**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	10 MW Solar Photovoltaic Power Plant in Rajkot, Gujarat (India)
Version number of the PDD	05
Completion date of the PDD	13/12/2012
Project participant(s)	Green Infra Solar Energy Limited
Host Party(ies)	India
Sectoral scope(s) and selected methodology(ies)	Sectoral Scope: 01 (renewable energy) Methodology: AMS I.D (grid connected renewable electricity generation), version 17, EB 61
Estimated amount of annual average GHG emission reductions	16,497 tCO_2e

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

General Description:
The project activity is the installation of a 10 MW solar photovoltaic power plant in Rajkot district in the state of Gujarat. The project activity has been implemented by Green Infra Solar Energy Limited (GISEL).

Purpose of the project activity:
The purpose of the project activity is to generation clean power utilising solar energy and to sell it to Gujarat Urja Vikas Nigam Limited (GUVNL) through a long term Power Purchase Agreement (PPA).

Pre-project scenario

The project activity is a Greenfield project. There was no activity at the site prior to the implementation of this project activity.

Baseline

The baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources. In the absence of the CDM project activity, the equivalent amount of electricity would have been generated from the connected / new power plants in the NEWNE grid. The installed capacity in NEWNE grid is predominantly fossil fuel based[1] and therefore is a major source of carbon dioxide emissions. The main emission sources in the pre-project scenario are the power plants connected to the NEWNE grid and the main greenhouse gas involved is CO_2.

Nature of Project

The Project is a non-polluting solar power generation project that seeks to export green power to the NEWNE grid that otherwise primarily receives electricity from fossil fuel fired thermal power plants[2]. The project activity exports power to the state grid via a dedicated substation installed in the project premises. A set of main and check meters have been installed at the project site to measure export and import of electricity from the project activity. The difference between export and import, i.e. net export is then used for billing purposes.

The estimated emission reductions for the first year are 16,994 tCO_2e (with the annual average as 16,497[3] tCO_2e). The total GHG emission reductions for the chosen crediting period are 164,976 tCO_2e, taking into account an annual degradation factor of 0.7%.

Contribution to sustainable development

Ministry of Environment and Forests (MoEF), Govt. of India has formulated following guidelines for consideration of a CDM project:

[1] CEA CO_2 database ver. 7 (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm) mentions that only 17.6% of electricity in the NEWNE grid is generated from hydro/nuclear
[2] CEA CO_2 database ver. 7 (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm) mentions that only 17.6% of electricity in the NEWNE grid is generated from hydro/nuclear
[3] Round down value

Social well being:

- The project activity will provide direct and indirect employment in the area, thus providing additional source of revenue to the villages. This will further be augmented by CSR (Corporate Social Responsibility) schemes that will be adopted by the investors during the lifetime of the power plant.
- The power generated by these plants is injected into distribution grid, and not in transmission grid, and thus the generated electricity is directly supplied to the local consumers.

Economic well being:

- Power generation from the project will contribute to the State Domestic Product (SDP) of the state where the plant is installed.
- This project will also provide business opportunities to the local contractors and suppliers.
- The project will increase availability of power in the grid that is generated from an emission-free resource and thereby contribute towards sustainable development.

Technological well being:

- The project is one of the few Megawatt size solar power projects in India. It uses latest and most efficient thin film technology available in the country and will contribute to India's experience in a new technology area.
- This will also give rise to increased interest in solar energy in the country and it may encourage other investors implementing solar projects.

Environmental well being:

- Generating power from solar energy, a renewable source, contributes to resource conservation. There is no harmful impact on the environment because of emissions
- CO_2 abatement and reduction of greenhouse gas emissions through development of renewable technology;
- Reducing the average emission intensity (SO_x, NO_x, PM, etc.), average effluent intensity and average solid waste intensity of power generation in the system that would have been generated if electricity was produced in conventional fossil fuel based power plants in absence of CDM project activity

A.2. Location of project activity
A.2.1. Host Party(ies)

India

A.2.2. Region/State/Province etc.

District: Rajkot
State: Gujarat

A.2.3. City/Town/Community etc.

Village: Meravadar
Tehsil: Upleta

A.2.4. Physical/ Geographical location

The project activity is situated at 21° 44' 11.16" N latitude and 70° 7' 11.19" E longitude at an altitude of about 48 m above mean sea level. The site is approximately 128 km from Rajkot city and is connected to the Meravadar village through an internal road. The site is 7.5 km away from National Highway NH 8b.

The physical location of the site is as follows:

A.3. Technologies and/or measures

As per Appendix B of the simplified modalities and procedures for small scale CDM project activities, the project activity comes under **Type I (renewable energy activities)** and **Category I.D (grid connected renewable electricity generation)**.

Technology/Measure:

The project activity is the installation of a 10 MW solar photovoltaic (PV) based power plant. The project uses fixed thin film Cadmium Telluride (CdTe) PV modules. In the baseline, equivalent amount of energy was being produced by the regional grid, which is predominantly fossil fuel based. The project activity exports electricity produced from the solar PV plant, thereby resulting in GHG emission reductions.

A solar photovoltaic (SPV) system converts solar irradiation in to DC (direct current) electricity and then inverts in to AC (alternating current) power and steps up the voltage levels in transformer such that the energy generated shall be exported to grid with synchronization or to meet the load. The plant has been divided into 8 modular plots, with each plot comprising of 1.25 MWp of solar PV and two 630 kW inverters. The inverters convert the DC electrical output from the PV modules into AC. The PV modules face southwards and are titled at an angle of 15^{o} from the ground to maximise solar irradiation on the panels. A summary of the technical details is given below:

Parameter	Value
PV Module	FS – 380
PV module peak power (Wp)	80
Modules per plant	125,025

Modules per plot	15,600
Strings per plot	1,040
Inverters	SMA SC 630CP
Inverter power (kVA)	630 kW
Inverters per plot	2
Total plots	8
Total inverters	16
Mounting structure	Haticon (German Make)

The technical specifications of the PV modules have been presented below:

Type	Thin Film Cadmium Telluride (CdTe)
Max. Output at STC (W), P_{max}	80
Maximum Power Voltage, V_{mpp} (Volts)	50.7
Maximum Power Current, I_{mpp} (A)	1.58
Open-circuit voltage, V_{OC} (V)	61.7
Short-circuit current, I_{SC} (A)	1.76
Length (mm)	1200
Width (mm)	600
Thickness (mm)	6.8
Weight (kg)	12

The technical specifications of the inverters have been given below:

Inverter	SMA Sunny Central 630CP
Max. DC voltage	1000 V
PV voltage range, MPPT	500 – 820 V
Max. Input current	1,350
Number of MPP trackers	1
Max. Number of strings (parallel)	9
Nominal AC output	630 kVA
Max. Output current	1271 A
Nominal AC voltage/range	315 V ± 10%
AC grid frequency	50 Hz
Max. Efficiency	0.987
Euro ETA	0.985
Normal ambient temperature range	-20 ^{o}C - +50 ^{o}C
Operation temperature range	-20 ^{o}C - +50 ^{o}C
Consumption: operating (standby)/night	<1500 W/ 100W
Warranty	5 years

The entire Engineering Procurement and Construction (EPC) contract has been given to Juwi Renewables and the Thin Film technology has been sourced from First Solar. The total output capacity of the power plant is 10 MWp. While the aggregate peak capacity of the individual modules combined may be slightly different than 10 MWp (the aggregate capacity of the plant is 10.02 MW), the system in total has been designed for 10 MWp, which takes into account certain losses as well..

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India (host)	Green Infra Solar Energy Limited (Private Entity)	No

A.5. Public funding of project activity

There is no public funding available for the project activity. The project proponents have arranged funds from financial institutions and internal resources.

A.6. Debundling for project activity

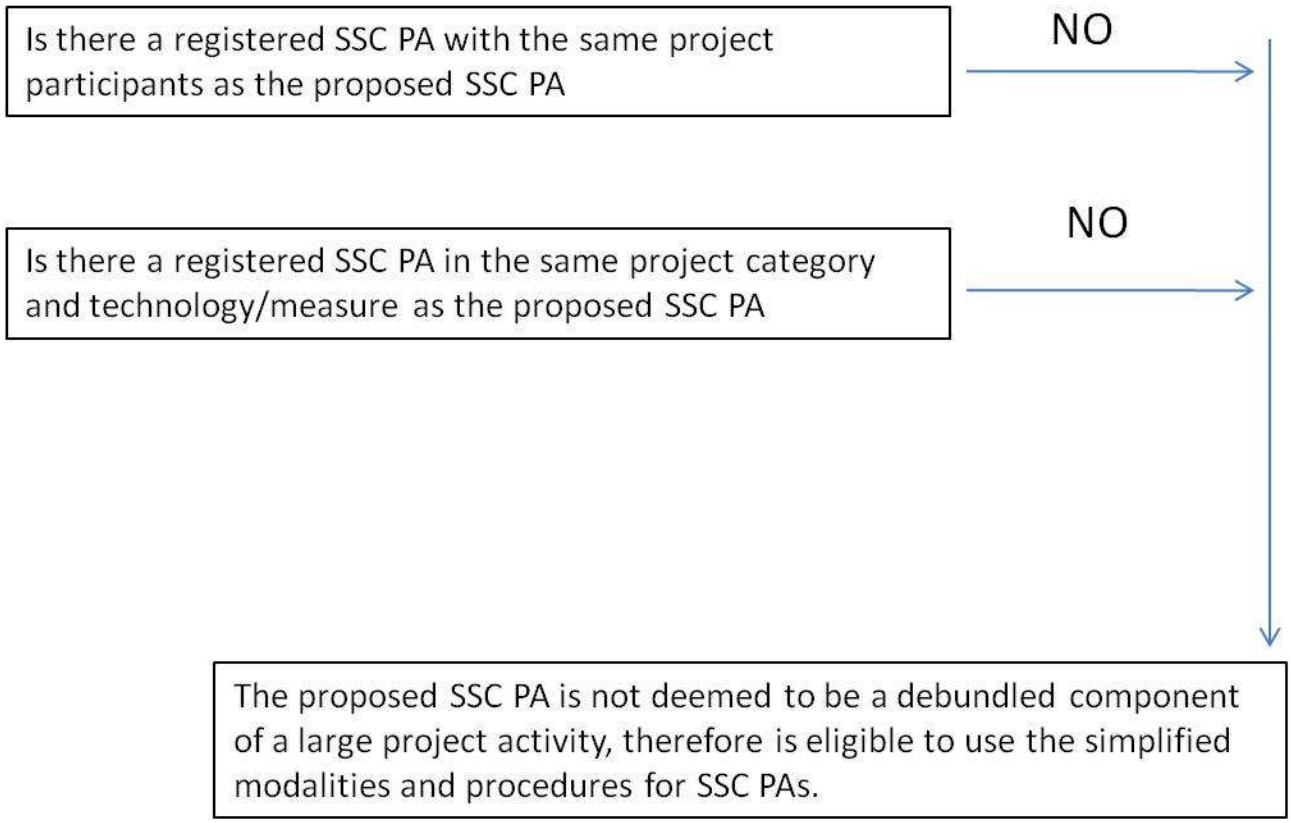
As per the "guidelines on assessment of debundling for SSC project activities" version 3 (EB 54 Annex 13),

A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- *with the same project participants*
- *in the same category and technology/measure; and*
- *registered within the previous 2 years*
- *whose project boundary is within 1 km of project boundary of the proposed small scale project activity at the closest point*

The project participant does not have any other registered CDM project activity in the same region in the same category and technology, neither have they applied for the same.

The same is shown in the flow chart below:



Thus, the project activity is not a debundled component of a large scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology

Title: AMS I.D (grid connected renewable electricity generation), version 17, EB 61
Reference: Appendix B of the Simplified Modalities and Procedures for small-scale project activities.

"Tool to calculate the emission factor for an electricity system"
Version 02.2.1, EB 63 Annex 19

B.2. Project activity eligibility

Applicability condition	Project activity
This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:[4] a) Supplying electricity to a national or a regional grid; or b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as	The project activity involves installation of solar photovoltaic power plant. The project activity supplies electricity to the state grid of Gujarat, which forms a part of the NEWNE regional grid.

[4] Refer to EB 23, annex 18 or the definition of renewable biomass.

<table>
<tr><td>wheeling.</td><td></td></tr>
<tr><td>Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A[5]) applies is included in Table 2.

<table><tr><td></td><td>Project type</td><td>AMS-I.A</td><td>AMS-I.D</td><td>AMS-I.F</td></tr><tr><td>1</td><td>Project supplies electricity to a national/regional grid</td><td></td><td>√</td><td></td></tr><tr><td>2</td><td>Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)</td><td></td><td></td><td>√</td></tr><tr><td>3</td><td>Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td><td></td><td>√</td><td></td></tr><tr><td>4</td><td>Project supplies electricity to a mini grid[6] system where in the baseline all generators use exclusively fuel oil and/or diesel fuel</td><td></td><td></td><td>√</td></tr><tr><td>5</td><td>Project supplies electricity to household users (included in the project boundary) located in off grid areas</td><td>√</td><td></td><td></td></tr></table></td><td>The project activity supplies electricity to a national/regional grid. Hence, as per the Table 2 of the approved methodology AMS-I.D version 17, the project activity is justified to use AMS-I.D.</td></tr>
<tr><td>This methodology is applicable to project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating 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).</td><td>The project activity is the installation of a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity.</td></tr>
<tr><td>Hydro power plants with reservoirs that satisfy at least</td><td>The project activity is power generation</td></tr>
</table>

[5] AMS-I.D "Grid connected renewable electricity generation", AMS-I.F "Renewable electricity generation for captive use and mini-grid" and AMS-I.A "Electricity generation by the user"

[6] The sum of installed capacities of all generators connected to the mini-grid is equal to or less than 15 MW.

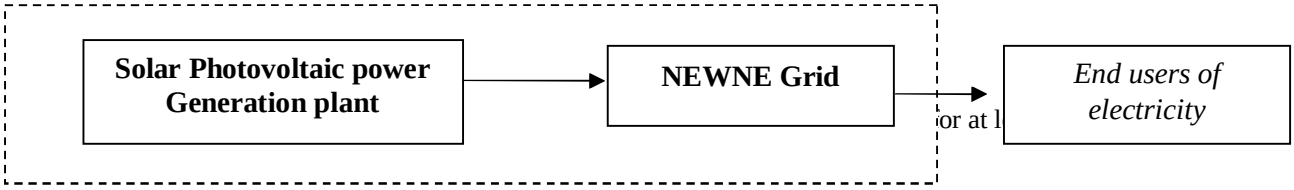
one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir,[7] where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2; • 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/m2.	through solar PV modules. Hence, this condition is not applicable to the project activity
If the unit added has both renewable and non renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component.	The project activity consists only of renewable components. The capacity of the project activity is 10 MW, which is below the eligibility limit for a small-scale CDM project activity.
Combined heat and power (co-generation) systems are not eligible under this category	The project activity is not a co-generation unit
In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The project activity is the installation of new solar PV based power plant. Hence, this condition is not applicable.
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	The project activity does not involve any retrofit or replacement.

The project activity parameters (capacity, etc.) are not expected to change throughout the crediting period. Hence, the above mentioned eligibility conditions shall remain applicable for the entire crediting period of the project activity.

B.3. Project boundary

As per the approved small scale methodology AMS I.D, 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*".

Thus, the project boundary consists of the all the solar PV modules, the allied equipments including the inverters, transformers and metering system and the state grid to which the project activity is connected. The project boundary has been depicted below:



The greenhouse gases and emission sources included in or excluded from the project boundary are shown below:

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_2O	No	Minor emission source
Project activity	CO_2 emissions from combustion of fossil fuels for electricity generation	CO_2	No	No project emissions
		CH_4	No	No project emissions
		N_2O	No	No project emissions

B.4. Establishment and description of baseline scenario

The project activity aims to sell the entire power generated to the state grid of Gujarat through a Power Purchase Agreement. It shall thus displace an equivalent amount of electricity which would have been generated through the power plants connected to the state grid of Gujarat, which are predominantly fossil fuel based. The same can be seen from the table below:

Region	Mode-wise breakup[8] (MW)					
	Thermal			Total Thermal	Hydro	RES
	Coal	Gas	Diesel			
Western region	28145.50	8143.81	17.48	**36303.79**	7447.50	**4630.74**

Thus, the baseline scenario for the project activity is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.

As per approved small-scale methodology AMS I.D version 17, the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

Also, the emission factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system";

[8] Source: CEA Annual report 2009-10, page 217

OR

(b) The weighted average emissions (in t CO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The project proponent has chosen option (a) to calculate the emission factor. The emissions factor shall be calculated using the "tool to calculate emission factor for an electricity system", version 2.2.1 while using data from the CEA (Central Electricity Authority) CO_2 baseline database version 7.

The emission factor has been calculated as follows:

Step1. Identify the relevant electricity systems:

The Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into two regional grids[9].

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

The project activity is situated in the state of Gujarat. The state forms a part of the NEWNE grid (as per the latest CEA guidelines). Hence, relevant Operating margins and Build margins shall be used for calculations.

Step2. Choose whether to include off-grid power plants in the project electricity system (optional):

For calculating the grid emission factor for the project activity, "*Option I (only grid power plants are included in the calculation)*" of this step has been chosen. PP has chosen not to include off-grid power plants in the project electricity system.

Step3. Select a method to determine the Operating Margin (OM):

For the purpose of this project activity, the simple OM method has been used. However, as per the tool, *the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.*

As per CEA Data, the share of low cost must run sources are as follows[10]

Year	2006-07	2007-08	2008-09	2009-10	2010-11	Average
NEWNE	18.5%	19.0%	17.4%	15.9%	17.6%	17.7%

[9] http://www.cea.nic.in/reports/planning/cdm_co2/database_7.zip
[10] http://www.cea.nic.in/reports/planning/cdm_co2/database_7.zip

Hence, simple OM can be used as the share of low cost must run source is less than 50% for the NEWNE grid of India. For OM calculations, *"a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period"* option shall be used.

Step4. Calculate the operating margin emission factor according to the selected method

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

For the project activity, the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission has been considered. The data is published annually by the Central Electricity Authority. Thus:

Simple OM	**NEWNE Grid (tCO_2/MWh)**	**Generation (GWh)**
2008-09	1.0066	421802.6329
2009-10	0.9777	458043.0846
2010-11	0.9707	476986.7213
Generation weighted OM (tCO_2/MWh)	0.9842	

STEP 5. Calculate the build margin emission factor ($EF_{grid, BM,y}$)

The value of the BM has been taken from the data published by the CEA, which is based on the procedures mentioned in the Tool to calculate emission factor for an electricity system, version 2.2.1.

The BM has been calculated as per option 1 (*Calculate the Build Margin emission factor $EF_{BM,y}$* ***ex-ante*** *based on the most recent information available on plants already built for sample group m at the time of PDD submission).*

Option 1 as described above is chosen in 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.

As per the CEA CO_2 Baseline Database, the BM for the 2010-11 has been calculated to be $EF_{grid, BM,y}$

BM	**NEWNE Grid (tCO_2/MWh)**
2010-11	0.8588

STEP 6. Calculate the combined margin (CM) emission factor ($EF_{grid, CM, y}$)

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM}$$

Where:

EFgrid, OM,y = Build Margin CO2 emission factor in the year *y* (tCO_2/GWh)

EFgrid, BM,y = Operating Margin CO_2 emission factor in the year *y* (tCO2/GWh)
W_{OM} = Weighting of operating margin emission factor (%)
W_{BM} = Weighting of build margin emission factor (%)

Owing to their intermittent and non-dispatchable nature, the default weights for wind and solar projects are as follows: W_{OM} = 75% and W_{BM} = 25%

In the project activity, **combined margin has been chosen as the baseline emission factor** for grid emission factor. The value chosen is taken from relevant official sources and is publicly available[11].

Parameter	NEWNE grid (tCO_2/MWh)
OM, Operating Margin – Generation weighted	0.9842
BM, Build Margin	0.8588
CM, Combined Margin (tCO_2/ MWh)	**0.9529**

The combined margin thus obtained shall be fixed ex-ante for the entire crediting period of the project activity.

The OM and BM have been fixed *ex-ante* for the entire crediting period of the project activity.

B.5. Demonstration of additionality

The description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity has been done as per "**GUIDELINES ON THE DEMONSTRATION OF ADDITIONALITY OF SMALL-SCALE PROJECT ACTIVITIES**", version 09 (EB 68 Annex 27).

As per paragraph 2 of EB 68 Annex 27,
The positive list of grid-connected renewable electricity generation technologies that are automatically defined as additional, without further documentation of barriers, consists of the following grid-connected renewable electricity generation technologies of installed capacity up to 15 MW:

- *Solar technologies (photovoltaic and solar thermal electricity generation);*
- *Off-shore wind technologies;*
- *Marine technologies (wave, tidal)*
- *Building integrated wind turbines or household rooftop wind turbines of a size up to 10 kW.*

The project activity involves generation of electricity through solar technology (solar photovoltaic) with a total capacity of 10 MW (<15 MW).

Thus the project activity qualifies under the positive list of grid-connected renewable electricity generation technology which is automatically defined as additional.

CDM consideration:

[11] http://www.cea.nic.in/reports/planning/cdm_co2/database_7.zip

Early consideration of CDM for the project activity has been demonstrated using the "Guidance on the Demonstration and Assessment of Prior Consideration of CDM" (EB 62, Annex 13).

As per guidance on the demonstration and assessment of prior consideration of CDM of the Project Standard, EB 62 Annex 13, "*for project activities with a starting date on or after 02 August 2008, the project participant must inform a Host Party DNA and/or the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date and shall contain the precise geographical location and a brief description of the proposed project activity*".

Following the guidelines, the project proponent sent intimations to both the host party DNA and the UNFCCC (email dated 4th March 2011), about the project activity and intentions of the project proponent to apply for registration under the Clean Development Mechanism of UNFCCC. The project proponent has also contracted consultants for taking the project through the CDM process.

Following is the chronology of events for the project activity:

Stage of project implementation	Date	Remarks
Power Purchase Agreement (PPA)	06/12/2010	PPA signed with GUVNL
CDM intimation	**04/03/2011**	The PP sends intimation to both UNFCCC and MoEF intimating about its intention to apply for carbon credits for the project activity.
EPC contract for implementation of the project activity	18/03/2011	PP enters into an EPC contract for the implementation of the project activity (**This is the project start date**).
Acknowledgements received from UNFCCC and host DNA	**24/03/2011**	Email acknowledgements received from UNFCCC and host DNA.
Commissioning of the project activity	11/11/2011	The project activity started commercial operations
Local stakeholder meeting	10/02/2012	Stakeholder meeting was held at the project site involving the local stakeholders
Contract with the DOE	27/06/2012	PP signed validation contract with a DOE for carrying out validation of the project activity
CDM webhosting	10/07/2012 to 09/08/2012	The period for which the project was webhosted on the UNFCCC website for global stakeholder consultation

Based on the above, it is evident that PP took substantial steps towards CDM registration of the project along with the implementation of it.

Summary:
Thus, it can be seen that the project proponent was aware of the CDM benefits during the decision making phase and took steps to achieve the same. Also, the project activity is additional following the guidelines of EB 68 Annex 27.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

As per AMS I.D version 17, the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor. The detailed justification has been provided in Section B.4 of this PDD.

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y} \quad \textbf{(1)}$$

Where:

BE_y	Baseline Emissions in year *y* (t CO_2)
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (t CO_2/MWh)

Baseline Emissions:
The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

As per para 11 of the methodology,

$$BE_y = EG_{BL,y} \times EF_{CO2,grid,y} \quad (1)$$

Where,

BE_y	Baseline emissions due to displacement of electricity during the year y (tCO_2)
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the project activity in year *y* (MWh)
$EF_{CO2,grid,y}$	Emission factor of the grid in year y (tCO_2/MWh) (as calculated in section B.4)

Project emissions:
As per the approved small scale methodology AMS I.D version 17, for most renewable energy project activities, $PE_y = 0$.

Leakage emissions:
If the energy generating equipment is transferred from another activity, leakage is to be considered. Since this is not the case for this project activity, leakage is zero.

$LE_y = 0$,

Where,
LE_y = Leakage emissions due to the project activity

Emission Reductions
The total emissions reduction from the project activity is thus calculated as –

$$ER_y = BE_y – PE_y – LE_y$$

Where,

ER_y	total emissions reductions achieved in the year y (tonnes of CO_2)
BE_y	baseline emissions due to displacement of electricity during the year y (tCO_2)

PE_y project emissions from on-site fossil fuel combustion in year y (tCO_2e)
LE_y leakage emissions due to the project activity (tCO_2e)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{grid,OM,y,}$
Unit	tCO_2/MWh
Description	This is the simple operating margin for the NEWNE grid of India
Source of data	CEA database version 7 has been used[12]
Value(s) applied	0.9842
Choice of data or Measurement methods and procedures	The data is used to calculate the combined margin for the NEWNE grid of India as per the procedures laid down in the tool to calculate emission factor for an electricity system, version 2.2.1
Purpose of data	Calculation of baseline emissions
Additional comment	The value is fixed ex-ante

Data / Parameter	$EF_{grid,BM,y,}$
Unit	tCO_2/MWh
Description	This is the build margin for the NEWNE grid of India
Source of data	CEA database version 7 has been used
Value(s) applied	0.8588
Choice of data or Measurement methods and procedures	The data is used to calculate the combined margin for the NEWNE grid of India as per the procedures laid down in the tool to calculate emission factor for an electricity system, version 2.2.1
Purpose of data	Calculation of baseline emissions
Additional comment	The value is fixed ex-ante

Data / Parameter	$EF_{grid,CM,y,}$
Unit	tCO_2/MWh
Description	This is the combined margin for the NEWNE grid of India
Source of data	CEA database version 7 has been used
Value(s) applied	0.9529
Choice of data or Measurement methods and procedures	The data is used to calculate the combined margin for the NEWNE grid of India as per the procedures laid down in the tool to calculate emission factor for an electricity system, version 2.2.1
Purpose of data	Calculation of baseline emissions
Additional comment	The value is fixed ex-ante

[12] http://www.cea.nic.in/reports/planning/cdm_co2/database_7.zip

B.6.3. Ex-ante calculation of emission reductions

Baseline emissions:

Total Capacity: 10 MW
Run hours = 24×365 = 8760 hrs
PLF = 20.36%[13]

Hence, net power exported = 17835.36 MWh/ annum
Baseline emission factor = 0.9529 tCO_2/MWh

Hence, Baseline emissions = 16,994 tCO_2

Emission reductions

Since, $ER_y = BE_y$ (Since PE_y and LE_y are zero)

Hence, emission reductions for the project activity in the first year = 16,994 tCO_2 per annum

For calculating the emission reductions for the subsequent years, an annual degradation factor of 0.7% has been considered.

Thus, Annual average emission reductions = 16,497 tCO_2 per annum
Total emission reductions for the crediting period = 164,976 (rounded down value)

[13] As per DPR section 10.8

B.6.4. Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
2012-13[14]	4,749	0	0	4,749
2013-14	16,994	0	0	16,994
2014-15	16,875	0	0	16,875
2015-16	16,757	0	0	16,757
2016-17	16,640	0	0	16,640
2017-18	16,523	0	0	16,523
2018-19	16,407	0	0	16,407
2019-20	16,293	0	0	16,293
2020-21	16,179	0	0	16,179
2021-22	16,065	0	0	16,065
2022-23[15]	11,495	0	0	11,495
Total	164,976	0	0	164,976
Total number of crediting years	10			
Annual average over the crediting period	16,497	0	0	16,497

[14] From 20/12/2012 to 31/03/2013
[15] From 01/04/2022 to 19/12/2022

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	**$EG_{export,y}$**
Unit	MWh
Description	Gross Electricity export from the project activity
Source of data	Monthly Joint Meter Reading reports
Value(s) applied[16]	-
Measurement methods and procedures	For measuring the electricity exported by the project activity, the state electricity board has installed two sets of energy meters (main and check) at the substation of the project activity (one for each feeder). Monthly readings are taken jointly by the representative of Gujarat Energy Transmission Corporation (GETCO) and site in charge of Project Proponent and a statement is prepared. The meters have an accuracy class of 0.2S
Monitoring frequency	Continuous measurement, hourly monitoring and monthly recording
QA/QC procedures	The energy meters installed at the grid interconnection point shall be once every three years, in accordance with the para iv of section 7.2 of the PPA. The values can be cross checked with the invoices raised by the PP for payment purposes.
Purpose of data	Calculation of baseline emissions
Additional comment	NA

[16] The values for gross export and import will be available during actual monitoring of the project activity.

Data / Parameter	$EG_{import,y}$
Unit	MWh
Description	Electricity imported by the project activity
Source of data	Monthly Joint Meter Reading reports
Value(s) applied	-
Measurement methods and procedures	For measuring the electricity imported by the project activity, the state electricity board has installed two sets of energy meters (main and check) at the substation of the project activity (one for each feeder). Monthly readings are taken jointly by the representative of Gujarat Energy Transmission Corporation (GETCO) and site in charge of Project Proponent and a statement is prepared. The meters have an accuracy class of 0.2S
Monitoring frequency	Continuous measurement, hourly monitoring and monthly recording
QA/QC procedures	The energy meters installed at the grid interconnection point shall be once every three years, in accordance with the para iv of section 7.2 of the PPA. The values can be cross checked with the invoices raised by the PP for payment purposes.
Purpose of data	Calculation of baseline emissions
Additional comment	NA

Data / Parameter	$EG_{actual,y}$
Unit	MWh
Description	Net Electricity exported by the project activity
Source of data	Monthly Joint Meter Reading reports
Value(s) applied	17835.36
Measurement methods and procedures	The net export is calculated as the difference between energy exported to grid and energy imported by the project activity.
Monitoring frequency	Monthly recording
QA/QC procedures	This value can also be cross checked from the invoices raised by the PP.
Purpose of data	Calculation of baseline emissions
Additional comment	NA

B.7.2. Sampling plan

Sampling procedures are not required to be followed for this project activity

B.7.3. Other elements of monitoring plan

Energy meters (main and check) have been installed at the transformer yard of the dedicated substation, situated within the project premises. The energy meters are owned and managed by Gujarat Energy Transmission Corporation Limited (GETCO). During commissioning of the project activity, the meters were sealed in the presence of officials from GETCO and the project proponent representative(s).

Monitoring of power generation at Inverter end:

Power generated by the project activity at the inverter end will be recorded hourly in the dedicated Monitoring Station situated at the project site. The project activity consists of a number of solar modules connected to a total of 16 inverters. The generation details of each inverter at any point of time is monitored both at the Data Display System integrated in the inverter panel and simultaneously at the CMS. Monthly data is compiled and stored electronically.

Monitoring of power supplied from the project site:

The power supplied from the project activity is monitored using energy meters (main and check) positioned at the Transformer Yard of the dedicated substation situated within the project premises. Joint Meter Reading (JMR) is taken every month by GETCO / GUVNL officials and site personnel from these Transformer Yard meters. A monthly State Energy Accounting statement is generated by State Load Dispatch Centre (SLDC - GETCO) and sent to the project proponent. The project proponent raises an invoice on the basis of the statement and submits it to GUVNL. These readings (net export to the grid) from the JMR shall form the basis of estimation of emission reductions in the project activity.

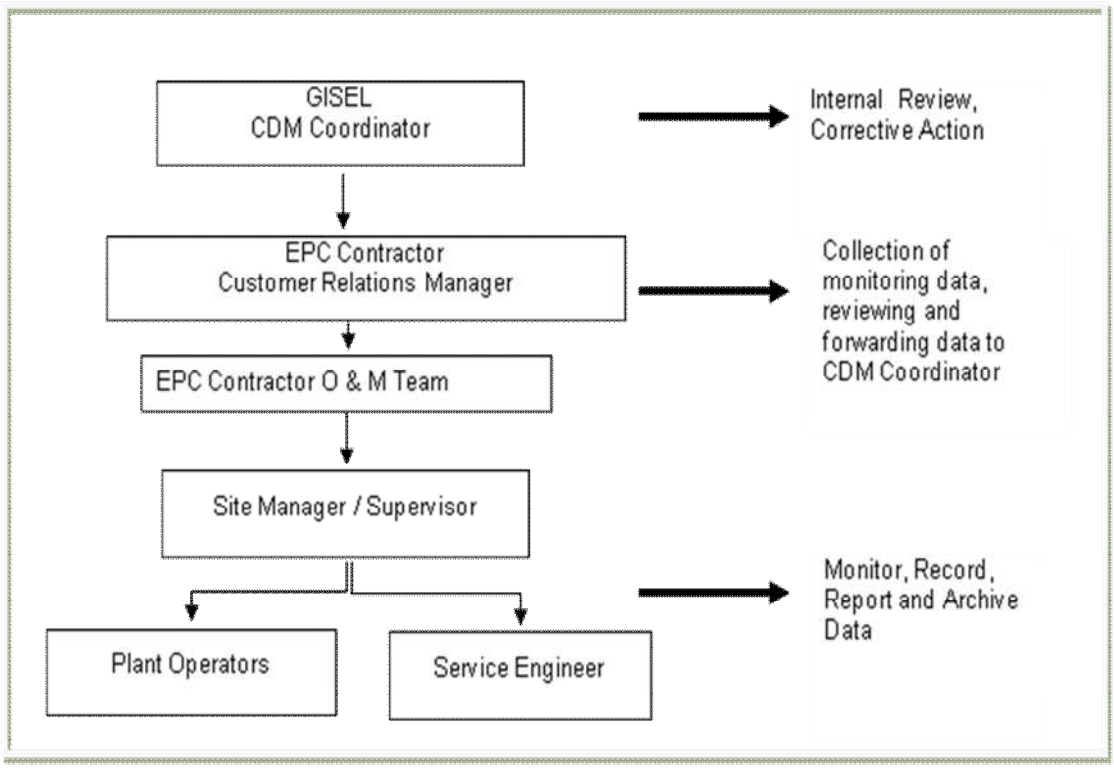
The project activity supplies power to the grid through two feeders. Each feeder has a set of main and check meters. The meter serial numbers are as follows:

	Sr. No.
Main Meter-1	GJU62650
Main Meter-2	GJU62651
Check Meter-1	GJ 0952 A
Check Meter-2	GJ 0953 A

In case of an error/fault in the meters, the board shall replace the same as soon as possible. For such period, where readings from the main meter are not available, the export values from the check meter reading shall be considered.

Roles and Responsibility structure:

The operations and maintenance of the project activity has been outsourced to the EPC contractor (Juwi India Renewable Energies Private Limited). The roles and responsibility structure is as follows:



Handling data Uncertainty:

- Main meter is faulty- Main meter is immediately replaced by a new meter and meter reading from the replaced meter is used thereafter. The generation during the intervening period is forfeited
- Error is identified during annual meter testing- If during the annual tests, the meter is found to be beyond the permissible limits of error (0.2%), the meter shall be immediately calibrated and replaced, if necessary. The error that is identified in the calibration would be applied to entire range of data from the date of last calibration. Billing for the period thereafter till the next monthly reading shall be as per the calibrated meter

Apportioning procedure used by PP in case of mismatches in monitoring period date and billing date:
Apportioning is required in cases where the date of monitoring period doesn't match with the date of Monthly statement showing the energy generated through the project activity.

In such a case, the power sent out through the inverters shall be used for the apportioning. The readings from the inverters will be only used to arrive at an apportioning ratio for the energy as indicated in the Monthly statement showing the energy generated through the project activity in cases of mismatch in the start date of the monitoring period and dates of monthly statement. The apportioning of net exported electricity from the project would be done by multiplying the net electricity exported, as mentioned in the monthly statement showing the energy generated, and the ratio of inverter readings of the intervening period and total period as shown in monthly statement showing the energy generated.

A – Inverter readings for the partial days' generation of the month for which CERs are being claimed

B - Inverter readings for the period corresponding to the dates mentioned in the monthly statement showing the energy generated

C - ratio of A and B; A/B
D = C x Energy as indicated in the monthly statement showing the energy generated

Data Archiving:
All data shall be electronically archived and stored for the entire crediting period and two years thereafter.

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity

18/03/2011 (Date of EPC contract for the project activity)

C.1.2. Expected operational lifetime of project activity

25 years 00 months[17]

C.2. Crediting period of project activity
C.2.1. Type of crediting period

Fixed

C.2.2. Start date of crediting period

20/12/2012 (but not before the date of submission of the project activity to UNFCCC by the DOE)

C.2.3. Length of crediting period

10 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

As per the EIA notification number S.O. 1533[18], the generation of electricity using solar energy does not require a prior EIA assessment and environmental clearances.

Also, the project proponents have acquired all the necessary consents and approvals required for the installation and operation of the project activity.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

The local stakeholders were informed about the project activity through an advertisement in a regional newspaper "*Fulchhab*" dated 04/02/2012 in vernacular language. Invitation letters were sent to the heads of the village governing council (panchayat). A public notice was also displayed in the office of village council.

A stakeholder consultation meeting was held at the project site on 10/02/2012. In the meeting, the project proponent representatives explained the local stakeholders of the project activity and its benefits. The

[17] As provided by the technology supplier
[18] http://envfor.nic.in/legis/eia/so1533.pdf

stakeholders were details about the benefits of producing clean energy as compared to producing energy from fossil fuel based power plants. This was followed by a discussion round where comments/views from local stakeholders were invited. The project proponents responded to the comments of the stakeholders.

E.2. Summary of comments received

The stakeholders appreciated the efforts of the project proponent to promote clean energy. The stakeholders expressed satisfaction on the project activity and were happy about the fact that local people were provided employment at the project site.

E.3. Report on consideration of comments received

No negative comments were received during the stakeholder consultation process

SECTION F. Approval and authorization

The project proponent has applied to the host country DNA for the approval letter. The same shall be submitted to the DOE as and when available.

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Appendix 1: Contact information of project participants

Organization	Green Infra Solar Energy Limited
Street/P.O. Box	NBCC Plaza, Tower II, 2nd Floor,
Building	Pushp Vihar, Sector V, Saket,
City	New Delhi
State/Region	New Delhi
Postcode	110017
Country	India
Telephone	+91 11-49190563
Fax	+91 11-49190510
E-mail	
Website	http://www.greeninfralimited.in/solar-power-projects.php
Contact person	
Title	Chief Operating Officer
Salutation	Mr.
Last name	Nimbargi
Middle name	
First name	Shivanand
Department	-
Mobile	
Direct fax	+91 11-49190510
Direct tel.	+91 11-49190563
Personal e-mail	gilcdm@greeninfralimited.in

Appendix 2: Affirmation regarding public funding

No public funding is involved in the project activity.

Appendix 3: Applicability of selected methodology

The applicability of selected methodology has been demonstrated in Section B.2 of this PDD.

Appendix 4: Further background information on ex ante calculation of emission reductions

The information on ex-ante calculation of emission reductions is presented in Section B.6 of the PDD.

Appendix 5: Further background information on monitoring plan

Information on monitoring plan has been presented in Section B.7 of the PDD.

Appendix 6: Summary of post registration changes

Not applicable

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		