

TEJUVA – CHANDGARH WIND PROJECT



Document Prepared By CLP Wind Farms (India) Private Limited

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Prepared By	CLP Wind Farms (India) Private Limited
Contact	CLP Wind Farms (India) Private Limited 15 th Floor, Oberoi Commerz, Off. Western Express Highway, Goregaon (E) Mumbai, Maharashtra India, 400 063 + 91 22 6758 8888 carbon@clpindia.in www.clpindia.in

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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

CLP Wind Farms (India) Private Limited (CLPWF) is setting up a wind project which is located at 2 wind sites viz. Tejuva site in Jaisalmer district in the state of Rajasthan and Chandgarh site in the state of Madhya Pradesh in India. The project activity has been planned to be implemented in 2 phases - the first phase i.e. Tejuva site with capacity of 100.8 MW (48 * 2.1 MW) has been installed at Dilawar ka gaon, Ishaniyo ki basti, Chattrei, villages in the distt. of Jaisalmer, Rajasthan and second phase i.e. Chandgarh site with capacity of 92 MW (46 * 2 MW) has been installed at Agrod, Amona, Bardu, Bercha, Bhayagaion, Bhikhedhi, Chandgarh, Chayan hazam, Guradiya Surdas, Jamodi, Mohammed kheda, Raheli, Rranayalkala and Samgi villages in the distt. Of Dawas and Shajapur, Madhya Pradesh. The project activity envisages implementation of a total of 192.8 MW wind power project which is using Suzlon make 2.1 MW S97 wind turbine generators at Tejuva site and Gamesa make 2.0 MW G97 and G114 WTGs at Chandgarh site. The project activity utilises wind power to generate clean power with a view to bring in greenhouse gas emission reductions.

During conceptualization of Chandgarh (phase-2) wind project, capacity of the project was considered as 100 (50*2) MW. However, after project initiation, management of CLPWF has decided to install only 92 MW out of 100 MW project capacity.

The first machine under this project activity was commissioned on 29-03-2015 and last machine was commissioned on 29-12-2015.

The Project activity is a new facility (Greenfield) and it plans to utilize wind energy to generate electricity and supply it to distribution licences which is a part of the NEWNE (Northern, Eastern, Western and North-Eastern) grid of India. In the absence of Project activity, quantity of the electricity that would be delivered by the other Project activity to the NEWNE grid would be sourced from the existing grid-connected fossil fuel based power plants and future capacity additions to meet the growing electricity requirements. Hence, generation mix of NEWNE grid is considered as the baseline scenario. Thus, the project activity reduces the dependency on fossils fuels which are pre-dominantly used for electricity generation in India and helps reduction of climate change impacts. Prior to implementation of this project activity, there was no project activity by the CLPWF. Same amount of electricity was generated from other grid connected power plant.

The Project activity helps to reduce the demand- supply gap in the country and also helps in contributing to the sustainable development by using wind energy as the source of power generation and reduction of GHG emissions

The project activity is expected to supply 368.8 GWh of energy to the NEWNE Grid of India each year. This is expected to result in emission reductions of 364,244 tCO₂e per year of operation.

During this monitoring period (from 29-03-2015 to 31-07-2016 (both days inclusive)) the project activity has exported 387.77 GWh of energy to the NEWNE Grid of India. The total emission reductions achieved during the monitoring period is 383,890 tCO₂.

1.2 Sectoral Scope and Project Type

The project activity has a capacity more than 15 MW and is considered under “Grid-connected electricity generation from renewable sources”. As per the scope of the project activities enlisted in the latest version of the “List of Sectoral Scopes and related approved baseline and monitoring methodologies”, the project activity can be categorized as follows:

Methodology: Grid-connected electricity generation from renewable sources, ACM0002 of version 17.0

Sectoral Scope: 01, Energy Industry (Renewable/Non Renewable Sources)

Web link: <http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN>

The project activity is not a group project

1.3 Project Proponent

Organization name	CLP Wind Farms (India) Private Limited
Contact person	Mr. Dipjay Sanchania
Title	Head – CDM
Address	15 th Floor, Oberoi Commerz, Off. Western Express Highway, Goregaon (E), Mumbai, Maharashtra 400 063
Telephone	+ 91 22 6758 8888
Email	carbon@clpindia.in

1.4 Other Entities Involved in the Project

Organization name	Not Applicable
Role in the project	Not Applicable
Contact person	Not Applicable
Title	Not Applicable
Address	Not Applicable
Telephone	Not Applicable
Email	Not Applicable

1.5 Project Start Date

The start date for this project is 29th March 2015. This is the earliest commissioning date of the project WTG.

1.6 Project Crediting Period

The Project has stated generating GHG emission reductions from 29th March 2015 i.e. from earliest date of commissioning of WTG. Hence, crediting period for VCS begins on 29th March 2015 and ends on 28th March 2025 i.e. 10 years crediting period which can be renewed for maximum 2 times.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

The project is a large scale project that involves setting up of 192.8 MW of wind power project.

Project Scale	
Project	
Large project	√

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
Year 1	364,244
Year 2	364,244
Year 3	364,244
Year 4	364,244
Year 5	364,244
Year 6	364,244
Year 7	364,244
Year 8	364,244
Year 9	364,244
Year 10	364,244
Total estimated ERs	3,642,440
Total number of crediting years	10 Years
Average annual ERs	364,244

1.8 Description of the Project Activity

The Project activity involves implementation of a 192.8 MW wind power project consisting of Suzlon make 48 WTGs of individual capacity 2.1 MW in Rajasthan and Gamesa make 45 numbers of WTGs of G97 model and 1 number of WTG of G114 model of individual capacity 2.0 MW in Madhya Pradesh of India by CLP Wind Farms (India) Private Limited.

The electricity generated by the Project will be exported to the NEWNE 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 Proponent plans to avail the VCS benefits for the Project.

The Project activity is in line with the sustainable development criteria of the country. The electricity generated from the wind farm will be exported to the NEWNE grid and sold to the state electricity utility, thereby contributing to reducing the energy demand supply gap in the state of Rajasthan and Madhya Pradesh.

Technology

The project is using wind energy technology by both Suzlon and Gamesa and implemented 48 numbers of WTGs of Suzlon make S97 model with a capacity of 2.1 MW each and Gamesa make 45 numbers of WTGs of G97 model and 1 number of WTG of G114 model with a capacity of 2.0 MW each. The technical details of the technologies are mentioned below:

Turbine model	Suzlon S-97
OPERATING DATA	
Rated power	2.1 MW
Cut-in wind speed	4.0 m/s
Rated wind speed	11 m/s
Cut-out wind speed	20 m/s
Wind Class	IIIA
Blade	
Length	47.3 m
Types of aerodynamic brake	Pitch/full brake
ROTOR	
Speed at rated power	15.46 rpm
Power Generation	DFIG inverter system
No of poles	4
Synchronous Speed	1500 rpm
GENERATOR	
Type	Asynchronous 3 phase induction generator with slip rings operated with rotor circuit inverter system (DFIG)
Frequency	50Hz
TOWER	
Type	Welded steel plate according to EN10025
Hub heights	90m

Turbine model	Gamesa G97
OPERATING DATA	
Rated power	2.0 MW
Cut-in wind speed	3 m/s

Turbine model	Gamesa G97
Cut-out wind speed	25 m/s
Wind Class	IIA/ IIIA
Blade	
Length	47.5 m
Material	Composite material with fiberglass, carbon fiber and pre-peg.
ROTOR	
Rotor diameter	97 m
Swept area	7389.8 m ²
Rotational speed	9.6 – 17.8 rpm
Control	Variable pitch and speed
Hub	
Material	Nodular cast iron
GENERATOR	
Type	Doubly-fed with coil rotor and slip rings
Voltage (Vac)	690
TOWER	
Type	Tubular truncated cone
Height	Height of 45 WTGs is 104 meter and one WTG of 93 meter
GEARBOX	
Type	1 stage planetary / 2 parallel
Ratio	1:106.8 (50Hz)/ 1:127.1 (60Hz)

Turbine model	Gamesa G114
OPERATING DATA	
Rated power	2.0 MW
Blade	
Length	56 m
ROTOR	
Rotor diameter	114 m
Swept area	10207 m ²
Rotational speed	13.97 rpm
Hub	
Material	Nodular cast iron
GENERATOR	
Type	Doubly-fed with coil rotor and slip rings
Nominal power (kW)	2,070 (stator + rotor)
Voltage (Vac) 690	Voltage (Vac) 690
TOWER	

Turbine model	Gamesa G114
Type	Conical barrel tube
Hight	93 m
GEARBOX	
Type	1 stage planetary / 2 parallel

The average life time of the WTGs under project activity is considered as 25 years in line with tariff order issued by the respective state electricity regulatory commission.

In the absence of the project activity the equivalent amount of electricity would have been generated/imported from the connected/ new power plants in the NEWNE grid, which is predominantly based on fossil fuels¹, hence baseline scenario of the project activity is the grid based electricity system, which is also the pre-project scenario. Since, the wind power is Green House Gas (GHG) emissions free, the power generated will prevent the anthropogenic GHG emissions generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas. The estimation of GHG reductions by this project is limited to carbon dioxide (CO₂) only.

1.9 Project Location

The project activity is implemented in 2 phases. Phase –I is located at Dilawar ka gaon, Ishaniyo ki basti and Chattrei, villages in the distt. of Jaisalmer, Rajasthan. Further, the remaining WTGs are installed at Agrod, Amona, Bardu, Bercha, Bhayagaion, Bhikhedhi, Chandgarh, Chayan Hazam, Guradiya surdas, Jamodi, Mohammed kheda, Raheli, Ranayalkala and Samgi villages in the distt. of Dewas and Shajapur in Madhya Pradesh which constitutes the phase-II of the project activity.

The geo- coordinates and commissioning date of WTGs under the project activity are provided in the Appendix 1.

1.10 Conditions Prior to Project Initiation

The project activity is a Greenfield activity that is the installation of new 192.8 MW wind energy based plant for generating electricity. In the absence of the project activity, the equivalent power generation would have taken place from the fossil fuel dominated NEWNE Gird. Prior to implementation of this project activity, there was no project activity by the CLPWF. Same amount of electricity was generated from other grid connected power plant.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

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

¹ http://www.cea.nic.in/executive_summary.html

1.12 Ownership and Other Programs

1.12.1 Right of Use

The project has uses wind energy technology by both Suzlon and Gamesa and implements 48 numbers of WTGs of S97 model with a capacity of 2.1 MW each and 45 numbers of WTGs of G97 model and 1 number of G114 with a capacity of 2.0 MW each. All the WTGs are owned by CLP Wind Farms (India) Private Limited. CLP Wind Farms (India) Private Limited is the sole owner of project activity, hence it possess right of use of ER credits. Further the ownership is demonstrated through the following documents.

- 1) Commissioning certificates for the project WTGs in the name of CLP Wind Farms (India) Private Limited
- 2) Purchase orders of the project activity issued by CLP Wind Farms (India) Private Limited
- 3) Power Purchase Agreement between CLP Wind Farms (India) Private Limited and state utilities

1.12.2 Emissions Trading Programs and Other Binding Limits

Net GHG emission reductions or removals generated by the Project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions of CLP Wind Farms (India) Private Limited.

1.12.3 Other Forms of Environmental Credit

The Project does not intend to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under the VCS Program.

1.12.4 Participation under Other GHG Programs

The project activity has not been registered or currently seeking registration under any other GHG programs.

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

Further Information

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 wellbeing & Economic wellbeing:

The project activity will lead to improved infrastructure in the area due to construction of roads and other project related activities. The project will provide employment opportunities to skilled and unskilled workers from the region during its construction and operation. The proposed project activity also contributes to the improvement of the economic conditions of the local people as there will be an improvement in the availability of electricity which leads to further economic development of the area. Further, series of CSR activities has been planned for the project location which would positively stimulate the social & economic wellbeing of the local area.

Technological wellbeing: The technology employed is proven and environmentally safe and sound. The technology is available and supplied from the host country and hence there is no transfer of technology from an Annex-I country.

Environmental well-being: The project activity reduces carbon dioxide emissions through the avoided usage of fossil fuel based electricity generation. Being a renewable resource, using wind energy to generate electricity contributes to resource conservation. Thus the project will cause no negative impact on the surrounding environment contributing to environmental well-being.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Following approved baseline & monitoring methodology is applied in this project activity:

Title: Grid-connected electricity generation from renewable sources, ACM0002

Version: 17

Scope: 01, Energy industries (renewable - / non-renewable sources)

Web link: <http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN>

The tools referenced in this methodology include:

- Tool to calculate the emission factor for an electricity system Version 05.0.0, Annex 9 of EB 87 Report (<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v5.0.pdf>)
- **Guidelines:**
- Methodological tool for Investment analysis, Version-06, Annex-12 of EB 85 Report (<https://cdm.unfccc.int/Reference/tools/index.html>)

Tool for the demonstration and assessment of additionality, Version-07, Annex-08 of EB 70 Report (<https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf>)

2.2 Applicability of Methodology

The project activity complies with the technology/measure applicability conditions of the approved large scale methodology ACM0002, version 17. Justification for applicability of the technology/measure as described below:

Applicability criteria	Applicability Status of this project
This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (a) Involve a capacity addition to (an) existing plant(s); (b) Involve a retrofit of (an) existing operating plants/units; (c) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (d) Involve a replacement of (an) existing plant(s)/unit(s).	The proposed project activity is a Greenfield, grid connected renewable power project. The project activity uses renewable wind source to generate electricity that will be fed into the NEWNE regional grid. In the absence of the project activity this power would have been produced by the current grid generation mix which is predominantly fossil fuel based, thus the project activity meets this criterion.
The methodology is applicable under the following conditions: a) 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; b) 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 wind power plant/unit. Therefore, the project activity is satisfying the said criteria .
In case of hydro power plants, one of the following	The proposed project activity

Applicability criteria	Applicability Status of this project
conditions shall apply:² - The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or - The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3), is greater than 4 W/m²; or - The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m²; or - 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.	involves installation of a wind power plant/unit. As the criteria is related to hydro power project, therefore, the said criteria is not applicable

² Project participants wishing to undertake a hydroelectric project activity that result in a new reservoir or an increase in the volume of an existing reservoir, in particular where reservoirs have no significant vegetative biomass in the catchments area, may request a revision to the approved consolidated methodology.

Applicability criteria	Applicability Status of this project
In the case of integrated hydro power projects, project proponent shall: • Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or • Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	The proposed project activity is the installation of a wind power plant/unit. As the criteria is related to hydro power project, therefore, the said criteria is not applicable.
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 wind power plant/unit. Therefore, the said criteria is not applicable.
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 proposed project activity is a Greenfield project, thus this criteria is not applicable.
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; (a) "Tool to calculate the emission

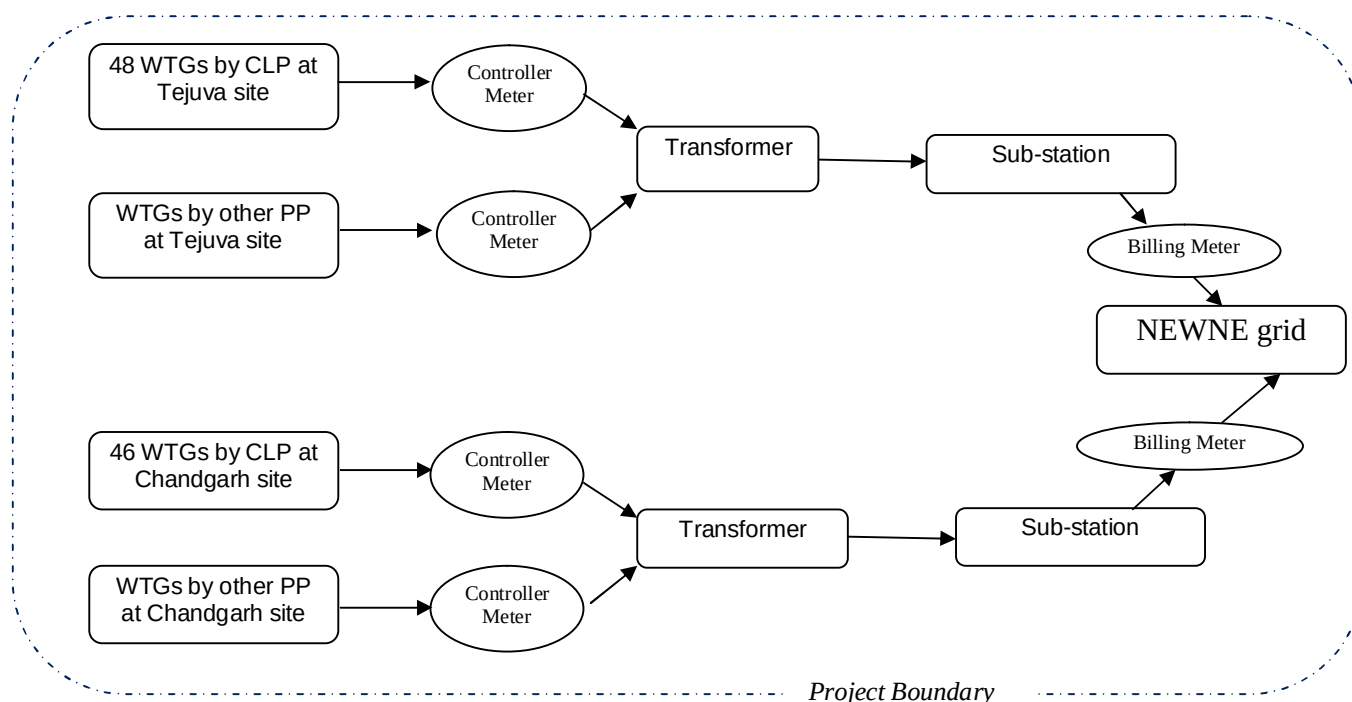
Applicability criteria	Applicability Status of this project
	factor for an electricity system"; (b) "Tool for the demonstration and assessment of additionality";

2.3 Project Boundary

As per the para 22 of the applicable methodology ACM0002 (Version 17.0.0) "The spatial extent of the project boundary includes the project power plant/unit and all power plants/units connected physically to the electricity system that the CDM project power plant is connected to".

Thus, the project boundary for the proposed project activity consists of WTGs installed, the connected substation, metering instruments and the NEWNE grid. The project boundary is diagrammatically represented in the figure below:

Project Boundary Diagram:



Therefore, the project boundary includes all the 94 numbers of WTGs along with the WTGs of the other project proponents connected to the sub-station, which is further connected to the network of the NEWNE grid, i.e. the project boundary also includes the NEWNE grid. Thus, the project boundary further includes all the power plants physically connected to the NEWNE grid.

Source	Gas	Included?	Justification/Explanation
Bas eline CO2 emissions from electricity generation in fossil fuel fired	CO ₂	Yes	Major emission source

Source		Gas	Included?	Justification/Explanation
	power plants that is displaced due to the project activity	CH ₄	No	Minor Emission Source. Same has been excluded from consideration for simplification.
		N ₂ O	No	Minor Emission Source. Same has been excluded from consideration for simplification.
Project Scenario	For geothermal power plants, fugitive emissions of CH ₄ and CO ₂ from non-condensable gases contained in geothermal steam	CO ₂	No	The project activity is a wind power project and not a geothermal project. Thus these emission sources are not applicable to the proposed project.
		CH ₄	No	
		N ₂ O	No	
	CO ₂ emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO ₂	No	The project activity is a wind power project and not a geothermal project. Thus these emission sources are not applicable to the proposed project.
		CH ₄	No	
		N ₂ O	No	
	For hydro power plants, emissions of CH ₄ from the reservoir	CO ₂	No	The project activity is a wind power project and not a geothermal project. Thus these emission sources are not applicable to the proposed project.
		CH ₄	No	
		N ₂ O	No	

2.4 Baseline Scenario

As per para 24 of ACM0002 version 17.0, if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

“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 per para 44 of ACM0002 version 17.0, “Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants”.

The baseline case is in compliance with all applicable legal and regulatory requirements.

2.5 Additionality

In line with VCS Standard version 3.5, 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 published by the UNFCCC i.e. "Tool for demonstration and assessment of Additionality" Version 07.0.0. The tool provides a step-wise approach to demonstrate additionality which is displayed below:

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

The proposed project activity is a wind power project located in Rajasthan and Madhya Pradesh which is using the latest available and proven technology. Thus, this project activity is not a first-of-its-kind project. The additionality of the project activity has demonstrated by using the investment analysis and the same has been discussed in the following steps.

Outcome of Step 0: This project activity is not a first-of-its-kind project.

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

The methodology ACM0002, prescribe the baseline for the project activity which is an installation of new grid connected power plant and hence no further analysis is required for identification of alternatives.

Outcome of Sub-step 1b: The alternative for this project activity is has been prescribe by the ACM0002. Hence, no further analysis is required for identification of alternatives.

Step 2: Investment analysis

According to the "Tool for the demonstration and assessment of additionality" (version 7.0) there are three options for the execution of the investment analysis.

- | | |
|-------------|--------------------------------|
| Option I: | Simple cost analysis |
| Option II: | Investment comparison analysis |
| Option III: | Benchmark analysis |

Appropriateness of the same are described below:

Sub-step 2a: Determine appropriate analysis method

The project will generate revenues from energy sale and also from credits of emissions reduction. 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. The most appropriate financial analysis method is therefore option III i.e., the benchmark analysis, where the returns on investment in the project activity are compared to benchmark returns that is available to any investors in the country. 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 during the decision to undertake the project was taken and management approval.

Choice of Financial Indicator:

As allowed by the Methodological tool for Investment analysis (version 6.0³), post tax Equity Internal Rate of Return (IRR) was selected as the financial indicator to assess the attractiveness of the project.

Choice of Benchmark:

As per para 20 of Methodological tool for Investment analysis (version 6.0), the value for cost of equity is selected from Table-1 of EB 85 Annex 12. The default value of Return on Equity for Group-1 projects for India is 11.1%.

As per paragraph 17 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".

Calculations of Default Benchmark Value:

As mentioned in Table-1 of Methodological tool for Investment analysis (version 6.0), default value benchmark is presented below:

Table-1 of Methodological tool for Investment analysis (version 6.0) specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = 11.1%

The Required return on equity (benchmark) was computed in the following manner:

$$\text{Nominal Benchmark}^4 = \{(1 + \text{Real Benchmark}) * (1 + \text{Inflation rate})\} - 1$$

Where:

- Default value for Real Benchmark i.e. 11.1%
- Inflation Rate forecast by Reserve Bank of India (RBI) (i.e. Central Bank) for India

The project has been implemented in 2 phases with different decision making dates. Thus, the investment analysis has been carried out for the 2 phases separately.

Phase 1: Tejuva wind farm in Jaisalmer District of Rajasthan.

³ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-27-v1.pdf>

⁴ As per Pg. 320 of Corporate Finance, Second Edition of Aswath Damodaran

The decision making date for the project activity was on 09/01/2012

Benchmark estimation for Tejuva Project:

Table-1 of EB 85 Annex 12 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = **11.1%**

Further, Long Term Median Forecasts for Growth and Inflation Rate Forecast issued by RBI which was available during decision making = 6.0% (<https://www.rbi.org.in/scripts/PublicationsView.aspx?id=14021>)

$$\begin{aligned}\text{Thus, Benchmark} &= \{(1+11.1\%)(1+6.0\%)\}-1 \\ &= 17.77\%\end{aligned}$$

Phase 2: Chandgarh wind farm in Dewas and Shajapur, Madhya Pradesh.

The decision making date for the project activity was on 10/12/2014.

Benchmark estimation for Chandgarh Project:

Table-1 of EB 85 Annex 12 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = **11.1%**

Further, Inflation Rate (median) forecast issued by RBI which was available during decision making = 4.8% (<https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=16141>)

$$\begin{aligned}\text{Thus, Benchmark} &= \{(1+11.1\%)(1+4.8\%)\}-1 \\ &= 16.43\%\end{aligned}$$

Sub-step 2c: Calculation and comparison of financial indicators

All the input values used in all investment analysis were valid and applicable at the time of the investment decision taken by the management. Thus, it complies with guidance 11 of EB 85, Annex 12.

Phase 1: Tejuva wind farm in Jaisalmer District of Rajasthan.

Key assumptions used for calculating post-tax Equity IRR applicable at the time of investment decision are mentioned below:

Particulars	Value	Unit	Source/Remarks
No. of wind turbines	48	nos	Proposal from technology supplier dated 26/07/2011
Capacity of each wind turbine	2.1	MW	Proposal from technology supplier dated 26/07/2011
Capacity of the project	100.8	MW	Calculated
Net generation	187.80	GWh	Wind energy assessment report by third party (Pg. No. 42 Table 7-6)
Project cost	6105.65	INR Million	Proposal from technology supplier dated 26/07/2011
Debt	70	%	RERC Tariff Order dated 14/12/2011 (Ref

Particulars	Value	Unit	Source/Remarks
Equity	30	%	pg 3) (http://www.erc.rajasthan.gov.in/TariffOrders/Order120.pdf)
Debt	4273.95	INR Million	Calculated
Equity	1831.69	INR Million	Calculated
Interest rate	13.25	%	RERC Tariff Order dated 14/12/2011 (Ref pg 3) (http://www.erc.rajasthan.gov.in/TariffOrders/Order120.pdf)
Debt Repayment tenure	10	years	CERC Tariff Order dated 14/12/2011 (Ref pg 53) (http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf)
Moratorium	0	year	CERC Tariff Order dated 14/12/2011 (Ref pg 53) (http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf)
Operation and Maintenance (First Two years)	0.0	INR Million	Proposal from technology supplier dated 26/07/2011
Operation and Maintenance (3rd year) per WTG	2.0	INR Million/WTG	Proposal from technology supplier dated 26/07/2011
Operation and Maintenance (3rd year)	96.0	INR Million	Calculated
Escalation in O & M	5	%	Proposal from technology supplier dated 26/07/2011
Service tax on O & M fees	10.30	%	Calculated as per Indian IT Act for FY11-12 (http://indiabudget.nic.in/ub2010-11/bh/bh1.pdf)
Insurance premium	4.97	INR Million / Yr	As per quotation received from K M Dastur Reinsurance Brokers Pvt. Ltd. dated 18/11/2011
Tariff	4.46	Rs/kWh	As per RERC Tariff Order dt. 14 December 2011 (http://www.erc.rajasthan.gov.in/TariffOrders/Order120.pdf)
Depreciation Rate (Book)	4.75	%	Companies Act Schedule XIV (http://www.mca.gov.in/Ministry/latestnews/Explanatory_Statement_alongwith_Schedule_XIV_4dec2008.pdf)
IT Depreciation Rate	7.69	%	Appendix IA of IT Rules (http://www.incometaxindia.gov.in/charts%20%20tables/depreciation%20rates.htm)
Income tax rate	33.22	%	Calculated as per Indian IT Act for FY11-12 (http://indiabudget.nic.in/ub2010-11/fb/bil91.pdf)
MAT rate	19.93	%	Calculated as per Indian IT Act for FY11-12 (http://indiabudget.nic.in/ub2010-11/bh/bh1.pdf)

Particulars	Value	Unit	Source/Remarks
Service Tax	10.3	%	Calculated as per Indian IT Act for FY11-12 (http://indiabudget.nic.in/ub2010-11/bh/bh1.pdf)
Surcharge	7.50	%	Indian IT Act for FY11-12 (http://indiabudget.nic.in/ub2010-11/fb/bill91.pdf)
Education cess	3.0	%	Indian IT Act for FY11-12 (http://indiabudget.nic.in/ub2010-11/fb/bill2.pdf)
Salvage Value	10	%	CERC Tariff Order dated 14/12/2011 (Ref pg 27) (http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf)
Depreciable cost of Project	90	%	CERC Tariff Order dated 14/12/2011 (Ref pg 27) (http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf)

Particulars	Value	Unit	Source/Remarks
GBI Benefit	0.5	INR/kWh	MNRE GBI Guidelines dated 17/12/2009 (http://www.inwea.org/others/OPERATIONAL_GUIDELINES.pdf)
Max duration for GBI	10	years	
GBI cumulative cap	6.2	INR Million per MW	
Max. GBI allowed in a year	1.55	INR Million per MW	
GBI cumulative cap	624.96	INR Million	Calculated
Max. GBI allowed in a year	156.24	INR Million	Calculated

The result of the analysis is as follows:

Considering the above input values, Equity IRRs for Tejuva wind project activity is given below:

Equity IRR without Carbon Revenue	Benchmark
8.78%	17.77%

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

Phase 2: Chandgarh wind farm in Dewas and Shajapur, Madhya Pradesh.

During project conceptualization of Chandgarh wind project, management has considered capacity of the project would be 100 MW (50*2 MW). However, during project implementation, capacity of the project was reduced to 92 MW (46*2 MW). As during project conceptualization, capacity of the Chandgarh wind project was 100 MW, thus, additionality has been demonstrated considering with 100 MW.

Key assumptions used for calculation of Equity IRR and Emission Reductions are listed in the table below:

Particulars	Value	Unit	Source/Remarks
No. of wind turbines	50	nos	Proposal from technology supplier dated 26/09/2014
Capacity of each wind turbine	2	MW	Proposal from technology supplier dated 26/09/2014
Capacity of the project	100	MW	Calculated
Net generation	196.80	GWh	Wind energy assessment report by third party (Pg. No. 30)
Project cost	7375.00	INR Million	Proposal from technology supplier dated 26/09/2014
Debt	70	%	MPERC Tariff Order dated March 2013 (Ref pg 9) (http://www.mperc.nic.in/26032013-Wind-tariff-order.pdf)
Equity	30	%	
Debt	5162.50	INR Million	Calculated
Equity	2212.50	INR Million	Calculated
Interest rate	12.75	%	MPERC Tariff Order dated March 2013 (Ref pg 9) (http://www.mperc.nic.in/26032013-Wind-tariff-order.pdf)
Debt Repayment tenure	12	years	CERC Tariff order dated 27/03/2012 (Ref pg no 50) (http://www.cercind.gov.in/2012/orders/RE_3_5_2012.pdf)
Moratorium	0	year	
Operation and Maintenance (First Two years)	0.0	INR Million	Proposal from technology supplier dated 26/09/2014
Operation and Maintenance (3rd year) per WTG	2.61	INR Million/WTG	Proposal from technology supplier dated 26/09/2014
Operation and Maintenance (3rd year)	130.5	INR Million	Calculated
Escalation in O & M	5	%	Proposal from technology supplier dated 26/09/2014
Service tax on O & M fees	10.30	%	Calculated as per Indian IT Act for FY14-15 (http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html)
Insurance premium	6.04	INR Million / Yr	As per quotation received from K M Dastur Reinsurance Brokers Pvt. Ltd. Dated 05/09/2014
Tariff	5.92	Rs/kWh	MPERC Tariff Order dated March 2013 (http://www.mperc.nic.in/26032013-Wind-tariff-order.pdf)
Depreciation Rate (Book)	4.75	%	Companies Act Schedule XIV (http://www.mca.gov.in/Ministry/latestnews/Explanatory_Statement_alongwith_Schedule_XIV_4dec2008.pdf)
IT Depreciation Rate	7.69	%	Appendix IA of IT Rules (http://www.incometaxindia.gov.in/charts%20%20tables/depreciation%20rates.htm)

Particulars	Value	Unit	Source/Remarks
Income tax rate	33.99	%	Calculated as per Indian IT Act for FY14-15 (http://indiabudget.nic.in/budget2013-2014/ub2013-14/fb/bill31.pdf)
MAT rate	20.96	%	Calculated as per Indian IT Act for FY14-15 (http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html)
Service Tax	10.3	%	Calculated as per Indian IT Act for FY14-15 (http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html)
Surcharge	10	%	Calculated as per Indian IT Act for FY14-15 (http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html)
Education Cess	3	%	Calculated as per Indian IT Act for FY14-15 (http://taxguru.in/income-tax/income-tax-rate-chart-assessment-year-201516-financial-year-201415.html)
Salvage Value	10	%	CERC Tariff order dated 27/03/2012 (Ref pg no 31) (http://www.cercind.gov.in/2012/orders/RE_3_5_2012.pdf)
Depreciable Value of Project	90	%	CERC Tariff order dated 27/03/2012 (Ref pg no 31) (http://www.cercind.gov.in/2012/orders/RE_3_5_2012.pdf)

Particulars	Value	Unit	Source/Remarks
GBI Benefit	0.5	Rs/kWh	MNRE GBI Guidelines, 04.09.2013 (http://mnre.gov.in/file-manager/grid-wind/gbi-scheme.pdf)
Max duration for GBI	10	years	
GBI cumulative cap	10	INR Million per MW	
Max. GBI allowed in a year	2.5	INR Million per MW	
GBI cumulative cap	1000	INR Million	Calculated
Max. GBI allowed in a year	250	INR Million	Calculated

The result of the analysis is as follows:

Considering the above input values, Equity IRRs for Chandgarh wind project activity is given below:

Equity IRR without Carbon Revenue	Benchmark
12.79%	16.43%

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

Sub-step 2c: Sensitivity Analysis:

As per Guidance 28 and 29 of Annex 12 of EB 85, 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 PD 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 State Electricity Board Tariff Order available at the time of investment making decision 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 generation needs to be subjected to reasonable variation. Nevertheless, following factors have been considered in to sensitivity analysis:

- Tariff Rate
- Net generation
- Project Cost
- O&M Cost

The results of sensitivity analysis are as follows:

Phase 1: Tejuva wind farm in Jaisalmer District of Rajasthan

Variation %	-10%	Normal	10%	Variation required to breach benchmark
Tariff Rate	6.43%	8.76%	11.16%	36.25%
Net Generation	6.41%	8.76%	11.21%	35.25%
Project Cost	11.39%	8.76%	6.74%	-26.18%
O&M Cost	9.14%	8.76%	8.41%	-307.50%

The electricity tariff structure is sourced from prevailing tariff order of Rajasthan Electricity Commission (RERC) dated 14/12/2011. Further, CLP has been signed Power Purchase Agreement with Jodhpur Vidyut Vitaran Nigam Limited on 18/03/2015 at INR 5.64/kWh wherein the tariff is fixed for a period of 25 years. Since the tariff is fixed for a period of 25 years, i.e. lifetime of the project, revenue generation is also fixed for the entire lifetime of the project and considering this tariff rate, equity IRR is coming out 15.23%. Thus, considering this tariff rate, in any scenario, equity IRR would not cross the benchmark. Further, sensitivity analysis of +10% to -10% have been conducted and in both the cases equity IRR is less than the benchmark. Sensitivity analysis shows that project would cross the benchmark if electricity tariff increased by 36.25% which is not possible in as PPA has already been signed for the entire life time of the project. Thus, the financial indicator crossing the benchmark can be ruled out.

The plant load factor (PLF) affects the equity IRR of the project activity as increase in the PLF would lead to an increase in exports and as a result the revenues associated with the project activity. At this Tejuva site, PP has considered 21.27% PLF to demonstrate the additionality of the project in line with the 3rd party PLF assessment report. Further, sensitivity analysis of +10% to -10% have been conducted and in both the cases equity IRR is less than the benchmark. Sensitivity analysis shows that project would cross the benchmark, if in any favorable scenario, PLF increased by 35.25%. Further, actual generation from this project site is available. During this monitoring period from 29/03/2015 to 31/07/2016 (i.e. 491 days), 200,913.225 MWh of electricity has been exported to the NEWNE grid from this site. Thus, actual PLF achieved during this monitoring period from Tejuva site is 16.19% which is 20.51% less than the envisaged value. Considering actual PLF, equity IRR is coming out 3.91% which is far behind the benchmark value.

Project cost proposed by the WTG supplier has been considered additionality of the project activity. According to the proposal, to project cost was INR 6,105.65 Million. If project cost decreased by -26.18%, then equity IRR would cross the benchmark. Further, as the PP has already placed the purchase orders for all the WTGs, thus, actual project cost is available. Actual project cost for this project is INR 5,536.21 Million which is 9.33% less than the project cost mentioned in proposal. Considering the actual project cost equity IRR is coming out 11.20% which is less than the benchmark. Further, sensitivity analysis of +10% to -10% have been conducted and in both the cases equity IRR is less than the benchmark. As the purchase orders are already placed, thus, the project cost is firm and further change is not possible.

The O & M costs associated with the project has a major impact on the financial returns of the project. Project proponent has signed O&M agreement with Suzlon Energy Limited on 11/01/2012. According to the agreement, O&M cost is free for first two years of the commissioning of WTGs, 3rd year onwards the O&M cost would be INR 2.83 Million/WTG with 5% escalation. Thus, financial analysis predicts that if the O&M cost decrease by -307.50% then only project would be financially viable. Further, decrease of O&M cost more than 100% is not possible. Thus, in any scenario project will not breach the benchmark return.

Phase 2: Chandgarh wind farm in Dewas and Shajapur, Madhya Pradesh.

As mentioned in the project description, during project conceptualization of Chandgarh wind project, management has considered capacity of the project would be 100 MW (50*2 MW). However, during project implementation, capacity of the project was reduced to 92 MW (46*2 MW). As during project conceptualization, capacity of the Chandgarh wind project was 100 MW, thus, additionality has been demonstrated considering with 100 MW. Further, to demonstrate the financials of the actual project status, sensitivity analysis has been performed considering 92 MW as well as 100 MW project capacity.

Sensitivity Analysis considering 100 MW project capacity:

Variation %	-10%	Normal	10%	Variation required to breach benchmark
Tariff Rate	9.86%	12.79%	15.85%	11.85%
Net Generation	9.71%	12.79%	16.05%	11.12%

Variation %	-10%	Normal	10%	Variation required to breach benchmark
Project Cost	16.26%	12.79%	10.15%	-10.44%
O&M Cost	13.19%	12.79%	12.39%	-99.10%

Sensitivity Analysis considering 92 MW project capacity:

Variation %	-10%	Normal	10%	Variation required to breach benchmark
Tariff Rate	9.85%	12.78%	15.84%	11.90%
Net Generation	9.69%	12.78%	16.04%	11.15%
Project Cost	16.24%	12.78%	10.14%	-10.48%
O&M Cost	13.17%	12.78%	12.38%	-99.40%

The electricity tariff structure is sourced from prevailing tariff order of MPERC Tariff Order dated March 2013. Further, CLP has been signed Power Purchase Agreement with Madhya Pradesh Power Management Company Limited on 07/08/2015 at same tariff rate i.e. INR 5.92/kWh wherein the tariff is fixed for a period of 25 years. Since the tariff is fixed for a period of 25 years, i.e. lifetime of the project, revenue generation is also fixed for the entire lifetime of the project. Thus, in any scenario, equity IRR would not cross the benchmark. Further, sensitivity analysis of +10% to -10% have been conducted and in both the cases equity IRR is less than the benchmark. Sensitivity analysis shows that project would cross the benchmark if electricity tariff increased by 11.85% which is not possible in as PPA has already been signed for the entire life time of the project. Thus, the financial indicator crossing the benchmark can be ruled out.

The plant load factor (PLF) affects the equity IRR of the project activity as increase in the PLF would lead to an increase in exports and as a result the revenues associated with the project activity. At Chandgarh site, PP has considered 22.47% PLF to demonstrate the additionality of the project in line with the 3rd party PLF assessment report. Further, sensitivity analysis of +10% to -10% have been conducted and in both the cases equity IRR is less than the benchmark. Sensitivity analysis shows that project would cross the benchmark, if in any favorable scenario, PLF increased by 11.12%. Further, actual generation from this project site is available. During the monitoring period from 29/03/2015 to 31/07/2016 (i.e. 491 days), 188,007.863 MWh of electricity has been exported to the NEWNE grid from this site. Thus, actual PLF achieved during this monitoring period from Chandgarh site is 17.34% which is 22.81% less than the envisaged value. Considering actual project capacity and actual achieved PLF, equity IRR is coming out 5.95% which is far behind the benchmark value.

Project cost proposed by the WTG supplier has been considered additionality of the project activity. According to the proposal, to project cost was INR 7,375 Million. In line with the sensitivity analysis, if project cost decreased by -10.44%, then equity IRR would cross the benchmark. Further, sensitivity analysis of +10% to -10% have been conducted and in both the cases equity IRR is less than the benchmark. Further, as the PP has already placed the purchase orders for all the WTGs, thus, actual project cost is available. Actual project cost for this project is INR 7,375 Million which is the same value mentioned in proposal. Thus, thus, the project cost is firm and further change is not possible.

The O & M costs associated with the project has a major impact on the financial returns of the project. Project proponent has signed O&M agreement with Gamesa Wind Turbines Private Limited on 15/12/2014. According to the agreement, O&M cost is free for first two and half years of the commissioning of WTGs and after that the O&M cost would be INR 1.15 Million/WTG with 5% escalation. Thus, financial analysis predicts that if the O&M cost decrease by -99.10% then only project would be financially viable. As the agreement has already signed for operation and maintenance for this project, thus, further change is not possible.

It can be observed from above elastration 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 VERs is important to alleviate this gap and hence the project has been considered to be additional.

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 EB84, Annex 7". 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 9): The host country, i.e. India has been considered as the applicable geographical area for this project.
2. Measure (Para 10): The project activity reduces greenhouse gas emissions by generating electricity using renewable energy source-wind. 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 11): The project activity produces electricity. Therefore, electricity is considered as output of the project activity.
4. Different Technologies (Para 12): The project activity uses wind energy for producing electricity and hence as per Para 12(a), the technologies which use energy source/ fuel other than wind will be considered as the different technologies for the project activity.

The common practice analysis is carried out as per Stepwise approach for common practice. Stepwise approach for common practice as follows:

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%	289.2	MW

Range	Capacity	Unit
Capacity of the proposed project activity	192.8	MW
-50%	96.4	MW

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

- The projects are located in the applicable geographical area;*
- The projects apply the same measure as the proposed project activity;*
- 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;*
- 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;*
- The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;*
- 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:

- As the projects are located in India, therefore, the applicable geographical area is India and projects in the host country India have been chosen for analysis.
- The project activity is a green-field wind 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.

- The energy source used by the project activity is wind. Hence, only wind energy projects have been considered for analysis.
- The project activity produces electricity; therefore, all power plants that produce electricity are candidates for similar projects.
- The capacity range of the projects is within the applicable capacity range from 96.4 MW to 289.2 MW.
- The start date of the project activity is 29/03/2015. As Kyoto Protocol was ratified by India on 26/08/2002⁵, therefore projects, which had started commercial operation between 26/08/2002 to 29/03/2015, have been identified.

⁵ http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php

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

Particulars	No. of Projects	Source
N_{wind}	15	Directory - Indian Wind Power published by CECL, Bhopal

Sources: Indian Wind Power Directory 2015

Project Proponent	Capacity in MW	CDM Reference
DLF Limited	148.5	http://cdm.unfccc.int/Projects/DB/BVQI1229917560.71/view Project No: 2347
DJ Energy Private Ltd.	98.7	http://cdm.unfccc.int/Projects/DB/BVQI1356535544.64/view Project No: 9230
Tadas Wind Energy Ltd.	100	http://cdm.unfccc.int/Projects/DB/RINA1356126148.87/view Project No: 9083
NuPower Renewables Ltd.	100.5	http://cdm.unfccc.int/Projects/DB/KBS_Cert1348556974.27/view Project No: 7432
Panama Wind Energy Private Ltd.	100.8	http://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1354531234.95/view Project No: 8524
Fortune Five Hydel Projects Private Ltd.	100.8	http://cdm.unfccc.int/Projects/DB/DNV-CUK1351166669.28/view Project No: 7880
Simran Wind Project Pvt Ltd	111.9	http://cdm.unfccc.int/Projects/DB/BVQI1351312018.91/view Project No: 7901
RS India Wind Energy Pvt. Ltd.	100	http://cdm.unfccc.int/Projects/DB/SGS-UKL1243424941.8/view Project No: 2605
DLF Ltd.	150	http://cdm.unfccc.int/Projects/DB/BVQI1229917560.71/view Project No: 2347
MSPL Ltd.	125	http://cdm.unfccc.int/Projects/DB/DNV-CUK1142448670.58/view Project No: 315
Tamilnadu Spinning Mills Association (TASMA)	129.975	http://cdm.unfccc.int/Projects/Validation/DB/SFX7WFZFLX BABZIYZH1LHPHJP6C9TD/view.html Bundled Wind Power Project in Tamilnadu, India, Coordinated by Tamilnadu Spinning Mills Association (TASMA-IV)
Tamilnadu Spinning Mills Association (TASMA)	142.275	http://cdm.unfccc.int/Projects/Validation/DB/BJX1RZF6KJ1 LUSVYDAYGAXC8M88P5M/view.html Bundled Wind Power Project in Tamilnadu, India, co-ordinated by Tamilnadu Spinning Mills Association (TASMA-III)
Kamachi Green Energy Ltd.	200	http://cdm.unfccc.int/Projects/Validation/DB/UH5I9PDNJ5P O17UA09DYZJDJDNKVF4/view.html

Project Proponent	Capacity in MW	CDM Reference
		200 MW wind power project in Tamil Nadu by KGEL
Axis Wind Farms (Borampalle) Private Ltd.	150	http://cdm.unfccc.int/Projects/Validation/DB/YDALPTQO0JT E0RDDV9MAA40L7APR1O/view.html Axis Wind Energy Project with a capacity of 150 MW to reduce Green House Gases Emissions
NSL Power Ltd.	120	http://cdm.unfccc.int/Projects/Validation/DB/CLOM/VOKJ8E S5XE0GTBWKRK552MK6SP/view.html 120MW Wind Power Project at Bagalkot

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 $N_{all} = 0$

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} .

As $N_{all} = 0$; 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 $F = 1 - N_{diff}/N_{all}$

As N_{all} is zero thus, $N_{all} - N_{diff} = 0$; is less than 3

Outcome of Step 5:

As,

- $F = \text{Not defined}$
- $N_{all} - N_{diff} = 0$; 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 CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

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

Where:

BE_y = Baseline emissions in year y (tCO₂)

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)

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

Calculation of EG_{PJ,y}

The methodology ACM0002 (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 all the three projects included in the proposed project activity are Greenfield plants, option (a) as provided in the methodology ACM0002 (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":

$$EG_{PJ,y} = EG_{facility,y} \quad (2)$$

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 ACM 0002 (Version 17.0) requires that the combined margin for the grid be calculated in accordance with the procedure provided in the *“Tool to calculate the emission factor for an electricity system”, ver 5.0*

As per version 5 of Tool to calculate emission factor for an electricity system, following steps are included in the calculation of the emission factor for the baseline scenario:

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) emissions factor.

The Central Electricity Authority (CEA) has published CO₂ baseline database in its version 10.0⁶ (December, 2014). The values for OM, BM, CM are given excluding and including imports. For the present project activity, including imports are considered.

Step 1: Identifying the relevant electricity system

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.

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 synchronized with the NEWNE grid, hence forming one unified Indian Grid.

The project activity is located in the state of Rajasthan and Madhya Pradesh which come under NEWNE grid and the electricity generated by this project displaces the electricity from the NEWNE grid. Due to the displacement of electricity, the project activity would have impact on the NEWNE grid only. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

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

⁶ http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf

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

Option I: Only grid power plants are included in the calculation.

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

Only grid power plants are included in the calculation of OM & BM.

Step 3: Selection of an Operating Margin method

The calculation of the operating margin emission factor ($EF_{\text{grid, OM, } y}$) is based on one of the following methods: which are described under step 4 (Refer "Tool to calculate the emission factor for an electricity system", version 05.0)

- (a) Simple OM, or
- (b) Simple adjusted OM, or
- (c) Dispatch data analysis OM, or
- (d) Average OM.

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.

The Share of Low Cost / Must-Run (% of Net Generation) in the generation profile of the different grids in India in the last five years is as follows:

Grid	2009-10	2010-11	2011-12	2012-13	2013-14
NEWNE	15.9%	17.6%	19.0%	17.2%	18.0%

Source: CEA Baseline Carbon Dioxide Emission Data Base Version 10

In Integrated (NEWNE) Grid, the low-cost/must run resources vary from 15.9% to 19.0% of the total net grid generation (From Year 2009-10 to Year 2013-14). The calculation above shows that the generation from low-cost/must-run resources constitutes less than 50% of total grid generation, hence usage of the Simple OM method in the project case is justified.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) y:

- Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period,
Or
- Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

The project proponents choose the Ex ante option for estimating the simple OM emission factor wherein as described above a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period will be undertaken.

As observed in the CEA database, (Version 10, Dec'14) the percentage of total grid generation by low-cost/must-run plants (on the basis of average of five most recent years) for the NEWNE grid is only 18.1% which is much lesser than 50% of the total generation. Thus, Simple OM method has been used for calculating the emission factor.

The project proponent has chosen the ex-ante option for the calculation of the OM with a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

Step 4: Calculation of the OM according to the Simple OM method

The simple OM method has been selected as justified above. 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 using the following formula:

$$EF_{grid,OM,simple,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,OM,simple,y}$	=	Simple operating margin CO ₂ emission factor of in year y (tCO ₂ /MWh)
$FC_{i,m,y}$	=	Amount of fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fuel type i in year y (GJ / mass or volume unit)
$EF_{CO_2,i,y}$	=	CO ₂ emission factor of fuel type i in year y (tCO ₂ /GJ)
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by power unit m in year y (MWh)
m	=	All power units serving the grid in year y except low-cost / must-run power units
i	=	All fuel types combusted in power plant / unit m in year y
y	=	Either the three most recent years for which data is available at the time of submission of the CDM-PD to the DOE for validation (ex-ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

In India, the Central Electricity Authority (CEA) has estimated the baseline emission factor for the power sector. This data has also been endorsed by the DNA and is the most authentic information available in the public domain. The details of same can be found on CEA website at http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf.

Therefore weighted OM average for NEWNE grid comes out to be 1.00 tCO₂/MWh

i.e. $EF_{grid,OM,y} = 1.00 \text{ tCO}_2/\text{MWh}$

In this PD *ex-ante* vintage has been fixed and will not be changed during the crediting period.

Step 5: Calculate the build margin emission factor

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group *m* at the time of PD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The project proponents choose option 1.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh);

(c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

In India, the installed capacity and corresponding annual generation from power plants is quite high. The Central Electricity Authority (CEA) has estimated the annual electricity generation from SET_{≥20%} to be larger than the generation from SET_{5-units}. The details of same can be found on CEA website at http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf. Further, none of the power units in SET_{≥20%} started to supply electricity to the grid more than 10 years ago.

Therefore, SET_{sample} is selected as SET_{≥20%} for the estimation of build margin.

The build margin emissions factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid, BM, y} = \frac{\sum_m EG_{m, y} \cdot EF_{EL, m, y}}{\sum_m EG_{m, y}}$$

Where:

- EF_{grid, BM, y} = Build margin CO₂ emission factor in year *y* (tCO₂ / MWh)
- EG_{*m, y*} = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
- EF_{EL, *m, y*} = CO₂ emission factor of power unit *m* in year *y* (tCO₂ / MWh)
- m* = Power units included in the build margin
- y* = Most recent historical year for which electricity generation data is available

Calculations for the Build Margin emission factor EF_{grid, BM, y} is based on the most recent information available on the plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of the power plant capacity additions in the electricity system that comprise 20 % of the system generation and that have been built most recently (SET_{≥20%}). PP has sourced the data from CEA website at http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf and same in inline with the Tool to calculate the emission factor of the electricity system.

Build margin emission factor is calculated, ex-ante as per the most recent data available. So, build margin emission factor for NEWNE grid for 2013-14 is 0.95 tCO₂/MWh

$$EF_{grid, BM, y} = 0.95 \text{ tCO}_2\text{e/MWh}$$

The build margin emissions factor is the generation-weighted average emission factor (tCO₂e/MWh) of all power units *m* during the most recent year *y* for which power generation data is available and will be calculated as follows:

$$EF_{grid, BM, y} = \frac{\sum_m EG_{m, y} \times EF_{EL, m, y}}{\sum_m EG_{m, y}} \quad (4)$$

Where:

- EF_{grid, BM, y}: Build margin CO₂ emission factor in year *y* (tCO₂e/MWh)

EG _{m, y} :	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
EF _{EL, m, y} :	CO ₂ emission factor of power unit m in year y (tCO ₂ e/MWh)
m:	Power units included in the build margin
y:	Most recent historical year for which power generation data is available

As described above, the Build Margin would be calculated annually during the entire crediting period. For the purpose of ex-ante emission reduction calculations the most recent data available (from CEA for 2013-14) has been used and the build margin thus calculated is 0.95 (tCO₂e/MWh)

Therefore, EF_{grid, BM, y} = 0.95 (tCO₂e/MWh)

Step 6: Calculation of the combined Build Margin emission factor

The combined margin emission factor will be calculated as follows:

$$EF_{grid, CM, y} = EF_{grid, OM, y} \times w_{OM} + EF_{grid, BM, y} \times w_{BM} \quad (5)$$

Where,

EF _{grid, BM, y}	= Build margin CO ₂ emission factor in year y (tCO ₂ e/MWh)
EF _{grid, OM, y}	= Operating margin CO ₂ emission factor in year y (tCO ₂ e/MWh)
w _{OM}	= Weightage of operating margin emissions factor (%)
w _{BM}	= Weightage of build margin emissions factor (%)

As per the 'Tool to calculate the Emission Factor for an electricity system' version 05, the default values for w_{OM} and w_{BM} are taken as 0.75 and 0.25 respectively as per the guidance provided for wind project activities for the first crediting period and subsequent crediting periods.

Hence, the Baseline Emission Factor is calculated using the formula stated below:

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

$$EF_{grid, CM, y} = 0.75 * 1.00 + 0.25 * 0.95 \text{ (tCO}_2\text{/MWh)}$$

$$EF_{grid, CM, y} = 0.99 \text{ tCO}_2\text{/MWh}$$

3.2 Project Emissions

As per the para 36 of methodology ACM0002 (Version 17.0), "For most renewable power generation project activities, PE_y = 0.

3.3 Leakage

As per para 5.6 of the methodology ACM0002 (Version 17.0) does not consider any leakage emissions.

3.4 Estimated Net GHG Emission Reductions and Removals

Baseline Emissions

As per the equation 6 of the methodology ACM 0002 (Version 17.0),

$$BE_y = EG_{PJ, y} * EF_{grid, CM, y} \quad (1)$$

Where:

BE_y : Baseline emissions in year y (tCO₂e/yr)

$EG_{PJ, y}$: Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid, CM, y}$: Combined margin CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO₂e/MWh)

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

$$BE_y = 368,856 \text{ (MWh)} * 0.99 \text{ tCO}_2/\text{MWh}$$

$$BE_y = 364,244 \text{ tCO}_2$$

Project Emissions

As per the para 36 of methodology ACM 0002 (Version 17.0), "For most renewable power generation project activities, $PE_y = 0$."

Leakage Emissions

As per para 5.6 of the methodology ACM 0002 (Version 17.0) does not consider any leakage emissions.

Emission reductions

As per equation number (17) of the applied methodology, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (7)$$

Where:

ER_y : Emission reductions in year y (tCO₂e/yr)

BE_y : Baseline emissions in year y (tCO₂e/yr)

PE_y : Project emissions in year y (tCO₂e/yr)

$$\text{Thus, } ER_y = 364,244 - 0 \text{ tCO}_2$$

$$= 364,244 \text{ tCO}_2$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
Year 1	364,244	0	0	364,244
Year 2	364,244	0	0	364,244
Year 3	364,244	0	0	364,244
Year 4	364,244	0	0	364,244
Year 5	364,244	0	0	364,244
Year 6	364,244	0	0	364,244
Year 7	364,244	0	0	364,244
Year 8	364,244	0	0	364,244
Year 9	364,244	0	0	364,244
Year 10	364,244	0	0	364,244
Total	3,642,440	0	0	3,642,440

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 of NEWNE Grid
Source of data	Central Electricity Authority:CO2 Emission Database CEA CO ₂ Baseline database Version 10 (http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf)
Value applied:	1.00
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" as 3-year generation weighted average using data for the years 2011-2012, 2012-2013 and 2013-14. The data are obtained from "CO ₂ Baseline Database for Indian Power Sector" version 10.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	Baseline Emission Factor
Comments	This database is an official publication of Government of India for the purpose of baseline emission calculation. It is based on most recent data available to the Central Electricity Authority and hence considered authentic. As the calculation of baseline emission has been done ex ante its value will remain fixed for the entire

	crediting period.
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Data / Parameter	EF _{grid,BM,y}
Data unit	tCO ₂ /MWh
Description	Build margin CO2 emission factor of NEWNE grid
Source of data	Central Electricity Authority:CO2 Emission Database CEA CO ₂ Baseline database Version 10 (http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf)
Value applied:	0.95
Justification of choice of data or description of measurement methods and procedures applied	CEA has Calculated it as per 'Tool to calculate the emission factor for an electricity system', version 05.0 for the year 2013-14. The build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation and option of ex ante calculation.
Purpose of Data	Baseline Emission Factor
Comments	This database is an official publication of Government of India for the purpose of baseline emission calculation. It is based on most recent data available to the Central Electricity Authority and hence considered authentic. As the calculation of baseline emission has been done ex ante its value will remain fixed for the entire crediting period.

Data / Parameter	EF _{grid,CM,y}								
Data unit	tCO ₂ /MWh								
Description	Combined margin CO2 emission factor of NEWNE grid								
Source of data	Central Electricity Authority:CO2 Emission Database CEA CO ₂ Baseline database Version 10 (http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver10.pdf)								
Value applied:	0.99								
Justification of choice of data or description of measurement methods and procedures applied	Calculation based on 75% of OM and 25% of BM values approach as directed by 'Tool to calculate the emission factor for an electricity system', version 05.0.0. <table border="1"> <tr> <th colspan="2">Combined Margin Estimation for NEWNE Grid (tCO₂/MWh)</th></tr> <tr> <td>Generation Weighted Average OM (EF_{grid, OM,y})</td><td>1.00</td></tr> <tr> <td>BM (EF_{grid, BM, y})</td><td>0.95</td></tr> <tr> <td>Combined Margin (EF_{grid,CM,y})</td><td>0.99</td></tr> </table>	Combined Margin Estimation for NEWNE Grid (tCO ₂ /MWh)		Generation Weighted Average OM (EF _{grid, OM,y})	1.00	BM (EF _{grid, BM, y})	0.95	Combined Margin (EF _{grid,CM,y})	0.99
Combined Margin Estimation for NEWNE Grid (tCO ₂ /MWh)									
Generation Weighted Average OM (EF _{grid, OM,y})	1.00								
BM (EF _{grid, BM, y})	0.95								
Combined Margin (EF _{grid,CM,y})	0.99								
Purpose of Data	Baseline Emission calculation								

Comments	This database is an official publication of Government of India for the purpose of CDM baseline. It is based on most recent data available to the Central Electricity Authority and hence considered authentic. As the calculation of baseline emission has been done ex ante its value will remain fixed for the entire crediting period.
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4.2 Data and Parameters Monitored

Data / Parameter	EG _{BL,Tejuva,y}
Data unit	MWh
Description	Quantity of net electricity supplied to the grid by phase-1 (Tejuva) site to the grid in year y
Source of data	Credit subdivision of Energy issued by the O&M contractor
Description of measurement methods and procedures applied	As the project WTGs in phase-1 (Tejuva) in Rajasthan are connected to a common feeder (a common pool where project developers under this project activity and other project developers feed electricity), O&M contractor apportioned the electricity export and import data based on individual WTGs controller reading, summation of all controller reading of WTGs connected under the common feeder and joint meter reading (based on billing meter) and provide month wise "Credit subdivision of Energy" which contains electricity export, import and net export by the project WTGs under phase-1 (Tejuva site). These values would be the main source to calculate the baseline emission by this project activity. As the controller reading of WTGs belongs to other project developers are confidential information, hence, O&M contractor is not disclosing the same. Thus summation of controller readings (including other project developer connected to the same feeder) is not available to the project proponent. The detailed apportioning procedure followed by the O&M contractor has been provided below in section 4.3. On receipt of the "Credit subdivision of Energy" sheet, the project proponent raises the invoice for the electricity export to the grid and same would be cross checked with records of invoices.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and monthly recording
Value applied:	187,800
Monitoring equipment	Energy meters of accuracy class 0.2s
QA/QC procedures applied	- The energy meter reading are taken on monthly basis - Energy meters will be calibrated once in a five year in line with guidance stipulated by Central Regulatory Authority, Govt. of

	India and faulty meters will be duly replaced immediately. - All the energy meters are under the control of state utility and calibration/testing 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	O&M contractor apportioned the electricity export and import data based on individual WTGs controller reading, summation of all controller reading of WTGs connected under the common feeder and joint meter reading (based on billing meter) and provide month wise "Credit subdivision of Energy "which contains electricity export, import and net export by the project WTGs under phase-1 (Tejuva site). Detailed calculation procedure is mentioned in section 4.3.
Comments	The data will be archived both in electronic and paper format for crediting period + 2 years.

Data / Parameter	EG _{BL,Chadgarh,y}
Data unit	MWh
Description	Quantity of net electricity supplied to the grid by phase-2 (Chadgarh) site to the grid in year y
Source of data	Credit report issued by the O&M contractor
Description of measurement methods and procedures applied	As the project WTGs in phase-2 (Chadgarh) in Madhya Pradesh are connected to a common feeder (a common pool where project developers under this project activity and other project developers feed electricity), O&M contractor apportioned the electricity export and import data based on individual WTGs controller reading, summation of all controller reading of WTGs connected under the common feeder and joint meter reading (based on billing meter) and provide month wise "Credit report "which contains electricity export, import and net export by the project WTGs under phase-2 (Chadgarh site). These values would be the main source to calculate the baseline emission by this project activity. As the controller reading of WTGs belongs to other project developers are confidential information, hence, O&M contractor is not disclosing the same. Thus summation of controller readings (including other project developer connected to the same feeder) is not available to the project proponent. The detailed apportioning procedure followed by the O&M contractor has been provided below in section 4.3. On receipt of

	the "Credit report", the project proponent raises the invoice for the electricity export to the grid and same would be cross checked with records of invoices.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and monthly recording
Value applied:	181,056
Monitoring equipment	Energy meters of accuracy class 0.2s
QA/QC procedures applied	• The energy meter reading are taken on monthly basis • Energy meters will be calibrated once in a five year in line with guidance stipulated by Central Regulatory Authority, Govt. of India and faulty meters will be duly replaced immediately. • All the energy meters are under the control of state utility and calibration/testing 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	O&M contractor apportioned the electricity export and import data based on individual WTGs controller reading, summation of all controller reading of WTGs connected under the common feeder and joint meter reading (based on billing meter) and provide month wise "Credit report "which contains electricity export, import and net export by the project WTGs under phase-2 (Chadgarh site). Detailed calculation procedure is mentioned in section 4.3
Comments	The data will be archived both in electronic and paper format for crediting period + 2 years.

4.3 Monitoring Plan

Suzlon Infrastructure Services Limited and Gamesa Wind Turbines Pvt. Ltd are the O&M contractors for Tejuva and Chandgarh site respectively. Respective O&M contractor will be responsible for the maintaining all the monitoring data on behalf of state utility in respect of the project activity. O&M contractors have implemented the management structure for managing the monitored data.

This approved monitoring methodology requires monitoring of the following:

Net electricity supplied from the project activity. While Emission factor of the project activity is fixed ex ante hence no further monitoring of this parameter is required. As per ACM0002 leakage need not be considered hence leakage has not been considered for the project activity. Hence, the sole parameter for monitoring is the net electricity supplied by the project activity to the grid.

The Project activity is operated by O&M contractor for the project activity and managed by the CLP. The operational and maintenance contracts for the project activity are with Suzlon Infrastructure Services Limited and Gamesa Wind Turbines Pvt. Ltd, which are an ISO 9001

certified company. O&M contractors follow the documentation practices to ensure the reliability and availability of the data for all the activities as required from the identification of the site, wind resource assessment, logistics, finance, construction, commissioning and operation of the wind power project.

Monitoring Procedure:

WTG installed under this project activity is connected to a common feeder. A particular feeder may comprise of WTGs belonging to owners other than PP but belonging to the same O&M service provider. At the respective District Vidyut Vitran Nigam Ltd sub-station, the total export & import to this feeder is monitored using the main meter & the backup meter, which are electronic tri-vector meters. The total export at this meter is generally arrived at by multiplying the monthly meter reading to the multiplying factor of the meter concerned. The monthly meter reading is arrived at as the difference between the current meter reading and the previous meter reading. The period between these two readings is usually a period of 30 days which may vary. In a similar fashion, total import at this meter is also calculated. Additionally, O&M contractors are monitoring electricity generation by each WTG at the WTG controller by their Central Monitoring System. With the help of WTG controller readings and JMR reading O&M contractor calculates the electricity export by each WTG (by apportioning procedure) and generate the "Credit report". Based on the same, all the project investors raise the invoice for the electricity export to the grid. The allocation of electricity or apportion procedure is executed as per the following procedure:

Sample calculation of the net export of electricity from project activity:

Time duration for calculation = 30 days

X = Electricity generation at controller of the WTG for 30 days in MWh
Y = Electricity generation at by all WTG attached to the common feeder in MWh
R = % allocation for each of the WTG on the common feeder = $X \times 100\% / Y$
E = Electricity supplied by the common feeder to the grid monitored at main meter in MWh
I = Electricity imported by the common feeder from the grid monitored at main meter in MWh

Thus,

Apportioned electricity exported by the each WTG = $R\% \times E$ in MWh
Apportioned electricity imported by the each WTG = $R\% \times I$ in MWh
Net electricity generation = $EG_{BL,y} = (R\% \times E) - (R\% \times I)$ in MWh

Baseline emission = $EG_{BL,y} \times EF_{CM,y}$ tCO₂

Based on the above procedure, O&M contractor apportioned the electricity export and import and PP received the "Credit Report" (consists of electricity exported and imported by the PP). This document will be the main source of information for the emission reduction calculation.

As the controller reading of WTGs belongs to other project developers are confidential information, hence, O&M contractor is not disclosing the same. Thus controller readings of other project developer connected to the same feeder are not available to the project proponent.

Upon receipt of these reports, PP generates invoices on sale of electricity and sends to respective District Vidyut Vitran Nigam Ltd. Thereafter respective District Vidyut Vitran Nigam Ltd makes payments against the invoices.

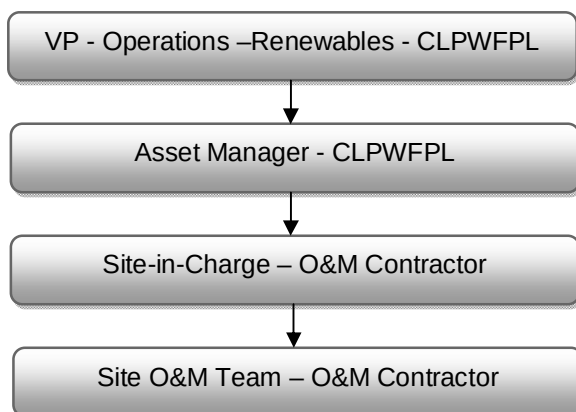
Training and maintenance requirements:

Training on the machine is an essential pre-requisite, to ensure necessary safety of man and machine. Further, in order to maximize the output from the wind turbine, it is extremely essential, that the engineers and technicians understand the machines and keep them in good health. In order to ensure, that O&M contractor's service staffs is deft at handling technical snags on top of the turbine, the necessity of ensuring that they are capable of climbing the tower with absolute ease and comfort has been established. The training is contemporary, which results in imparting focused knowledge leading to value addition to the attitude and skills of all trainees. This ultimately leads to creativity in problem solving.

Monitoring roles and responsibilities

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

The Project activity is operated by O&M contractor for the project activity and managed by the PP. O&M contractor follows the documentation practices to ensure the reliability and availability of the data for all the activities as required from the identification of the site, wind resource assessment, logistics, finance, construction, commissioning and operation of the wind power project. The data for the project is compiled by the O&M Contractor and subsequently stored by the PP. The roles and responsibilities for the project are described as below;



Data Recording

The state utility and representative of concerned Power Producer / developer shall jointly read the metering system every month at the delivery point.

Meter readings taken jointly will be signed by the representatives of state utility and of concerned power producer/developer. If Power Producer/ Developer's representative is not present for joint meter reading then the meter reading taken by state utility shall be considered as final; provided a signed copy of the meter reading is sent to the Power Purchase / Developer within twenty four (24) hours of such reading of the main metering system or back up metering system as the case may be.

Calibration Frequency

The main and backup meters shall be calibrated once in a five year in line with notification issued by Central Electricity Authority, Govt of India dated the 17th March, 2006. The meters would be tested by any accredited laboratory in the presence of the parties (State Electricity Board, Project investor and the O&M Contractor) involved. Both parties shall seal main and backup meters. Defective meters shall be replaced immediately. As per the schedule, calibration of all energy meter, instruments and equipment will be carried out once in five year and recorded in calibration reports.

Description of calibration of WTG Controller

The controller used for the WTGs which is an LCS Controller is a micro-processor based intelligent controller which has been specially designed for control of wind turbines. In case there is any mismatch in the energy values recorded by the controller panel meter and the energy values calculated by the inverting system; the WTG machine will stop working and generate the error report automatically. Then the O&M team at the project site will replace the controller panel meter immediately. Hence calibration of the controller panel meter is not required.

Emergency Preparedness

In case of any abrupt breakdown, the fault will be immediately identified by the O&M personnel. All minor faults shall be taken care of by the O& M personnel, In case of any major faults, the grid personnel will be informed and replacement of the equipment shall be made within 24 hours.

5 ENVIRONMENTAL IMPACT

As per the Schedule 1 of the EIA notification dated 1/12/2009⁷ and latest notification dated 24/12/2013⁸, given by the Ministry of Environment and Forests under the Environment (Protection) Act 1986, the proposed Project activity does not fall under the list of activities requiring EIA as the environmental impacts for such project are not considered as significant by the host Party or PP.

⁷ <http://moef.nic.in/downloads/rules-and-regulations/3067.pdf>

⁸ <http://envfor.nic.in/sites/default/files/ia-24122013.pdf>

6 STAKEHOLDER COMMENTS

CLPWFPL had identified different stakeholders for its wind power project as per the different phases of Implementation. Separate stakeholder consultation was carried out for all the 2 phases. Following are the identified stakeholders,

- a) Representatives from O&M contractor;
- b) Employees of CLPWFPL;
- c) Contractor of CLPWFPL;
- d) Villagers from nearby villages

As the project is located at two project sites, thus, two separate stakeholders' meeting were organized to receive comprehensive feedback from the local peoples. Description of the same are mentioned below:

Stakeholders' meeting at Tejuva Site:

At Tejuva project, the meeting was carried out by CLPWFPL on 22/02/2012 at the Suzlon Infrastructure Services Limited office at 11.30 am in Jaisalmer District. All stakeholders were invited via newspaper advertisement was made on 10/02/2012, and also by public notice .

During the meetings the stakeholders emphasized that the project has not only provided employment but also significantly contributed to the infrastructure development likes good roads. The stakeholders also expressed satisfaction that the project would help alleviating the power deficit currently being faced by the region.

During stakeholder meeting, no negative feedback was received from any of the stakeholders. All of them supported the initiative and appreciated the project proponent for carrying out such an activity in the region. Hence no comments warranting action from the project proponent were received.

Stakeholders' meeting at Chandgarh Site:

At Chandgarh project site, the meeting was carried out by CLPWFPL on 08/09/2016 at the Site office of CLP Wind Farms (India) Private Limited at 2:00 pm in Dewas, Madhya Pradesh district. All stakeholders were invited via personal invitation letters and public notices.

During the meeting, the stakeholders appreciated the project activity as local villagers have received direct and indirect employment in this project activity. Further, local stakeholders also appreciated project management to significant contribution to the local infrastructure development likes good roads, water supply etc. The stakeholders also expressed satisfaction for this project activity and also requested project management to install more new project at the local area.

All the stakeholders were happy in knowing that the project activity in their locality will be contributing to a global cause and they commended the CLP wind farms for their initiatives in the

areas of climate change and sustainable development. In particular, the stakeholders appreciated the project promoter for the environment friendly power generation using wind energy.

The questions asked during the meetings at the site have been summarized below:

Stakeholder Name	Question	Answer by CLP
Rahul Bajpai	Will the project help in improving the electricity supply to the villagers?	The power generated is fed to the state electricity grid, but the same cannot be promised. It becomes the jurisdiction of the electricity board in the state. They have to decide from the amount of power available as to how much is to given to which area.
Mr. Binod Kumar	Do these projects affect the rainfall?	No, such projects do not affect the rainfall by any chance. The WTG is at a height of approximately 90 to 114 m and the clouds bearing rainfall are usually at a much higher altitude.
Mr. Sachin Patel	Are there any other benefits of wind power projects that you have observed? Did project provide employment opportunities or improve economic development of area?	Yes, there has been improved transportation for villagers, increased connectivity and employment to local villagers and therefore benefits of economic betterment. Yes, it has definitely done so. It has brought employment opportunity at the village level. Lot of villagers have got employment have got employment – either as security guards, drivers etc.
Mr. Lakhan Singh	Do the project personnel and authorities maintain a good relationship with villagers?	Yes, they all maintain a very good relationship. PP is looking forward to more such renewable energy projects being brought here.

Further to above the stakeholders expressed their pleasure with the setting up of the wind power project as it had provided the rural population with permanent employment opportunities. During stakeholder meeting, no negative feedback was received from any of the stakeholders. All of them supported the initiative and appreciated the project proponent for carrying out such an activity in the region. After ensuring that all the queries of the stakeholders were answered, the meeting was concluded after thanking all the participants for attending the meeting.

7 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	EG _{BL,Tejuva,y}									
Data unit	MWh									
Description	Quantity of net electricity supplied to the grid by phase-1 (Tejuva) site to the grid in year y									
Value applied:	<table><tr><th>Year</th><th>Value (MWh)</th></tr><tr><td>2015 (29/03/2015 to 31/12/2015)</td><td>87,097.84</td></tr><tr><td>2016 (01/01/2016 to 31/07/2016)</td><td>113,184.84</td></tr><tr><td>Total</td><td>200,282.67</td></tr></table>		Year	Value (MWh)	2015 (29/03/2015 to 31/12/2015)	87,097.84	2016 (01/01/2016 to 31/07/2016)	113,184.84	Total	200,282.67
Year	Value (MWh)									
2015 (29/03/2015 to 31/12/2015)	87,097.84									
2016 (01/01/2016 to 31/07/2016)	113,184.84									
Total	200,282.67									
Comments	O&M contractor apportioned the electricity export and import data based on individual WTGs controller reading, summation of all controller reading of WTGs connected under the common feeder and joint meter reading (based on billing meter) and provide month wise “Credit subdivision of Energy “which contains electricity export, import and net export by the project WTGs under phase-1 (Tejuva site).									

Data / Parameter	EG _{BL,Chandgarh,y}									
Data unit	MWh									
Description	Quantity of net electricity supplied to the grid by phase-2 (Chandgarh) site to the grid in year y									
Value applied:	<table><tr><th>Year</th><th>Value (MWh)</th></tr><tr><td>2015 (29/03/2015 to 31/12/2015)</td><td>55,197.98</td></tr><tr><td>2016 (01/01/2016 to 31/07/2016)</td><td>132,288.07</td></tr><tr><td>Total</td><td>187,486.05</td></tr></table>		Year	Value (MWh)	2015 (29/03/2015 to 31/12/2015)	55,197.98	2016 (01/01/2016 to 31/07/2016)	132,288.07	Total	187,486.05
Year	Value (MWh)									
2015 (29/03/2015 to 31/12/2015)	55,197.98									
2016 (01/01/2016 to 31/07/2016)	132,288.07									
Total	187,486.05									
Comments	This data has been used to calculate the baseline emissions. Additionally The data will be archived for crediting period+2 years.									

7.2 Baseline Emissions

As per the equation 6 of the methodology ACM 0002 (Version 17.0),

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

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 CDM 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)

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

Month	Quantity of net electricity supplied to the grid by phase-1 (Tejuva) site to the grid in year y (MWh)	Quantity of net electricity supplied to the grid by phase-2 (Chandgarh) site to the grid in year y (MWh)	Total Net Electricity Export by the Project (MWh)
	$EG_{BL, Tejuva, y}$	$EG_{BL, Chandgarh, y}$	$EG_{PJ, y}$
March-15	-1.76	0.00	-1.76
April-15	2,376.00	1,454.84	3,830.84
May-15	6,304.00	4,401.22	10,705.22
June-15	6,017.44	5,051.32	11,068.76
July-15	7,008.36	15,461.08	22,469.44
August-15	10,811.85	9,375.71	20,187.56
September-15	17,217.11	6,670.21	23,887.32
October-15	17,661.44	3,813.44	21,474.88
November-15	12,590.30	3,526.15	16,116.45
December-15	7,113.11	5,444.01	12,557.12
January-16	6,829.91	4,103.47	10,933.38
February-16	9,424.24	14,732.92	24,157.16
March-16	13,288.50	14,319.68	27,608.18
April-16	11,876.99	25,848.70	37,725.69
May-16	24,027.37	29,391.13	53,418.49
June-16	19,931.74	21,494.79	41,426.53
July-16	27,806.08	22,397.40	50,203.48
Total	200,282.67	187,486.05	387,768.72

Thus, $BE_y = 387,768.72 \text{ MWh} * 0.99 \text{ tCO}_2e/\text{MWh}$
 $= 383,890 \text{ tCO}_2 \text{ (after rounding down)}$

7.3 Project Emissions

Since the project activity is a renewable energy project which generates electricity using wind power and hence does not result in project emissions as per the applicable methodology ACM0002, version 17.

$$PE_y = 0$$

7.4 Leakage

No leakage is considered from the project activity as per approved methodology ACM0002

7.5 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2015 (29/03/2015 to 31/12/2015)	140,872.00	0.00	0.00	140,872.00
2016 (01/01/2016 to 31/07/2016)	243,018.00	0.00	0.00	243,018.00
Total	383,890.00	0.00	0.00	383,890.00

APPENDIX 1: PROJECT LOCATION AND COMMISSIONING DETAILS

SI No	WTG ID	Geo Co-ordinates		Commissioning Dates
		Latitude (North)	Longitude (East)	
1	HBR-020	27° 06' 39.2040" N	70° 37' 52.3200" E	30-Jun-2015
2	HBR-021	27° 06' 58.5360" N	70° 37' 32.5920" E	30-Jun-2015
3	HBR-022	27° 07' 09.7320" N	70° 37' 20.4960" E	30-Jun-2015
4	HBR-023	27° 07' 13.4040" N	70° 36' 59.2200" E	6-Aug-2015
5	HBR-024	27° 07' 28.5960" N	70° 36' 44.6040" E	6-Aug-2015
6	HBR-025	27° 07' 36.0840" N	70° 36' 24.4080" E	6-Aug-2015
7	HBR-027	27° 06' 21.1680" N	70° 37' 05.2320" E	6-Aug-2015
8	HBR-028	27° 06' 03.6720" N	70° 38' 10.7520" E	6-Aug-2015
9	HBR-029	27° 05' 55.3920" N	70° 38' 29.0760" E	6-Aug-2015
10	HBR-030	27° 05' 32.1360" N	70° 39' 26.6040" E	28-Aug-2015
11	HBR-031	27° 05' 19.7160" N	70° 39' 53.6400" E	28-Aug-2015
12	HBR-032	27° 04' 46.9200" N	70° 40' 10.0200" E	28-Aug-2015
13	HBR-033	27° 04' 54.3000" N	70° 39' 55.0080" E	28-Aug-2015
14	HBR-034	27° 05' 06.4320" N	70° 39' 30.1680" E	29-Mar-2015
15	HBR-035	27° 05' 18.3120" N	70° 38' 56.2560" E	29-Mar-2015
16	HBR-036	27° 05' 18.6720" N	70° 38' 32.4240" E	29-Mar-2015
17	HBR-037	27° 05' 29.1480" N	70° 38' 04.7400" E	28-Aug-2015
18	TJW-001	27° 05' 21.5160" N	70° 37' 02.8200" E	28-Aug-2015
19	TJW-002	27° 05' 05.1000" N	70° 37' 41.0520" E	6-Aug-2015
20	TJW-003	27° 04' 51.3840" N	70° 37' 55.9920" E	29-Mar-2015
21	TJW-004	27° 04' 42.2760" N	70° 38' 29.1840" E	29-Mar-2015
22	TJW-005	27° 04' 42.3120" N	70° 39' 05.6520" E	29-Mar-2015
23	TJW-006	27° 04' 26.2560" N	70° 39' 25.5600" E	29-Mar-2015
24	TJW-007	27° 04' 55.8480" N	70° 37' 02.4240" E	14-Aug-2015
25	TJW-010	27° 04' 24.8520" N	70° 38' 05.7840" E	29-Mar-2015
26	TJW-014	27° 03' 57.0240" N	70° 37' 56.5680" E	29-Mar-2015
27	TJW-015	27° 03' 59.2200" N	70° 38' 20.4720" E	29-Mar-2015
28	TJW-017	27° 04' 05.8800" N	70° 39' 02.8800" E	30-Jun-2015
29	TJW-018	27° 03' 42.6960" N	70° 39' 23.7960" E	30-Jun-2015
30	TJW-019	27° 03' 05.5800" N	70° 39' 26.9640" E	6-Aug-2015
31	TJW-020	27° 03' 17.5680" N	70° 39' 01.0800" E	6-Aug-2015
32	TJW-021	27° 03' 22.9320" N	70° 38' 37.8600" E	6-Aug-2015
33	TJW-022	27° 03' 30.1320" N	70° 38' 18.3120" E	29-Mar-2015
34	TJW-029	27° 02' 58.4520" N	70° 38' 43.6200" E	6-Aug-2015
35	TJW-030	27° 02' 47.6880" N	70° 38' 57.9840" E	6-Aug-2015
36	TJW-031	27° 02' 38.2920" N	70° 39' 24.5880" E	6-Aug-2015
37	TJW-033	27° 01' 46.0920" N	70° 39' 01.2240" E	14-Aug-2015

SI No	WTG ID	Geo Co-ordinates		Commissioning Dates
		Latitude (North)	Longitude (East)	
38	TJW-034	27° 02' 04.2720" N	70° 38' 46.7520" E	28-Aug-2015
39	TJW-035	27° 02' 13.5240" N	70° 38' 32.5680" E	30-Jun-2015
40	TJW-036	27° 02' 40.8120" N	70° 38' 23.8560" E	29-Mar-2015
41	TJW-037	27° 01' 59.6640" N	70° 37' 58.5120" E	30-Jun-2015
42	TJW-038	27° 01' 50.3400" N	70° 38' 08.9160" E	30-Jun-2015
43	TJW-039	27° 01' 37.0920" N	70° 38' 25.7280" E	30-Jun-2015
44	TJW-040	27° 01' 25.9320" N	70° 38' 38.1840" E	14-Aug-2015
45	TJW-041	27° 01' 14.5200" N	70° 38' 52.3320" E	14-Aug-2015
46	TJW-042	27° 00' 33.3720" N	70° 38' 29.6880" E	6-Aug-2015
47	TJW-043	27° 00' 50.4000" N	70° 38' 12.6240" E	6-Aug-2015
48	TJW-045	27° 01' 06.3120" N	70° 37' 37.0200" E	6-Aug-2015

Phase 2: Chandgarh Site with a total capacity of 92 MW (46 WTGs)

Sl. No	WTG ID	Geo Co-ordinates		Commissioning Date
		Latitude (North)	Longitude (East)	
1	R-1	23° 09' 17.8200" N	76° 16' 00.4800" E	31-Mar-2015
2	R-4	23° 08' 35.5560" N	76° 17' 36.8880" E	31-Mar-2015
3	R-16-N	23° 07' 53.2560" N	76° 19' 23.3040" E	30-Jun-2015
4	R-17-N	23° 08' 07.8720" N	76° 19' 02.2440" E	31-Mar-2015
5	R-24-N	23° 08' 37.2480" N	76° 18' 44.8200" E	30-Jun-2015
6	R-35-N	23° 10' 01.5240" N	76° 19' 07.5000" E	30-Oct-2015
7	R-40	23° 10' 44.4000" N	76° 20' 45.0960" E	30-Jun-2015
8	R-42	23° 10' 28.6680" N	76° 21' 11.4480" E	30-Jun-2015
9	R-47	23° 11' 30.9120" N	76° 21' 18.6480" E	30-Oct-2015
10	R-54-N	23° 12' 21.6720" N	76° 20' 14.7120" E	30-Jun-2015
11	R-60-N	23° 12' 43.1640" N	76° 20' 46.8960" E	30-Oct-2015
12	R-62	23° 13' 08.0760" N	76° 21' 15.7320" E	29-Dec-2015
13	R-69-N1	23° 13' 42.3120" N	76° 19' 45.6240" E	30-Jun-2015
14	R-70	23° 13' 49.9080" N	76° 19' 21.5760" E	31-Mar-2015
15	R-79	23° 14' 47.1480" N	76° 19' 14.7000" E	30-Oct-2015
16	R-84-N	23° 15' 56.8080" N	76° 17' 56.4000" E	30-Oct-2015
17	R-87	23° 14' 37.2120" N	76° 18' 41.6880" E	30-Oct-2015
18	R-89	23° 08' 24.4680" N	76° 19' 05.5200" E	31-Mar-2015
19	R-94-N2	23° 13' 04.4040" N	76° 20' 10.3560" E	30-Jun-2015
20	R-97	23° 12' 15.3720" N	76° 19' 44.6160" E	31-Mar-2015
21	R-101-N	23° 13' 54.8400" N	76° 18' 53.7120" E	30-Oct-2015
22	R-103-N	23° 10' 31.6200" N	76° 20' 39.7320" E	30-Jun-2015
23	R-104-N	23° 10' 20.1000" N	76° 20' 47.5440" E	30-Oct-2015
24	R-106	23° 14' 05.8920" N	76° 19' 21.3960" E	30-Oct-2015
25	R-108	23° 13' 27.4440" N	76° 17' 53.5560" E	30-Jun-2015

Sl. No	WTG ID	Geo Co-ordinates		Commissioning Date
		Latitude (North)	Longitude (East)	
26	R-109	23° 08' 41.8200" N	76° 18' 07.7760" E	31-Mar-2015
27	R-111	23° 11' 59.4600" N	76° 19' 53.4000" E	31-Mar-2015
28	R-112	23° 09' 38.4840" N	76° 17' 17.3040" E	31-Mar-2015
29	R-113	23° 10' 11.7840" N	76° 14' 47.7600" E	31-Mar-2015
30	R-115	23° 10' 38.4240" N	76° 17' 39.9480" E	31-Mar-2015
31	R-121	23° 13' 24.1320" N	76° 19' 48.8640" E	31-Mar-2015
32	Gch-30	23° 15' 47.3040" N	76° 18' 34.7760" E	29-Dec-2015
33	Gch-160	23° 11' 38.5800" N	76° 16' 09.0120" E	29-Dec-2015
34	Gch-156	23° 08' 16.6920" N	76° 17' 23.1000" E	29-Dec-2015
35	Gch-196	23° 09' 36.7920" N	76° 14' 31.2360" E	29-Dec-2015
36	Gch-185-N	23° 07' 08.5800" N	76° 16' 36.4800" E	29-Dec-2015
37	Gch191-N1	23° 10' 54.6240" N	76° 13' 45.0840" E	29-Dec-2015
38	Gch-147	23° 09' 55.5480" N	76° 14' 46.5720" E	29-Dec-2015
39	Gch-220-A1	23° 06' 46.4400" N	76° 17' 11.3280" E	29-Dec-2015
40	Gch-157	23° 11' 24.5760" N	76° 16' 26.2200" E	29-Dec-2015
41	Gch-224-N	23° 08' 52.6560" N	76° 15' 53.6040" E	29-Dec-2015
42	Gch-248	23° 09' 33.2640" N	76° 13' 20.4600" E	29-Dec-2015
43	Gch-250-N	23° 07' 06.0960" N	76° 17' 44.1240" E	29-Dec-2015
44	Gch-222-A3	23° 06' 24.8760" N	76° 17' 14.0640" E	29-Dec-2015
45	Gch-252	23° 10' 58.5840" N	76° 16' 53.1480" E	29-Dec-2015
46	R-85-N	23° 15' 47.0520" N	76° 18' 06.1560" E	30-Oct-2015

APPENDIX 2: Meter Calibration Details:

A) Tejuva Location:

Sl. No.	Meter Identification No	Meter Make	Accuracy Class	Calibration Date	Calibration Validity Date
1	RJB85058 (Main Meter)	Secure Meter	0.2s	23/01/2015	22/01/2020
2	RJB85059 (Check Meter)	Secure Meter	0.2s	23/01/2015	22/01/2020

B) Chandgarh Locaton:

Sl. No.	Feeder No	Meter Identification No	Meter Make	Accuracy Class	Calibration Date	Calibration Validity Date
1	Feeder-I	XB587800 (Main Meter)	Secure Meter	0.2s	26/03/2015	25/03/2020
		XB587799 (Check Meter)	Secure Meter	0.2s	26/03/2015	25/03/2020
2	Feeder-II	XB587797 (Main Meter)	Secure Meter	0.2s	26/03/2015	25/03/2020
		XB587798 (Check Meter)	Secure Meter	0.2s	26/03/2015	25/03/2020

Calibration frequency of the meter is once in five years. There was not any significant period of shut-down or break-down period during this monitoring period.