cannot be eliminated in a systematic, well-balanced and diversified portfolio. The beta of equity is calculated as the covariance between its return and the return of a well-diversified market portfolio.

$$\text{Equity Beta } (\beta_e) = \text{Covariance } (r, r_m) / \text{Variance } (r_m)$$

Where:

r is the return from the equity investment in a single stock

r_m is the return from the equity investment in the well –diversified market portfolio

However, the measured equity beta for a particular company related to the unique capital structure of that firm and that a change in the capital structure will change the degree of financial risk borne by the equity holders and hence the equity beta. A common practice to allow equity betas to be compared across firms with different capital structures is to adjust the estimated equity beta into the equivalent asset beta (which is equity beta that would apply if the assets were financed wholly with equity) using the following formula:

$$\text{Asset beta} = \text{Equity beta} / [1 + (1 - \text{Tax}) \times (\text{debt} / \text{equity})]$$

Detail beta calculation is given in the excel sheet. Calculation of beta is done as under:

Table Equity Asset beta of power companies in India

Company Name	Equity Beta (Levered)	D/E	Tax Rate	Asset Beta (Unlevered)
TATA Power	0.97	0.59	25.71%	0.67
CESC	1.07	0.50	17.00%	0.76
GIPCL	1.17	0.85	14.77%	0.68
BFUL	2.02	1.87	-31.53%	0.58
NTPC	0.59	0.59	19.79%	0.40
NLC	1.43	0.39	18.76%	1.08
Torrents Power	1.32	0.84	29.51%	0.83
Average Beta				0.715

Based on the above facts, project participants considered average value of beta as 0.715. Cost of equity i.e. Required Rate of Return on equity based on above values of Risk Free Return, Market Return and Equity Beta are calculated as below

Required rate of return = $R_F + \beta \times (R_M - R_F)$

= 8.38% + 0.715 x (19.33% - 8.38%)

= 16.21 %

So the PP has chosen Cost of Equity as 16.21% for the proposed project activity

The 'cost on debt' is calculated based on benchmark prime Lending rate (PLR) available at the time of investment decision.

'Cost on debt' = Prime Lending Rate

SBI PLR = 12.25% at the time of investment decision

Weighted Average Cost of Capital (WACC)

$$WACC = \frac{E}{V} * R_E + \frac{D}{V} * R_D * (1 - T)$$

Parameter	Value	Remark
Return on Equity	16.21%	CAPM
Cost on Debt	12.25%	Investment Decision
E/V	30%	GERC Order
D/V	70%	GERC Order
T	19.93%	MAT rate
WACC	11.73%	$(0.3 \times 16.21) + \{(0.7 \times 12.25) * (1 - 19.93\%)\}$

Sub-step 2d. Sensitivity analysis

In accordance with the guidance on the assessment of investment analysis, 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. The project activity has been found sensitive to the following critical parameters:

According to “Guidance on the Assessment of Investment Analysis, Version 05” the purpose of sensitivity analysis is to establish that the result of the financial analysis is robust to reasonable variations in the critical assumptions. This provides that *“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 *“As a general point of departure variations in the sensitivity analysis should at least cover a range of +10% and -10%”*

Accordingly the ‘project cost’, ‘PLF’, ‘Tariff’ and ‘O&M’ has been considered for sensitivity analysis

Parameter	Unit	+10%	0%	-10%	Benchmark
Project Cost	%	6.52	7.75	9.23	11.73
PLF	%	9.04	7.75	6.37	11.73
O&M	%	7.62	7.75	7.87	11.73
Tariff	%	9.04	7.75	6.37	11.73

The above analysis indicates even with reasonable variations in the selected parameters, the Project IRR does not cross benchmark.

Hence the project is additional.

Step 3: Barrier Analysis:

This step is not selected for analysis.

Step 4: Common practice analysis**Sub-step 4a: Analyze other activities similar to the proposed project activity:**

Annex 21 of EB 65, the “Tool for the demonstration and Assessment of Additionality” been used for performing the common practice analysis for the project activity. Accordingly, the identification of projects and further analysis has been done in the following step wise manner.

As per para 47 of EB 65, Annex 21, and the following steps have been applied to prove that the proposed project activity is not a common practice within the applicable geographical area. The applicable geographical area has been defined as the host country, India as default as defined in para 5 of the tool.

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

The proposed project is photovoltaic power station with installed capacity 25MW, and then applicable output range of $\pm 50\%$ for 25MW, is 12.5 to 37.5 MW and set up by a single project proponent in the host country primarily for the sale of power to the grid.

Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all} . Registered CDM project activities and project activities undergoing validation shall not be included in this step;

For the analysis all the power plants in the host country India have been considered. From this list of plants, identified the plants as described above within the applicable output range of 12.5 MW to 37.5 MW, based on which, thermal, hydro, nuclear, wind, solar, biomass, tidal & geothermal projects have been considered for the analysis. From the identified list, the projects under CDM cycle i.e. Registered or under validation are excluded from the same and N_{all} is arrived at.

$$\begin{aligned}
 N_{all} &= \text{Thermal projects} + \text{Hydro Projects} + \text{Wind Projects} + \text{Biomass projects} + \text{Nuclear} \\
 &\quad \text{projects} + \text{Solar projects} + \text{Geothermal projects} + \text{Tidal projects} \\
 &= 92 + 213 + 71 + 0 + 0 + 0 + 0 + 0 \\
 &= 376
 \end{aligned}$$

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff} .

From the above identified number of projects those projects which employ “different technologies”, as per the clauses prescribed in the para 4 of the guidelines, have been excluded and the number of such projects has been identified as N_{diff} .

All the thermal & the hydropower projects are different from the projects activity Energy Source/Fuel (point (i), para 4 of the guideline). Therefore

$$\begin{aligned}
 N_{diff} &= \text{Thermal projects} + \text{Hydropower Projects} + \text{Wind Projects} + \text{Biomass projects} + \\
 &\quad \text{Nuclear Projects} + \text{Geothermal projects} + \text{Tidal projects} \\
 &= 92 + 213 + 71 + 0 + 0 + 0 + 0 \\
 &= 376
 \end{aligned}$$

Result of the analysis:

Technology Area	All projects in applicable capacity range (+/- 50% of Project activity capacity)	Projects excluding CDM projects in applicable cap range, (N_{all})	N_{diff}
Thermal	92	92	92
Hydro	213	213	213

Wind	102	71	71
Nuclear	0	0	0
Solar	0	0	0
Biomass	0	0	0
Tidal-Mechanical & Thermal	0	0	0
Geothermal	0	0	0
Total	407	376	376

Step 4: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

$$F = 1 - N_{diff} / N_{all} = 1 - (376/376) = 0 < 0.2$$

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

$$N_{all} - N_{diff} = 376 - 376 = 0 < 3$$

Based on the above analysis, we can conclude the proposed project is “not a common practice”.

Sub-step 4b: Discuss any similar options that are occurring:

The “Tool for demonstration and assessment of Additionality” states in Sub-step 4b that “If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive (as contended in Step 2) or faces barriers (as contended in Step 3).” On the basis of the conclusions of the analysis in Sub-step 4a, it is seen that there are no similar project activities in the host country currently under operation. Hence as per “Tool for demonstration and assessment of Additionality” Ver. 06.0.0 further analysis of step 4 (b) is not required and the project activity is not a common practice in the host country.

Prior Consideration of CDM:

As per the “Guidance on the demonstration and assessment of prior consideration of the CDM” Version 04, for project activities with start date after 02 August 2008, it is required to demonstrate that CDM was seriously considered in the decision to implement the project activity.

In accordance with Para 2 of the “Guidance on the demonstration and assessment of prior consideration of the CDM” this notification is to be made within six months of the project activity start date described in section C.1.1.

In line with the above guidance, the UNFCCC and the DNA of India i.e. National CDM Authority (NCDMA) have been intimated about consideration of CDM for the proposed project activity vide F- CDM form

dated 18/03/2011 and dispatched on 21/03/2011 to UNFCCC and NCDMA. Received an e- mail acknowledgement for the same from NCDMA on 24/03/2011 and from UNFCCC on 19/04/2011.

Project activity chronology of events:

Sr. No	Activity	Date (dd/mm/yyyy)
1	Allotment of 25 MW Project to GMR by Govt. of Gujarat	14/10/2010
2	Board Decision Date	19/10/2010
3	PPA signed with Gujarat Urja Vikas Nigam Ltd	08/12/2010
4	Date on the F-CDM Form for Prior Consideration of CDM intimation to UNFCCC & NCDMA	18/03/2011
5	Decision by GMR Solar for issuance of Letter of Award for EPC contract	20/04/2011
5	Letter of Award to EPC Contract	25/04/2011

2.6 Methodology Deviations

Not Applicable

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Not Applicable

3.2 Project Emissions

Not Applicable

3.3 Leakage

Not Applicable

3.4 Net GHG Emission Reductions and Removals

Not Applicable

4 MONITORING

4.1 Data and Parameters Available at Validation

Not Applicable

4.2 Data and Parameters Monitored

Not Applicable

4.3 Monitoring Plan

Not Applicable

5 SAFEGUARDS**5.1 No Net Harm**

Not Applicable

5.2 Environmental Impact

Not Applicable

5.3 Local Stakeholder Consultation

Not Applicable

5.4 Public Comments

Not Applicable

APPENDIX X: <TITLE OF APPENDIX>

Not Applicable