3.5 MW MANUNI HYDRO ELECTRIC PROJECT IN HIMANCHAL PRADESH BY WINSOME TEXTILE INDUSTRIES LTD

Document Prepared By (PA Research & Consultants Pvt. Ltd.)

Project Title	3.5MW Manuni Hydro Electric Project in Himanchal Pradesh by Winsome Textile Industries Ltd
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Prepared By	PA Research & Consultants Pvt. Ltd.
Contact	317, Vardhman Star Mall, Sector-19, Faridabad-121002 Haryana, India Ph: +91 129 4013677 E: info@pars-consultants.com W: www.pars-consultants.com

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Winsome Textile Industries Ltd. (hereinafter also called as WTIL), a leading manufacturer of textile product, started its operations in 1980 in Baddi, Himanchal Pradesh, India. WTIL has given special stress to minimise contamination, both at pre-spinning and post-spinning stages by adding machines like Vision Shield in Blow Room and Schlafhorst-338 with LOEPFE - 9001 (SIRO CLEANER) Contamination Control Channel at winding stage. Further addition was to generate renewable electricity for captive consumption to minimise carbon foot print in long term.

The project activity involves power generation from a 3.5 MW hydroelectric project based on Manuni Khad stream, a tributary of river *Beas* at village Khaniara, Dharamshala, District Kangra, Himachal Pradesh. The project activity is a run-of-river project being developed by M/s Winsome Textile Industries Ltd. The project activity comprises 2 Numbers of Pelton Turbines each with a generator output capacity of 1750 kW for generation of electricity.

The project was allotted to the M/s Winsome Textile Industries Ltd. on a Build, Own, Operate and Maintain (BOOM) basis for a period of 40 years. Wheeling and Banking Agreement (PPA) is being signed with the Himachal Pradesh State Electricity Board (HPSEB), the generated electricity will be used for captive consumption at its manufacturing unit Baddi.

The purpose of the project activity is to produce renewable energy using hydro power for captive consumption. In the absence of the project activity equivalent amount of electricity would have been generated by the operation of grid connected fossil fuel based power plants. The Project activity thus reduces the anthropogenic emissions of greenhouse gases (GHGs) in to the atmosphere associated with the equivalent amount of electricity generation from the fossil fuel based grid connected power plant. The project activity has commissioned both the turbine on 31/03/2017.

The estimated annual average and the total CO_2e emission reduction by the project activity over the first renewable crediting period of 10 years are expected to be **17,619** tCO_2e and **176190** tCO_2e respectively.

1.2 Sectoral Scope and Project Type

Sectoral scope-01, Energy Industries (Renewable -/non renewable sources)

Project Type-I Renewable Energy Project

The project activity is not a grouped project.

1.3 Project Proponent

Organization name	Winsome Textile Industries Ltd.
Contact person	Mr Sanjeev Mittal

Title	General Manager-Electrical & Electronics
Address	1, Industrial Area, Baddi, Himanchal Pradesh, India
Telephone	+91 70180 13078
Email	smittal@winsometextile.com

1.4 Other Entities Involved in the Project

Organization name	PA Research & Consultants Pvt. Ltd.
Role in the project	Consultant
Contact person	Mr Phool Chand
Title	Director
Address	317, Vardhman Star Mall, Sector-19, Faridabad-121002, Delhi NCR, India
Telephone	+91 129 4013677
Email	pchand@pars-consultants.com

1.5 Project Start Date

The start date of the project activity is 31 March 2017, which is date of commissioning of the turbines.

1.6 Project Crediting Period

The PP has chosen renewable crediting period of 10 years, crediting period start from 31st March 2017 (The date of commissioning) to 30th March 2027 (including both days). The crediting period can be renewed as 2x10 years.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	√
Large project	--

Year	Estimated GHG emission reductions or removals (tCO_2e)
2017-18*	17619
2018-19	17619
2019-20	17619
2020-21	17619

2021-22	17619
2022-23	17619
2023-24	17619
2024-25	17619
2025-26	17619
2026-27	17619
Total estimated ERs	**176190**
Total number of crediting years	**10**
Average annual ERs	**17619**

*The crediting period will start from start date of operation of turbines i.e. 31 March 2017

1.8 Description of the Project Activity

The 3.5 MW Manuni Hydro Power Project is a run-of-river (RoR) project located in Kangra District of Himachal Pradesh. The small scale hydro project has been constructed over existing water bodies and no water reservoir is being constructed for the project activity.

The main components of project are listed below:

The medium head project will have diversion-cum-trench type weirs with a crest level of 1585 meters and length 32 meters. It would divert 1.95 cubic meters design discharge by + 50% for desilting. The overall catchment area is 38 square kilometres. The diversion site is at an elevation of 1585 meter upstream of Khaniara village.

Two Numbers of horizontal shaft Pelton type turbines is used with rated output of 1750 kW and rated discharge of 0.98 cubic meters.

The rated output for each generator will be 1750 kW (2187.5kVA), generation voltage rating of 3.3 kV and frequency rating of 50 Hz with Brushless Synchronous Excitation system.

The power generated shall be fed to the HPSEB power grid 33 kV sub-station at *Shidhpur,* Dharamshala, through 33KV transmission line.

The Pelton turbine that will be installed as a part of the project activity is a horizontal flow double jet turbine, water flows along the tangent to the path of the runner. Nozzles direct forceful streams of water against a series of spoon-shaped buckets mounted around the edge of a wheel. Each bucket reverses the flow of water, leaving it with diminished energy. The resulting impulse spins the turbine. The buckets are mounted in pairs, to keep the forces on the wheel balanced, as well as to ensure smooth, efficient momentum transfer of the fluid jet to the wheel. The Pelton turbine is most efficient in high head applications. This technology is generally considered to be environmentally safe and sound technology and is used for hydro power generation worldwide. The project activity does not involve the technology transfer from

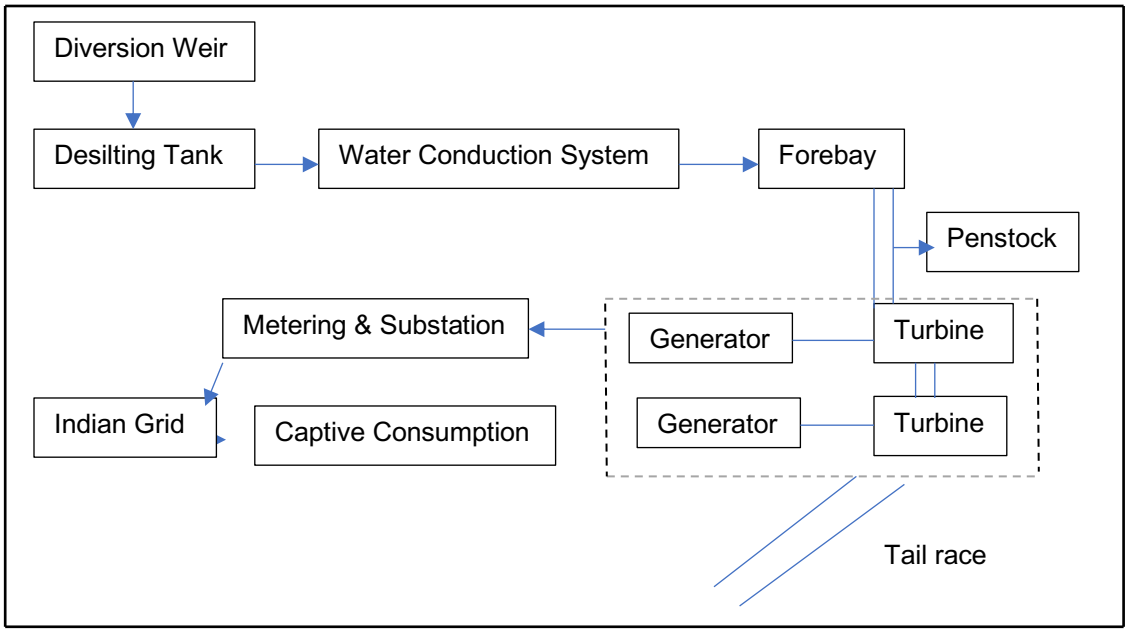
any country. The expected annual Net Electricity generation for captive use is expected to be 19328 MWh.

Technical Specification of Turbine

Rated Net Head	213 m
Design Flow	0.98 m^3/s
Rated Power	1750 kW
Turbine Type	Double Jet, Horizontal Pelton Wheel
Number of Turbine	2

Technical Specification of Generator

Capacity	2x1750 kW
Voltage Output	3300 V
Frequency	50Hz
Configuration	Horizontal
Type	Synchronous SESR, Brushless



No technology transfer is involved in the project activity, as the technology used and know how required for the project activity is available in India.

1.9 Project Location

Fig: Project Site

The proposed project activity is located at Village Khaniyara, Dharmashala in Kangra Dsirtict, Himanchal Pradesh, India . The Project site is connected by roads to the nearest town. The nearest airport is Dharamshala around 40 Km.

The physical address and geographic co-ordinate of project site is provided above.

Geo-coordinates are 32^0 11' 30" N 76^0 11' 30" E.

1.10 Conditions Prior to Project Initiation

The proposed project activity is Greenfield project activity and in absence of proposed project the project proponent would have continued to import electricity from Indian grid, which is the baseline scenario.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The relevant national laws and regulation pertaining to generation of energy are:

- Electricity Act 2003
- National Electricity Policy 2005

Power generation using hydro energy is not a legal requirement or a mandatory option. There are state and sectoral policies, framed primarily to encourage hydro power projects. These policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments. As per environmental act the proposed project activity does not require to carry out environmental impact assessment. The PP has secured all necessary regulatory and statutory clearances to establish and operate the project under discussion. The Indian Electricity Act, 2003 (May 2007 Amendment) does not influence the choice of fuel used for power generation. There is no legal requirement on the choice of a particular technology for power generation.

The project activity conforms to all the applicable laws and regulations in India. As per Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India), final document on

revised classification of Industrial Sectors under Red, Orange, Green and White Categories (February 29, 2016), the project falls under white category with no requirement for EIA and the project has secured all the nodal agency approval.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

The following evidences can verify the ownership of the Project and its right to use:

1. Commissioning certificate
2. Power Purchase Agreement

1.12.2 Emissions Trading Programs and Other Binding Limits

This project activity is voluntary initiative and it is not to meet any local laws or regulatory compliances. An undertaking has been submitted that PP shall not claim for GHG emission reduction credits for the given crediting period under any other emission-trading program or GHG binding limits.

1.12.3 Other Forms of Environmental Credit

PP declares that emission reductions generated from the project activity will not be double counted (i.e. issuance of other form of environmental credit like under CDM) for the particular crediting period, which is being claimed under VCS mechanism. PP has submitted an undertaking to the VVB that they shall not claim for GHG emission reduction credits for the given period under any other emission-trading 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. The project has not participated under any other GHG program.

1.12.5 Projects Rejected by Other GHG Programs

PP hereby declares that any other GHG program has not rejected the project activity; an undertaking for the same has been submitted by the PP.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project activity is not a grouped project.

Leakage Management

As per the applied methodology, there are no leakage emissions envisaged. Hence, leakage emissions are not applicable.

Commercially Sensitive Information

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

Sustainable Development

Government of India has stipulated following indicators for sustainable development in the interim approval guidelines[1] for CDM projects.

1. Social well-being
2. Economic well-being
3. Environmental well-being
4. Technological well-being

1. Social well-being:

The proposed project activity leads to alleviation of poverty by establishing direct and indirect employment opportunities via improved economic activity. It also strengthens the provision of electricity to local grid of the state electricity utility. The project improves the quality, frequency and availability of electricity which is being fed into a power-deficit grid. Thus, the provision of electricity through the project activity has a direct and positive impact on the local residents of the area.

2. Economic well-being:

With the proposed project activity, employment opportunities has increased in the local area, thereby improving economic conditions of the local population. The project has created indirect employment opportunities for skilled and unskilled workers during construction, which otherwise would not happen in the absence of the project. In addition, the project also creates direct permanent employment for operation of the project. By promoting the decentralization of economic power, the project contributes in bringing economic sustainability around the plant site.

3. Environmental well-being:

The project utilizes hydro energy for generating electricity which otherwise would have been generated through conventional fuel based power plants, thereby contributing to the reduction of associated GHG emissions (emissions of pollutants per unit of energy generated). The hydro power projects do not have end products in the form of solid waste (ash etc.) thereby, further contributing to the environmental sustainability.

4. Technological well-being:

The project has helped achieving economies of scale for small hydro projects and will contribute to the development of an infrastructure that can support such technologies. The project activity does not involve the technology transfer from any country.

In view of the above, the PP has considered that the project activity profoundly contributes to the sustainable development.

Further Information

NA

[1] Ministry of Environment and Forest web site: http://envfor.nic.in:80/divisions/ccd/cdm_iac.html

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Following approved baseline & monitoring methodology is applied;
Title: Type-I, Renewable Energy Project
Methodology: I.D. Grid connected renewable electricity generation

Version: 18, valid from 28/11/2014. Scope: 01, EB 81 Annex-14
Reference:
http://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

The tools referenced in this methodology used for the proposed project includes:

- Tool to calculate the emission factor for an electricity system Version 07.0.0, Annex 4 of EB 100
- "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" Version 03, Annex 3, EB93.
- Tool to Demonstrate Additionality of Small-Scale Project Activities (Version 12.0);
- Investment Analysis Version-09, Annex-11 of EB101

- **Guidelines:**
  - General guidelines for SSC CDM methodologies, Version 22.1, EB 86, Annex 13. (https://cdm.unfccc.int/filestorage/e/x/t/extfile-20160415160825656-Meth_guid25.pdf/Meth_guid25.pdf?t=R2Z8b2hrMTBwfDCJ3FsAgy3mXJjAohJ_m8CX)

2.2 Applicability of Methodology

The project activity involves generation of electricity by the means of renewable energy, hydro energy having installed capacity 3.5MW. Hence, the project is a type I project and the project activity falls under the category of small scale projects. The methodology chosen for the project activity and its applicability to the project activity is discussed below.

Applicability Conditions	Position of the project activity vis-à-vis applicability conditions
1. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass a) Supplying electricity to a national or a regional grid b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	The Project activity involves electricity generation using hydro power plant and supply of electricity through Indian grid for captive consumption.
Illustration of respective situations under which each of the methodology (i.e. "AMS-I.D.: Grid connected renewable electricity generation", "AMS-I.F.: Renewable electricity generation for captive use and mini-grid" and "AMS-I.A.: Electricity generation by the user) applies is included in the appendix.	As per Table No 2 of AMS – I. D. / Version 18, the AMS I.D is applicable to the project activity.

Applicability Conditions	Position of the project activity vis-à-vis applicability conditions
This methodology is applicable to project activities that (a) Install a Greenfield plant; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	The project involves installation of 3.5 MW hydro Power Plant at sites where there was no renewable energy power plant operating prior to the implementation of the project activity.
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2; • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	This is not applicable to the project activity as proposed project activity is a run-of-river project.
If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co fires fossil fuel4, the capacity of the entire unit shall not exceed the limit of 15MW.	The project activity is only 3.5MW hydro energy based renewable electricity generation project. It does not include any non-renewable unit and co-firing system.
Combined heat and power (co-generation) systems are not eligible under this category.	The project activity does not involve combined heat and power generation system as it involves hydro energy based power generation.
In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct5 from the existing units.	It is a Greenfield project and not the extension of an existing renewable energy facility.
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	The project activity is not the retrofitting or replacement of an existing facility for renewable energy generation. Hence this criteria in not applicable.
In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the	The proposed project activity is a hydroelectric power project, hence criterion not applicable.

Applicability Conditions	Position of the project activity vis-à-vis applicability conditions
recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.	
In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	The proposed project activity is a hydroelectric power project, hence criterion not applicable.

The project activity is installation of 3.5MW hydroelectric power project for captive consumption. The project installed capacity of plant is less than 15MW. Hence the choice of project Type I and category is justified.

2.3 Project Boundary

As per Para 18 of applied baseline and monitoring methodology AMS I.D, Version-18, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the VCS project power plant is connected to. This includes the turbine, generator and sub-stations.

The proposed project activity will use generated power for captive consumption by evacuating the power to the grid. Therefore, all the power plants contributing electricity to the Indian Grid have been considered in the project boundary for the purpose of baseline estimation. The project activity targets reduction of CO_2e as main GHG greenhouse gas in baseline, there are no GHG emission associated with project activity.

Source		Gas	Included?	Justification/Explanation
Baseline	Electricity from grid	CO_2	Yes	Main Emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	Electricity from hydro project via grid	CO_2	No	No emission
		CH_4	No	
		N_2O	No	

The project boundary is depicted in diagram below

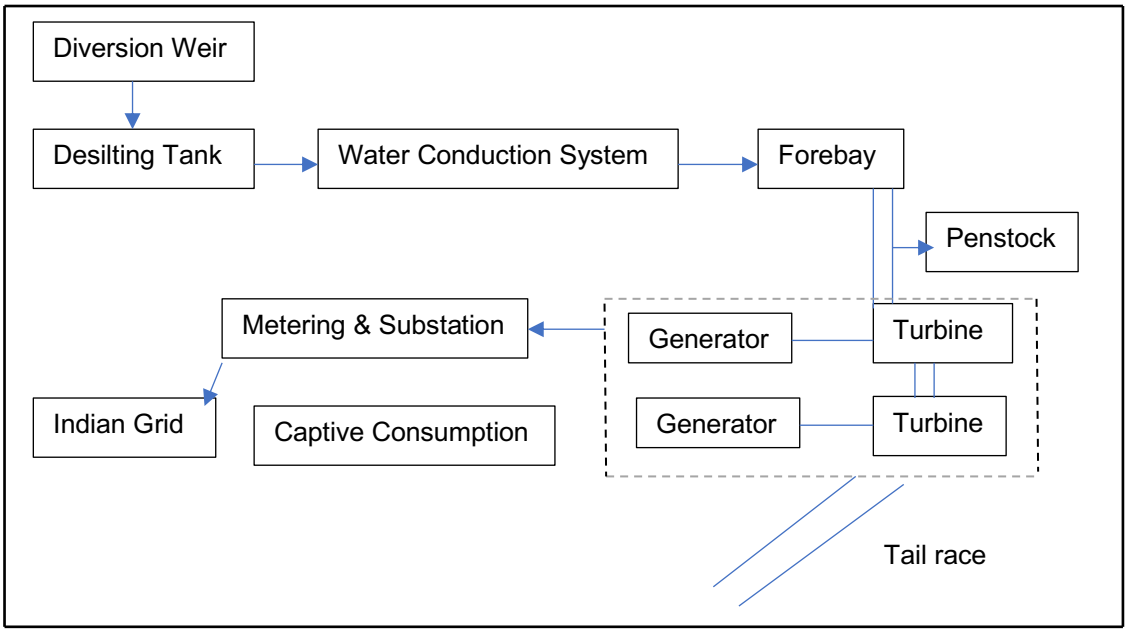


Fig: Project boundary

2.4 Baseline Scenario

The project activity involves installation of 3.5MW hydro power project. The generated power will be supplied to grid for captive consumption, which otherwise would have been imported from grid, which possesses a mix of generation types with fossil fuel fired power plants.

As per para 19 of AMS-I.D. (Version 18) "The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid- connected power plants and by the addition of new generation sources into the grid. In the absence of the project activity same amount electricity would have been generated from grid, in which the electricity is generated by the fossil fuel intensive power plant. Thus, baseline is in line with para 19 of AMS-I.D. (Version 18).

Para 22 of AMS-I.D. (Version 18) calculates baseline emissions as:

$BE_y = EG_{PJ,y} \times EF_{grid,y}$ ……..(A)

Where,

BE_y = Baseline Emissions in year y; t CO_2

$EG_{PJ,y}$ = 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)

$EF_{grid,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Accordingly, the emission factor of the grid will be used to estimate emission reductions. As per para 23 of AMS-I.D. (Version 18), PP has chosen option (a) and used the combined margin (CM) approach to calculate emission factor, as official data is available for operating margin (OM) and build margin (BM) values, whereas no such data exists in the public domain to support choice of option (b). Hence,

$EF_{grid,y} = EF_{grid,CM,y}$ .....*(B)*

DATA USED

Parameter	Description	Source
$EF_{OM,Y}$	Operating margin CO_2 emission factor for the project electricity system in year *y*	**Calculated as per "Tool to calculate the emission factor for an electricity system (Version 07.0.0)" using CEA CO2 database version-13**
$EF_{BM,Y}$	Build margin CO_2 emission factor for the project electricity system in year *y*	
$EF_{CM,Y}$	Combined margin CO_2 emission factor for the project electricity system in year *y*	
$EG_{PJ,Y}$	Quantity of net electricity supplied by the candidate project activity to the grid in year *y*	Estimated generation based on rated capacity of the project activity and the applicable PLF. During the crediting period, records of actual net electricity supply to the grid will be used.
PLF	69%	Third party report in line with para 3(a) of EB48 Annex-11

2.5 Additionality

The project activity meets the eligibility criteria to use the simplified baseline and monitoring methodology listed in annexure B of simplified modalities and procedure for small-scale CDM project activities. In accordance with "demonstration of additionality of small scale project activity" Version-12.0, PP shall provide an explanation to show that the project activity would not have occurred due to at least one of the following barrier

- Investment barrier:
- Technological barrier:
- Barrier due to prevailing practice:
- Other barriers

The project proponent identified “investment barrier” as the most relevant barrier faced by the project activity.

The revised investment decision for proposed project activity was taken on 24 January 2012 and project activity commissioned on 31 March 2017.

Below is chronology of event

Revised Investment decision	24/01/2012
Approval by Directorate of Energy, Government of Himanchal Pradesh	27/09/2012
NoC from Tehsil	15/02/2013
NoC from I&PH Himanchal Pradesh	20/04/2013
NoC from Public Works Department	01/05/2013
NoC from Forest Department	04/07/2013
NoC from Village Panchayat	08/09/2013
Consent to Establish and Operate from HPSPCB	01/02/2017
Commissioning of the project	31/03/2017

The investment analysis method recommends three analysis methods: simple cost analysis, investment comparison analysis and benchmark analysis. The proposed project produces economic benefits through the use/sale of electricity other than VCS related income; therefore, the simple cost analysis cannot be taken. The investment comparison analysis is not applicable to the proposed project because the alternative of the proposed project is “Equivalent electricity service provided by the grid”, is outside the direct control of the PP.

As per tool Investment Analysis, the benchmark approach is suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer, i.e. cases where the choice of the developer is to invest or not to invest. In the project activity the baseline scenario is the generation of equivalent amount of electricity from the grid connected power plants.

The baseline scenario is outside the direct control of the PP. Hence, the benchmark analysis is chosen and the Equity IRR is used as the financial indicator to assess the financial viability of the project activity.

Benchmark:

As per the “Investment Analysis” tool, Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Hence the benchmark for the sub projects is based upon weighted average of the cost of debt and equity component as determined for the project activity. Required/expected returns on equity are appropriate benchmarks for an equity IRR. Benchmarks supplied by relevant national authorities are also appropriate”. Since in this project activity, equity IRR has been considered as financial indicator, hence as per tool EB101 Annex11, Required/expected returns on equity are

considered as appropriate benchmarks and benchmark supplied by relevant national authorities has been used.

Since the choice of benchmark is based upon parameters that are standard in the market, hence as per tool EB 101 Annex 11, "the cost of equity should be determined either by: (a) selecting the values provided in the Appendix; or by (b) calculating the cost of equity using CAPM". Hence as per option (a), the default value for India is being considered as per the value provided in Appendix of EB 101 Annex 11. The benchmark thus selected complies as per the relevant guidelines on Investment Analysis.

Further as per tool EB 101 Annex 11, "In situations where an investment analysis is carried out in nominal terms and the available IRR benchmarks are in real terms, project participants shall convert the real term values of benchmarks 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". Following the above guidance, the default value is being converted to nominal values by adding inflation rate for 10 years, as per the inflation forecast rate provided by Reserve Bank of India.

As the proposed project activity generates power utilizing wind energy, Group 1 as per Appendix- Default values for cost of equity (return on equity) of EB101, Annex 11 has been identified as a suitable category.

The investment analysis has been carried out in Nominal terms. Accordingly, Default value as given in Appendix- Default values for cost of equity (return on equity), Annex 11, EB 101 has been adjusted by adding suitable forecasted inflation rate taken from RBI (Central Bank, India). In case of inflation data from RBI, Benchmark has been calculated based on WPI median inflation rate. As per Para 20 of EB 101, Annex 11, the inflation forecast should be for the duration of the crediting period. However, since RBI provides forecast inflation only for 5 & 10 years, the project investor has calculated benchmark using 10 Years forecast and the most conservative value is considered as Benchmark for the project activity.

The benchmark has been computed in the following manner:

Nominal Benchmark[2] *= {(1+Real Benchmark) * (1+Inflation rate)}-1*

Where,

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

The Reserve bank of India (RBI) provides the quarterly forecast (for the next five years and 10 years) for the inflation. Results of the Survey of Professional Forecasters on Macroeconomic Indicators – Round 18, third quarterly of 2011-12 (published dated 23/01/2012), RBI forecasted values for the next ten years for WPI inflation has been used to adjust the default value of ROE, which is given in real terms as per below for the project activity.

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

Long term WPI for 10 years forecast applicable to project activity is 5.9%[3] applicable for the proposed project activity as the same was available to PP at the time of investment decision date i.e. 24/01/2012.

Therefore,

Return on equity$_{Nominal}$ =(1+ 9.79%)*(1+5.9%) – 1=16.26%

Calculation and comparison of financial indicators

The period considered for Post Tax Equity IRR calculations is 30 years, which corresponds to the operational lifetime of the project activity. Depreciation, and other non-cash items related to the project activity, which have been deducted in estimating gross profits on which tax is calculated, is added back to net profits for the purpose of calculating the financial indicator.

The following table illustrates the assumptions used for the calculation of the financial indicator i.e. Post Tax Equity IRR for the given project activity. The use of these parameters indicating if they are assumed or based on actual figures is explained in the table. All the relevant costs and revenues for the project activity have been considered for calculation of Post Tax Equity IRR.

Parameter	Value	Source
Installed Capacity of each turbine in kW	1750	Commissioning certificate
Number of Turbine	2	Commissioning certificate
Project Capacity in MW	3.5	Commissioning certificate
Date of commissioning	31/03/2017	Commissioning certificate
Capital Cost		
Project Cost (INR. In Millions) Including IDC	314.80	DPR, Civil-172.5 INR millions, E&M Tx line-78.59 INR millions, IDC-63.71 INR millions
Construction period (months)	30	DPR
Loan Amount (INR Millions)	220.36	DPR
Equity Amount (INR Millions)	94.44	DPR
O&M and other recurring expenses		
Interest rate	14.5%	DPR
Auxiliary &Transmission losses	10%	DPR
Water Royalty to be paid to Govt. after 12 years	10%	DPR
Operation & Maintenance Cost	1.5%	DPR
% of escalation per annum on O & M	5.0%	DPR
Spares @15% of O&M	15%	DPR
Local Area development @1% of revenue	1%	DPR

[3] https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=14022

Generation		
Plant Load Factor (1-15 years)	69%	Third party PLF report in line with para 3(b) of EB48 Annex-11
Net Electricity Generation per year (GWh)	19.0398	Calculated
Book Depreciation and Residual value		
Book depreciation percentage of total project cost	90%	CERC
Residual Value (%)	10%	CERC
IT Depreciation		
Rate of Depreciation (As per Income Tax)	7.69%	Appendix IA of IT Rule
Income Tax		
MAT Rate	18%	Indian IT Rule
Income tax	33%	Indian IT Act for FY 2010-11
Surcharge	10%	Indian IT Act for FY 2010-11
Education Cess	3%	Indian IT Act for FY 2010-11
Corporate Tax including surcharge and cess	33.99%	Calculated
Lifetime of the project activity (years)	40	DPR, however the analysis is conducted for 30 years considering lifetime of turbine and other major repair in civil work required

The Post tax Equity IRR is evaluated for the 30 years. It is calculated based on the cash outflows from and cash inflows into the project activity.

Based on result of IRR excel spreadsheets, equity IRR i.e. 12.13% is less than the Benchmark expected rate of return on equity i.e. 16.26%.

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

Sensitivity Analysis

In accordance with tool "Investment Analysis", variables that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation.

The parameters e.g. project cost, plant load factor, electricity generation and O&M cost is considered for sensitivity analysis, which shows that project does not crosses the benchmark value within 10% variation.

Parameter	Variation			Breaching Value
	-10%	Original	+10%	
Project cost	15.89%	12.13%	9.28%	-10.86%
O&M	12.65%	12.13%	11.61%	-79.50%
Electricity Generation	9.10%	12.13%	15.36%	12.66%

Tariff rate	9.10%	12.13%	15.36%	12.66%
Interest rate on loan	12.63%	12.13%	11.64%	-72.40%
Benchmark Value	16.26%			

Project cost:

The project will breach the benchmark value on decrease of project cost by 10.86%, which is not likely as project cost is already incurred and is within 10% range of the cost considered for financial analysis.

O&M:

The project will breach the benchmark value on decrease of O&M cost by 79.5%, which is not a likely scenario.

Electricity Generation & Tariff rate:

The project will breach the benchmark value on increase of electricity generation or tariff by 12.66%, which is not likely as DPR is prepared by third party, wherein electricity generation estimates are shown based on historical water flow. The same is also verified from other projects in the region and based on actual generation which is lower than the estimated. The variation beyond 10% increase is not a possibility.

Interest rate:

The project will breach benchmark value when Interest rate considered for financial analysis is decreased by more than 72.4%, which is not a likely scenario as loan already sanctioned.

Hence it is evident that the carbon benefit will alleviate the investment barrier.

2.6 Methodology Deviations

There is no deviation from applied methodology.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

As per para 22 of AMS-I.D. (Version 18), baseline emissions are calculated as follows:

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

Where:
BE_y = Baseline Emissions in year y; t CO_2

$EG_{PJ,y}$= 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)

$EF_{grid,y}$= Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Calculation of $EG_{PJ,y}$

As proposed project activity is a greenfield project, in accordance with para 26 of applied methodology

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

Where,

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

Calculation of BE_y

Calculation of baseline emissions i.e. BE_y, requires calculation of grid emission factor ($EF_{grid,y}$), which is being presented below.

As per para 23 of the applied methodology, the emission factor can be calculated in a transparent and conservative manner as follows:

Emission factor of a grid has been calculated as per the procedures provided in AMS-I.D;

- For a mini-grid system other than described in paragraph 18 above, the baseline emission factor shall be determined as per the weighted average emissions for the current generation mix following the procedure provided in AMS-I.D;

- Emission factor for captive electricity generation shall be calculated as per the procedures described in the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

The emission factor of the grid will be used to estimate emission reductions. As per para 12 of AMS-I.D. (Version 18), PP has chosen option (a) and used the combined margin (CM) approach to calculate emission factor, as official data is available for operating margin (OM) and build margin (BM) values, whereas no such data exists in the public domain to support choice of option (b). Hence,

$EF_{CO2,y} = EF_{CM,y}$ .....(B)

This data is published by Central Electricity Authority (CEA) (a statutory body constituted under Electricity Act and having its office attached to Ministry of Power, Government of India) on their website (www.cea.nic.in). "Baseline Carbon Dioxide Emission Database Version 13.0" is the latest available data and is, therefore, being used in calculation of the baseline emissions.

For emission factor calculation of Indian grid please refer Appendix.

3.2 Project Emissions

As per the approved consolidated Methodology AMS I.D (Version 18.0, EB 81): "For most renewable energy power generation project activities, PE_y = 0.

As per applied methodology only emission associated with the fossil fuel combustion, emission from operation of geo-thermal power plants due to release of non-condensable gases, emission from water reservoir of Hydro should be accounted for the project emission. Since the project activity is a run of river hydro power project,

CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the Methodological tool "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 3.0). The project activity has installed of one DG set to meet the emergency requirements of power house. Emissions due to use of diesel in DG set will be accounted as project emissions based on the following derived equation based on tool.

CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$PE_{FC,j,y} = \sum FC_{i,j,y} \times CO_{EFi,y\,i}$
Where: $PE_{FC,j,y}$ = Are the CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/yr)

$FC_{i,j,y}$ = Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)

$CO_{EFi,y}$ = Is the CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)

i = Are the fuel types combusted in process j during the year y

Since the chemical composition of fossil fuel is not available with PP, the option B of tool is followed for CO_2 emission coefficient $CO_{EFi,y}$

Option B: The CO_2 emission coefficient $CO_{EFi,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows:

$CO_{EFi,y} = NCV_{i,y} \times EF_{CO2,i,y}$
Where: $CO_{EFi,y}$ = Is the CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)

$NCV_{i,y}$= Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = Is the weighted average CO2 emission factor of fuel type i in year y (tCO_2/GJ)

i = Are the fuel types combusted in process j during the year y

As per tool, IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 and 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC

Guidelines on National GHG Inventories is considered as ex –ante values for the current crediting period for NCV and CO2 emission factor of diesel.

3.3 Leakage

No other leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected.

3.4 Net GHG Emission Reductions and Removals

The baseline emissions are calculated as follows:

$BE_y = EG_{PJ,y} \times EF_{CO2,grid,y}$

Where,

$EG_{PJ,y} = EG_{PJ,facility,y}$ = 3.5MW x 24 (Hour/day) x 365 (days) x 69% (PLF) x(1-10% (auxiliary)

$EG_{PJ,y}$ =19328 MWh/year

$EF_{CO2,grid,y} = EF_{CM,y}$ =0.9254 tCO_2e/MWh

Hence

BE_y= 19328 x0.9254 = 17619.48 tCO_2e/year

BE_y= 17619 tCO_2e/year

Project emission:

Ex-ante value is considered as zero.

Leakage:

For ex-ante leakage emission considered as zero and shall be calculated if any during crediting period.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2017-18*	17619	0	0	17619
2018-19	17619	0	0	17619
2019-20	17619	0	0	17619
2020-21	17619	0	0	17619
2021-22	17619	0	0	17619

2022-23	17619	0	0	17619
2023-24	17619	0	0	17619
2024-25	17619	0	0	17619
2025-26	17619	0	0	17619
2026-27	17619	0	0	17619
Total	**176190**	**0**	**0**	**176190**

*The start date of crediting period is date of commissioning and operation of turbine i.e. 31st March 2017

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 for the Indian Grid in year y
Source of data	CEA's "*Baseline Carbon Dioxide Emission Database Version 13.0*"
Value applied	0.97839
Justification of choice of data or description of measurement methods and procedures applied	Calculated in line with "*Tool to calculate the emission factor for an electricity system (Version 07.0.0)*" using data from Central Electricity Authority of India's (CEA) "*Baseline Carbon Dioxide Emission Database Version 13.0*". The value used is calculated ex-ante as generation based weighted average of last three years of the operating margin provided in the CEA database. Weighted average = $\sum_{i=1 \text{ to } n}$ (Net generation in operating margin in year i * Simple operating margin in year i)/$\sum_{i= 1 \text{ to } n}$ (Net generation in operating margin of year i)
Purpose of Data	Calculation of baseline emissions
Comments	The value is fixed ex-ante

Data / Parameter	**$EF_{grid, BM, y}$**
Data unit	tCO_2/MWh
Description	Build Margin CO_2 emission factor for the India Grid in year y
Source of data	CEA's "*Baseline Carbon Dioxide Emission Database Version 13.0*
Value applied	0.870
Justification of choice of data or description of measurement methods and procedures applied	Calculated in line with "*Tool to calculate the emission factor for an electricity system (Version 07.0.0)*" using data from Central Electricity Authority of India's (CEA) "*Baseline Carbon Dioxide Emission Database Version 13.0*".

	The value is calculated ex-ante as most recent build margin provided by the CEA.
Purpose of Data	Calculation of combined margin emissions
Comments	The value is fixed ex-ante

Data / Parameter	**$EF_{grid, CM, y}$**
Data unit	tCO_2/MWh
Description	Combined Margin CO_2 emission factor for the India Grid in year y
Source of data	Central Electricity Authority(CEA) of India Database*Version 13.0*
Value applied	0.9254
Justification of choice of data or description of measurement methods and procedures applied	This has been calculated based on Operating Margin (OM) and Build Margin (BM) published by Central Electricity Authority (CEA) of India.
Purpose of Data	Calculation of baseline emissions
Comments	The value is fixed ex-ante

Data / Parameter	**$NCV_{diesel, y}$**
Data unit	GJ per mass or volume unit
Description	Net calorific value of diesel
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied	43.3 GJ/Ton
Justification of choice of data or description of measurement methods and procedures applied	Fuel supplier does not provide emission factor in their invoices and also this parameter value is not available top through measurement. Also Regional or national default values are not available. Hence IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. This is in line with Methodological tool "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 3.0). In case of density is required, the same is considered as 0.83 Kg/Lit as per CEA database version 12
Purpose of Data	Calculation of project emissions
Comments	The value is fixed ex-ante

Data / Parameter	**$EF_{CO2,diesel, y}$**

Data unit	tCO_2/TJ
Description	CO2 Emission Factor of Diesel
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied	74.8
Justification of choice of data or description of measurement methods and procedures applied	Fuel supplier does not provide emission factor in their invoices and also this parameter value is not available top through measurement. Also Regional or national default values are not available. Hence IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. This is in line with Methodological tool "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 3.0).
Purpose of Data	Calculation of project emissions
Comments	The value is fixed ex-ante

4.2 Data and Parameters Monitored

Data / Parameter	$\mathbf{EG_{PJ,Y}}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant to the grid in year y
Source of data	ABT Meter Report by MRI
Description of measurement methods and procedures to be applied	The value of net electricity generation supplied to the grid as per ABT Meter Report by MRI forms the basis for calculation of the emission reductions. Monthly meter readings are taken from the main and check meter installed at metering point and certified by the representatives of SEB Officials and the representatives of the project proponent.
Frequency of monitoring/recording	Continuous monitoring, Monthly recording
Value applied:	19328
Monitoring equipment	Electricity meter-ABT Accuracy class: 0.2s
QA/QC procedures to be applied	The calibration of all the meters will be undertaken at required intervals specified by DISCOM/CEA and faulty meters will be duly replaced immediately. The meters will be of accuracy class 0.2. The meter accuracy class and calibration interval is under purview of state electricity board and PP do not have any control on it.
Purpose of data	Calculation of baseline emissions

Calculation method	Monitored
Comments	Data will be archived for crediting period +2 years

Data / Parameter	$QC_{diesel,y}$
Data unit	Liters
Description	Volume of diesel used in year y
Source of data	Plant log book
Description of measurement methods and procedures to be applied	The volume of diesel used will be monitored based on each filling using gallon of fixed volume. The same will be cross-checked with purchase invoice and stock.
Frequency of monitoring/recording	Each filling and monthly aggregation
Value applied:	0
Monitoring equipment	Volume gallon
QA/QC procedures to be applied	NA
Purpose of data	Calculation of project emission
Calculation method	NA
Comments	Data will be archived for crediting period +2 years

4.3 Monitoring Plan

This monitoring plan is developed in accordance with the modalities and procedures for small-scale VCS project activities and in line with the guidance provided in the applied methodology. The monitoring plan, which will be implemented by the project proponents, describes about overall monitoring organization, Internal reporting procedure for data collection and archiving, Calibration of measurement equipment's, Training procedures and internal audit procedures.

Data and parameters, which will be monitored under this monitoring plan as sited in 4.2 will be measured and strictly monitored at the project site by means of accurately calibrated instruments.

The monitoring plan structure and the roles of the different member in the monitoring plan are explained below.

Internal reporting procedure: Technicians and operators are responsible for the recording of the relevant data in plant log books. Shift in-charges are also responsible of QA/QC of data recorded and maintenance of log-books and other records.

These records in plant log books will consolidate in the form of monthly GHG report by plant supervisor and will be submitted to plant manager for review. The Management, who represents the overall responsibility on the project activity, will be able, with this operational structure, to monitor the development of the project activity and make the relevant amendments to the process.
The VCS monitoring team will compose the following staff:

Position	**Report to:**
Operators	Site Engineer
Site Engineer	Site In-charge
Site In-charge	General Manager
Plant head	Director

Monitoring Provisions

Training and Maintenance:

All persons that form the part of the VCS Project Management Team shall receive appropriate training which shall provide an overview of the VCS and cover all elements of monitoring plan in detail. Training for operating and maintaining the plant shall also be provided.

Emergency Preparedness:
Being a small hydro plant intensive emergency preparation is not needed, however, the following may be highlighted:

- There are no critical loads that may require emergency power supply in case of total outage.
- A fire extinguisher has been installed in case of small fires
- Information regarding any safety earthing systems in place

5 SAFEGUARDS

5.1 No Net Harm

The facility does not produce any pollution in process of power generation as it utilizes renewable energy source that is hydro energy to generate electricity for captive consumption. Hence there is positive impact on the environment due to this small-scale project activity of reducing the pollution caused by fossil fuels would have been used in baseline scenario. Further this project will have no air pollution, no water pollution and no noise pollution.

The project activity has obtained the No Objection Certificate for Consent to Establish from the concern agencies.

5.2 Environmental Impact

As per the prevailing regulations of the Host Party i.e. India represented by the Ministry of Environment and Forests (MoEF), Govt. of India, Environment Impact Assessment Notification

no. 3067 dated 01/12/2009[4] and Feb 2016 the project activity does not require Environment Impact Assessment to be conducted.

However, the following is a brief summary of the assessment of environmental impacts of the development of project activity.

1. Only small portion of land will be used for construction of this project. Hence, practically, with the construction of this project there will be no adverse impact on the forest, wild life or aquatic animals.
2. The topography of the area comprises of compact strata and steep slope. The unstable strata would be used for plantation to enhance the green area around the project.
3. The project is based on run-of-the-river and does not require the construction of a reservoir, dam or pond. The catchment area of small weir dam is restricted to *river* bed only and so there won't be any submergence of the area. Hence, any problem related to reservoir induced seismicity and rehabilitation will not occur.
4. Since the project does not require the construction of a reservoir, there is no induced risk of incidences of infectious diseases.
5. Roads and paths approaching project site and water supply arrangements would be made for the construction site which would help in overall infrastructure development of the region.

5.3 Local Stakeholder Consultation

The local stakeholder consultation meeting for the proposed project activity has been conducted at project site on 22 September 2018. The PP has identified the relevant stakeholders and sends personal invitation letters well in advance dated 10/09/2018. The stakeholder meeting process is followed in the following sequence

- Welcome Speech by the organizers.
- Introduction to 'GHG' programme
- Interactive Sessions with the stakeholders.
- Vote of Thanks

5.4 Public Comments

Issues Raised by Villagers and response:

A. Does this project help the villagers in employment generation? (By Mr Ajay Kumar)

Answer: Yes. The project would make a significant contribution to the socio-economic development of the region, as it is generated direct and indirect employment to villagers during construction and operation of the project activity.

B. How the project will reduce the GHG emission to atmosphere? (By Mr Amit)

Answer: The project is utilising hydro energy to generate the electricity, which is emission free and will replace grid electricity being produced by grid mix power plant dominated by fossil fuel based thermal power plant. The project will generated around 19000 MWh of electricity and lead to avoidance of around 18000 tCO2 emission to atmosphere.

C. How long the carbon credit benefit will be available? (By Mr Nishant)

Answer: The project lifetime is more than 20 years, as per VCS standard the project can claim benefit until 20 years from date of commissioning.

[4] http://www.moef.nic.in/downloads/rules-and-regulations/3067.pdf

D. Any negative impact of the project activity on nearby villages? (By Mr Parshotam)

Answer: The project is a run of the river project and does not change have any dam. It has no associated emissions or other impact on nearby villages.

There were no negative comments raised by stakeholders in the local stakeholder consultation meetings and due to the associated benefits stakeholders have appreciated the proposed project activity.

APPENDIX A: DETERMINATION OF EMISSION FACTOR OF GRID

The PP has chosen option a i.e. combined margin (CM) consisting of combination OM and BM. Tool to calculate the emission factor for an electricity system (Version 07.0.0), has been used to determine the CO_2 emission factor for displacement of electricity generated by power plants in an electricity system, by calculating the combined margin emission factor (CM) of that electricity system.

Option (a) has been considered to calculate the grid emission factor as per the 'Tool to calculate the emission factor for an electricity system' since data is available from an official source.
CO_2 Baseline Database for the Indian Power Sector, Version 13, published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

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

STEP 1: Identify the relevant electricity systems;
STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional);
STEP 3: Select a method to determine the operating margin (OM);
STEP 4: Calculate the operating margin emission factor according to the selected method;
STEP 5: Calculate the build margin (BM) emission factor;
STEP 6: Calculate the combined margin (CM) emission factor.

STEP 1: Identify the relevant electricity power systems
The tool defines that "for determining the electricity emission factors, identify the relevant electricity system. Similarly, identify any connected electricity systems". It also states that, "If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used". Keeping this into consideration, the Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into five regional grids viz. Northern, Eastern, Western, North-eastern and Southern.

However, since August 2006, however, all regional grids except the Southern Grid had been integrated and were operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids were treated as a single grid named as NEWNE grid from FY 2007-08 onwards for the purpose of this CO2 Baseline Database. As of 31 December 2013, the Southern grid has also been synchronised with the NEWNE grid, hence forming one unified Indian Grid. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

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

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

Project participants have the option of choosing between the following two options to calculate the operating margin and build margin emission factor:

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

The Project Participant has chosen only grid power plants in the calculation.

STEP 3: Select a method to determine the operating margin (OM) method
The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

PP has chosen Option (a) i.e. simple OM, to determine the operating margin. Other available options in the tool were ruled out considering the fact that data required to calculate simple adjusted OM or dispatch data analysis is not available publicly. As per the tool, low cost/must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Data for the same, as published by Central Electricity Authority, has been presented below which illustrates that low cost/must run resources constitute less than 50% of total Indian grid generation, hence, the average OM method could not have been used.

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

	2012-13	2013-14	2014-15	2015-16	2016-17
India	16.9%	18.6%	16.8%	15.1%	14.6%

Data Source: Central Electricity Authority (CEA) database Version-13

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

The “Simple operating margin” has been calculated as per the weighted average emissions (in tCO_2/MWh) of all generating sources serving the system, excluding hydro, geo-thermal, wind, low- cost biomass, nuclear and solar generation;

As per tool to calculate emission factor for an electricity system (Version 07.0.0), 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. Since the low cost/must run resources constitute less than 50% of total grid generation as seen from the average of five most recent years, the Simple OM method can be used to calculate the Operating Margin Emission factor.

PP has chosen ex ante option, thus, no monitoring and recalculation of the emissions factor during the crediting period is required. PP has considered a data vintage of 3-year generation-weighted average, based on the most recent data available at the time of submission of the VCS-PD to the DOE for validation.

STEP 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO2 emission factor of each power unit; or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

The Central Electricity Authority, Ministry of Power, Government of India has published a database of Carbon Dioxide Emission from the power sector in India based on detailed authenticated information obtained from all operating power stations in the country. This database i.e. The CO_2 Baseline Database provides information about the Combined Margin Emission Factors of all the regional electricity grids in India. The Combined Margin in the CEA database is calculated ex ante using the guidelines provided by the UNFCCC in the "Tool to calculate the emission factor for an electricity system, Version 07.0.0". We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

As per „Tool to calculate the emission factor for an electricity system", Option A ("Based on the net electricity generation and a CO_2 emission factor of each power unit") is used to calculate simple OM emission factor. Where Option A is used, the simple OM emission factor is calculated based on the electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \Sigma (EG_{m,y} \times EF_{EL,m,y}) / \Sigma EG_{m,y}$$

Where:

$EF_{grid,OMsimple,y}$ Simple operating margin CO_2 emission factor in year y (tCO_2/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/MWh)

m All power units serving the grid in year y except low-cost / must-run power units y the relevant year as per the data vintage chosen in STEP 3

The CO_2 emission factor ($EF_{EL,m,y}$) data for simple OM, available under the CEA database (Version 12.0) for the last three years is as follows.

Net generation in operating margin GWh including import			
	2014-15	2015-16	2016-17
Indian Grid	972042	1027028	1072839

Simple operating margin(tCO_2/MWh) (Incl Import)			
	2014-15	2015-16	2016-17
Indian Grid	1.0	0.97	0.97

Weighted Avg. Operating Margin Indian Grid is

= (972042*1.0+1027028*0.97+1072839*0.97)/ (972042+1027028+1072839)
= 0.97839 tCO_2/MWh

Step 5: Calculate the build margin (BM) emission factor, $EF'_{grid',BM,y}$

The project participants have chosen Option I, i.e. fixing 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 CDM PDD submission to the DOE for validation.

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

$EFgrid_{BM,y} = \Sigma(EG_{m,y} X EF_{EL,m,y}) / \Sigma EG_{m,y}$

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (t CO_2 e/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* (t CO_2 e/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the procedures given in step 4 (a) for the simple OM, using options A1B1 using for y the most recent historical year for which power generation data is available, and using for m the power units included in the build margin.

The build margin emission factor ($EF_{grid,BM,y}$) for the year 2016-17 (most recent year) for Indian grid is 0.87 tCO_2/MWh.

CEA's "CO2 Baseline Database for the Indian Power Sector" Version 13.0,.

Build Margin (tCO2/MWh) (not adjusted for imports)	
	2016-2017
Indian Grid	0.87

Step 6: Calculate the combined margin (CM) emissions factor
The combined margin is the weighted average of the simple operating Margin and the build margin. As per the 'Tool to calculate the emission factor for an electricity system (Version 07.0.0)', allows to weigh the operating margin and Build margin at 75% and 25%, respectively

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

$= (EF_{grid,OM,y} \times 50\%) + (EF_{grid,BM,y} \times 50\%)$

Electronic spreadsheet showing calculation of all these parameters is being submitted separately and the final values are presented below:

Parameter	Value	Units

Operating Margin	: $EF_{OM,y}$	0.97839	tCO2e/MWh
Build Margin	: $EF_{BM,y}$	0.870	
Combined Margin	: $EF_{grid,CM,y}$	=0.97839*50%+0.870*50%	
Combined Margin	: $EF_{grid,CM,y}$	0.9254	