49.5 MW WIND POWER PROJECT BY MASTER WIND ENERGY LIMITED IN PAKISTAN

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Project Title	49.5 MW Wind Power Project by Master Wind Energy Limited in Pakistan
Version	1.5
Date of Issue	18-April-2017
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1 PROJECT DETAILS

1.1 Summary Description of the Project

M/s. Master Wind Energy Limited (hereafter referred to as the "MWEL") proposes to set up a 52.8 MW[1] grid-connected wind energy project in Jhampir, Thatta approximately 100 km east of Karachi, in Pakistan (hereafter referred to as the "Host Country"). The Project comprises the installation of 33 wind turbines of 1.6 MW each. MWEL has an Engineering Procurement Construction (EPC) Contract with Powerchina Huadong Engineering Corporation for installation of wind turbines. The project activity has received requisite clearances from nodal agencies.

Purpose of the project activity

The purpose of the Project is expected to generate 151.600 GWh of power per annum from wind energy and supply it to National Power and Despatch Company Limited (hereafter referred to as the "Grid"). The Project is therefore expected to reduce green house gases (GHG) emissions by 105,255 tCO_2e per year during the fixed crediting period. In the baseline scenario the electricity delivered to the Grid by the Project would have otherwise been generated by the operation of grid-connected power plants, and by the addition of new generation sources.

Pre-project scenario

In the pre-project scenario the electricity delivered to the Power Purchaser by the Project would have otherwise been generated by the operation of grid-connected power plants, and by the addition of new generation sources. The main emission source in the pre-project scenario is the power plants connected to the grid and main GHG involved is CO_2. In this case the pre-project scenario and baseline scenario both are same.

Project scenario

The project activity is renewable power generation from wind and supply of the power to the grid. The total installed capacity of the project activity is 52.8 MW equipped with 33 wind turbine generators (WTGs) of 1.6 MW installed capacity each.

MWEL has an EPC Contract dated 1st Feb 2015 with WTG supplier Powerchina Huadong Engineering Corporation for installation of wind turbines. The project has achieved commercial operation on 14th October 2016.

Reduction of GHGs emissions due to the project activity

The project activity harnesses wind energy to generate and supply electricity to the grid. The employed WTGs can only convert wind energy into electrical energy and do not use any other fuel as input for electricity generation. The operation of WTGs is emission free and no GHG emissions are produced during the lifetime of the project activity.

The electricity currently generated by the grid is relatively fossil fuel intensive, with three years weighted average of operating margin emission factor of 0.7732 tCO_2/MWh, a build margin emission factor of 0.4575 tCO_2/MWh and a combined margin of 0.6943 tCO_2/MWh (see section 2.4 for further details). The project activity is therefore expected to reduce emissions of GHGs by an estimated 105,255 tCO_{2e} per year by displacing equivalent amount of the electricity from the grid. The project activity would reduce 1,052,550 tCO_{2e} for the entire crediting period of 10 years.

1.2 Sectoral Scope and Project Type

Sectoral Scope: 1 - Energy Industries (renewable- /non-renewable sources).
Project Type: Non-Grouped

[1] Initially the project DPR was prepared for 49.5MW considering 33 WTGs of 1.5MW each. Later the capacity was changed to 52.8MW comprising of 33 WTGs of 1.6MW each.

1.3 Project Proponent

Organization name	M/s. Master Wind Energy Limited
Contact person	Muhammad Yousaf Malik
Title	Designation: Project Engineer
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1.4 Other Entities Involved in the Project

There is no other entity involved in the project activity.

1.5 Project Start Date

As per Verified Carbon Standards (VCS) standard, version 3.6, the project start date is the date on which the project began generating GHG emission reductions. The project activity has achieved commercial operations on 14th October 2016 and thus it started generating GHG emission reductions from 14th October 2016. Therefore, Project Start Date is 14th October 2016 (Day: 14, Month: Oct, Year: 2016).

1.6 Project Crediting Period

Crediting Period Start Date: 14/10/2016 (Day: 14, Month: Oct, Year: 2016)
Crediting Period End Date: 13/10/2026 (Day: 13, Month: Oct, Year: 2026)

Total number of years of the crediting period: 10 years

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Estimated average annual GHG emission reductions from the project activity are 105,255 tCO_2e per year, which is greater than 100,000 tCO_{2e} per year. Hence the project scale of the project activity will become "Large **Project**" as shown below:

Project Scale	
Project	
Large project	√

Year	Estimated GHG emission reductions or removals (tCO_2e)
14/10/2016 to 13/10/2017	105,255
14/10/2017 to 13/10/2018	105,255
14/10/2018 to 13/10/2019	105,255
14/10/2019 to 13/10/2020	105,255
14/10/2020 to 13/10/2021	105,255
14/10/2021 to 13/10/2022	105,255
14/10/2022 to 13/10/2023	105,255
14/10/2023 to 13/10/2024	105,255
14/10/2024 to 13/10/2025	105,255
14/10/2025 to 13/10/2026	105,255

Total estimated ERs	1,052,550
Total number of crediting years	10
Average annual ERs	105,255

1.8 Description of the Project Activity

Project Activity:

The project activity generates electricity from renewable wind energy and supplies electricity to the national grid. The total installed capacity of the project activity is 52.8 MW. The project is located at Jhimpir, District Thatta, Sindh, Pakistan. The project activity uses wind energy in producing electricity and no other input is being used, therefore, it will not produce any GHG emission during its lifetime. MWEL has an EPC Contract with WTG supplier Powerchina Huadong Engineering Corporation for installation of wind turbines. Powerchina is a well-known international supplier of wind turbines.

Purpose of the project activity
The purpose of the Project is to generate power from wind energy and supply it to the Power Purchaser. The project activity will result in generation of 151.600 GWh per annum from wind energy.

Technology:
The use of wind energy to generate electricity involves the conversion of power contained in masses of moving air into rotating shaft power. The conversion process utilises aerodynamic forces (lift and/or drag) to produce a net positive turning moment on a shaft, resulting in the production of mechanical power which can be converted to electrical power.

The project activity involves 33 number of General Electric (GE) 1.6MW Xle of rated capacity 1.6 MW each. The technical details[2] are provided below:

General data

- Wind turbine name: G.E. 1.6xle
- Nominal power: 1,600 kW/WTG

Rotor

- Number of Blades 3
- Rotor speed 9-18rpm
- Rotor diameter: 82.5 m
- Swept area: 5,346 m²
- Cut-in wind speed: 3 m/s
- Cut-out wind speed: 25 m/s

Blades

- Blade length: 40.3 m
- Weight: 6,200kg/blade

Gear box

[2] As per Modified generation license from NEPRA

- Type: Multistage planetary/helical gear design
- Ratio: 1:107

Generator

- Power: 1,600kW
- Speed: 1000 - 2000rpm
- Voltage: 690 V
- Weight: 8.450kg

Tower

- Type: Cylindrical tubular steel tower
- Hub height: 80 m

Others:

Life time: 20 years

Reduction of GHGs emissions due to the project activity

The project activity harnesses wind energy to generate and supply electricity to the national grid. The employed WTGs can only convert wind energy into electrical energy and do not use any other fuel as input for electricity generation. The operation of WTGs is emission free and no GHG emissions are produced during the lifetime of the project activity.

The electricity currently generated by the grid is relatively fossil fuel intensive, with three years weighted average of operating margin emission factor of 0.7732 tCO_2/MWh, a build margin emission factor of 0.4575 tCO_2/MWh and a combined margin of 0.6943 tCO_2/MWh (see section 2.4 for further details). The project activity is therefore expected to reduce emissions of GHGs by an estimated 105,255 tCO_2e per year by displacing equivalent amount of the electricity from the grid.

The wind turbines have facility design life of 20 years as specified by the contractor in EPC document[3]. The project activity has achieved commercial operations on 14th October 2016. The project activity is expected to generate 151,600[4] MWh per annum.

1.9 Project Location

Project is located at Jhimpir, District Thatta, Sindh, Pakistan. Geo-coordinates of individual WTGs are provided below:

Turbine No	Easting 'E' (M)	Northing 'N' (M)
T-01	397799	2776086
T-02	397862	2775205
T-03	398056	2775078
T-04	398269	2774934
T-05	398447	2774799
T-06	398653	2774657
T-07	398860	2774521
T-08	399074	2774379

[3] Agreement for Engineering, Procurement, Supply, Construction, Erection, Installation, Commissioning, Operation, Maintenance & Services between MWEL and Powerchina Huadong Engineering Corporation dated 1st Feb 2015.
[4] The net generation from the project is taken from Generation License – Schedule II.

T-09	399280	2774243
T-10	399487	2774101
T-11	399679	2773965
T-12	399879	2773823
T-13	400028	2773713
T-14	400292	2773517
T-15	400499	2773395
T-16	400691	2773267
T-17	400891	2773132
T-18	401090	2773004
T-19	398261	2776990
T-20	398468	2776222
T-21	398661	2776094
T-22	398844	2775984
T-23	399008	2775852
T-24	399188	2775745
T-25	399363	2775611
T-26	399532	2775477
T-27	399707	2775346
T-28	399890	2775228
T-29	399522	2777939
T-30	399102	2778188
T-31	399224	2777334
T-32	398738	2776787
T-33	400087	2775076

The above mentioned geo-coordinates are provided in UTM system. The applicable grid zone[5] is 42 R.

The project location has been highlighted on the map of Pakistan[6]:-

[5] http://www.dmap.co.uk/utmworld.htm
[6] http://www.mapsofworld.com/pakistan/

1.10 Conditions Prior to Project Initiation

The scenario prior to the project initiation is same as baseline scenario. Hence reader is requested to refer Section 2.4 (Baseline Scenario).

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The implementation of the project activity is a voluntary initiative and it is not mandatory or a legal requirement. It has received all the necessary clearances from nodal agencies. The list of approvals from nodal agencies is below:-

Date	Activity
20/12/2006	Letter of Intent issued for 50 MW wind power project by Alternate Energy Development Board (AEDB). (AEDB does not provide any approval in matters relating to capacity increase, hence the approval is available only for 50MW capacity which is envisaged during project conceptualization)
26/12/2011	Generation license by National Electric Power Regulatory Authority (NEPRA) for 50 MW
28/06/2016	Modified Generation license by NEPRA for enhanced capacity of 52.8MW
15/07/2016	Approval on Initial Environmental Examination (IEE) by Sindh Energy Protection Agency (SEPA)
14/10/2016	Notification of commercial operation date issued by Central Power Purchasing (Guarantee) Limited

1.12 Ownership and Other Programs

1.12.1 Project Ownership

Project Owner: M/s. Master Wind Energy Limited

Document(s) demonstrating the ownership of the project:

1. EPC Contract dated 1st Feb 2015
2. Land documents in favor of MWEL
3. Letter of intent issued for 50 MW wind power project by AEDB
4. Modified generation license provided to MWEL by NEPRA

1.12.2 Emissions Trading Programs and Other Binding Limits

There is no compliance / binding limit of emission reductions in the host country (Pakistan). Therefore, it is not applicable.

1.12.3 Other Forms of Environmental Credit

The project activity will not be involved in creating another form of GHG-related environmental credit, such as renewable energy certificates.

1.12.4 Participation under Other GHG Programs

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

1.12.5 Projects Rejected by Other GHG Programs

The project activity has not been rejected by any other GHG program.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project activity is Non-grouped project. The eligibility of the project activity has been explained below as per the methodology applied.

Leakage Management

The project activity generates electricity using wind energy; therefore, it will not have any leakage as per the applied methodology, ACM0002.

Commercially Sensitive Information

The project activity does not have any commercially sensitive information and nothing has been excluded from the public version of the project description.

Sustainable Development

The Project contribution for sustainable development of the Host Country has been explained below:-

Social Wellbeing

- The project activity has lead to the built up of road and local infrastructure development.

Economic wellbeing

- Employment generation for local people during the construction and operational phases of the project activity. The project activity has provided direct employment to local people during its operation phase. This will improve the socio-economic condition of the local people.
- Pakistan is passing through an acute energy crisis. The proposed project will supply an estimated amount of 151.600 GWh per year and will therefore contribute to a reduction in the number of black-outs and brown-outs experienced by other grid users, which can help to improve the economic performance of other businesses connected to the grid.

Environmental wellbeing

- The project activity produces power from wind which is clean source of energy and does not involve any GHGs emission.
- Wind is one of the cleanest forms of renewable energy and power generation from wind does not involve any fossil fuels.

Technological wellbeing

- The project activity uses the environmental safe and sound technologies for wind power generation in the Country. By adopting foreign manufacturer wind turbines, the project activity will promote important transfer of technical know-how to Pakistan, and can act as a pioneer in promoting the spread of this technology to other wind power projects.

Further Information

Not applicable

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

ACM 0002 - *Grid-connected electricity generation from renewable sources (Large-Scale)*[7]
Version – 17.0

Title and reference of tools applied to the project activity:
Tool for the demonstration and assessment of additionality, version 7.0.0
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

Tool to calculate the emission factor for an electricity system, version 5.0
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf

[7] http://cdm.unfccc.int/methodologies/PAmethodologies/approved

Tool-Additionality of first-of-its kind project activities" version 03.0
https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-23-v1.pdf

Tool24: Methodological Tool: Common practice, version 03.1
https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf

2.2 Applicability of Methodology

The project activity avoids the expansion of grid connected fossil fuel based power generation, as it utilizes renewable resources (wind energy) to generate power.

The adopted baseline methodology ACM 0002, version 17.0 has been chosen for the project activity based on fulfillment of the applicability conditions described below:

Applicability	**Project activity vis-à-vis applicability Conditions**
This methodology is applicable to grid-connected renewable energy power generation project activities that: a) Install a Greenfield power plant; b) Involve a capacity addition to (an) existing plant(s); c) Involve a retrofit of (an) existing operating plants/units; d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or e) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity is installation of a new grid connected wind power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant) and **hence this criterion is applicable.**
The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;	The proposed project activity is an installation of a new grid connected wind power plant and **hence this condition is met.**
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 project does not involve any capacity additions, retrofits or replacements and **therefore this condition is not applicable**.
In case of hydro power plants, one of the following conditions shall apply: a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3) of ACM0002 version 17, is greater than 4 W/m2; or	The project activity is a grid connected wind power project and not a hydro power plant. Therefore, **these criteria are not applicable for the project activity**.

c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m2; or d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m2, all of the following conditions shall apply: i. The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m2; i. Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; i. 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.	
In the case of integrated hydro power projects, project proponent shall: a) 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 b) 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 project activity is a grid connected wind power project and not a hydro power plant. **Therefore, these criteria are not relevant to the project activity**.
Methodology is not applicable to the following a. 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; b. Biomass fired power plants/units.	• The project activity is installation of a new grid connected wind power project and does not involve switching from fossil fuel to renewable energy and **hence this criterion is not relevant to the project activity**. • This is a wind power plant and not a biomass fired plant and **hence this criterion is not applicable to the project activity.**
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	The project activity is a new grid connected wind power plant and not a retrofits, replacement or capacity additions and **therefore this criterion is not applicable to the project activity**.

maintenance".	

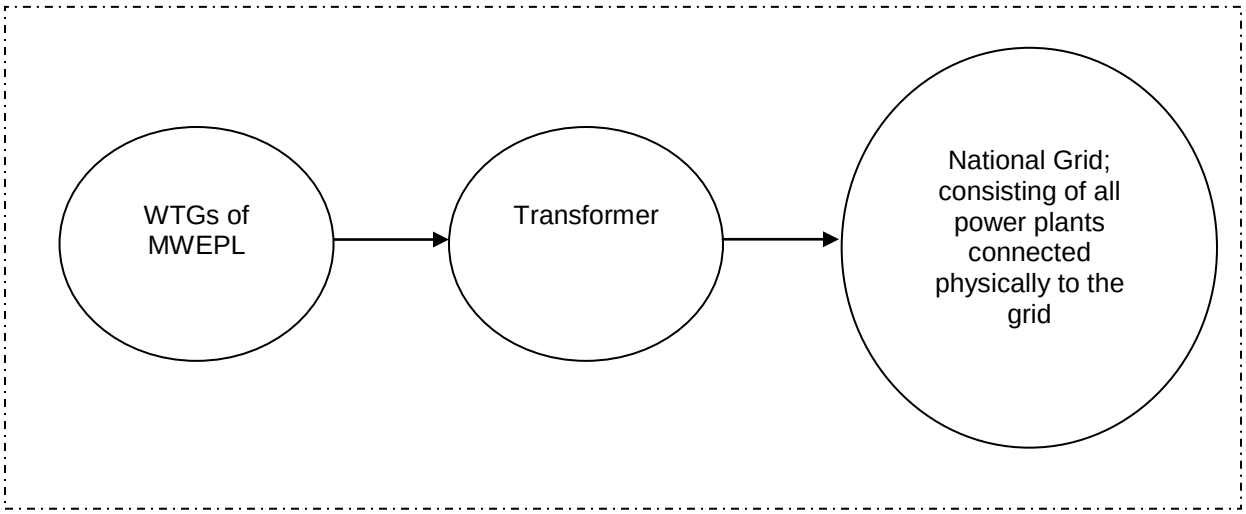
The justification provided in table above shows that the project activity satisfies the applicable conditions of the methodology, ACM0002, version 17.0.

As per the requirement of the applied methodology, ACM0002 for demonstrating and assessing the additionality the latest version 7.0 of the "Tool for the demonstration and assessment of additionality" is applied to the project activity.

The project activity supplies the generated electricity to the grid. Hence, the latest version of the Tool "Tool to calculate the emission factor for an electricity system", version 05.0 is applied in order to estimate the Operating Margin (OM), Build Margin (BM) and/or Combined Margin (CM) for the purpose of calculating baseline emissions for the project activity.

2.3 Project Boundary

The spatial extent of the project boundary includes the project wind power generation units and all power plants connected physically to grid that the project wind power generation units are connected to. Following this definition, the project boundary is drawn as follows:



Project Boundary

Source		Gas	Included	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal	CO_2	No	As per ACM 0002 project emissions are not considered for wind power project.
		CH_4	No	As per ACM 0002 project emissions are not considered

Source		Gas	Included	Justification/Explanation
	steam			for wind power project.
		N_2O	No	As per ACM 0002 project emissions are not considered for wind power project.
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	As per ACM 0002 project emissions are not considered for wind power project.
		CH_4	No	As per ACM 0002 project emissions are not considered for wind power project.
		N_2O	No	As per ACM 0002 project emissions are not considered for wind power project.
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	As per ACM 0002 project emissions are not considered for wind power project.
		CH_4	No	As per ACM 0002 project emissions are not considered for wind power project.
		N_2O	No	As per ACM 0002 project emissions are not considered for wind power project.

2.4 Baseline Scenario

As per the approved consolidated methodology ACM 0002, version 17.0, if the project activity is the installation of a Greenfield power plant, the baseline scenario is 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".

Calculation of combined margin CO_2 emission factor for the grid:

The "Tool to calculate the emission factor for an electricity system (version 05.0)" is applied in the context of the Project in the following six steps:

Step 1: Identify the relevant electric system.
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.

Step 1: Identify the relevant electricity systems:

According to the "Tool to calculate the emission factor for an electricity system", version 05.0, 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. However in the present case, the DNA of host country has not published a delineation of the project electricity system and connected electricity systems. Hence as per the tool, a project electricity system has to be defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity, and that can be dispatched without significant transmission constraints.

Therefore, in this Project activity, the project electricity system includes the Project site and all power plants attached to the interconnected National Transmission & Despatch Company (NTDC).
National Transmission & Despatch Company (NTDC) Limited organized to take over all the properties, rights and assets obligations and liabilities of 220 KV and 500KV Grid Stations and Transmission Lines/Network owned by Pakistan Water and Power Development Authority (WAPDA)[8].
Hence from here onward NTDC grid will be referred as WAPDA grid.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional).
Option I is selected, where only grid power plants are included in the calculation.

Step 3. Select a method to determine the operating margin (OM)
According to the "Tool to calculate the emission factor for an electricity system", version 05.0, in calculating the operating margin grid emission factor in a given year y ($EF_{grid,OM,y}$), project developers have the option of selecting from four potential methods:

(a) Simple OM,
(b) Simple adjusted OM,
(c) Dispatch Data Analysis OM, or
(d) Average OM.

Options (b) and (c) are not selected due to the limited availability of data for Pakistan. Option (d) is not selected since low-cost / must run resources[9] do not constitute more than 50% of total grid generation. Option (a) is therefore selected since low-cost / must run resources constitute less than 50% of total grid generation. The Share of low-cost/must run is calculated using following equation (i.e. approach I of the tool) which is the average of the five most recent years.

$$\text{Share}_{LCMR} = \text{average}\left[\frac{EG_{LCMR_{y-4}}}{total_{y-4}}, \ldots, \frac{EG_{LCMR_y}}{total_y}\right]$$

Table 2.4.1: Share of low cost/must run resources in recent years of the Pakistan Grid[10]

Power Plant	Electricity Generation Gross, GWh				
	2010-11	2011-12	2012-13	2013-14	2014-15
KESC					
TPS Korangi	270.51	163.16	326.60		
GTPS Korangi Town	675.68	595.34	-	392.86	435.07
GTPS Site	586.31	416.41	155.97	113.01	159.69

[8] http://www.ntdc.com.pk/
[9] Low-cost / must run resources include hydro and nuclear in Pakistan.
[10] Pakistan energy yearbook 2011, 2012, 2013, 2014 and 2015

TPS Bin Qasim	5,068.28	4,704.06	3,722.33	3,765.34	3,924.87
Korangi CCP	1,225.50	1,010.50	795.11	798.91	891.55
TPS Bin Qasim II	-	1,139.91	3,567.22	3,639.31	3,907.14
Private sector connected to KESC					
Gul Ahmed, Karachi	771.26	468.65	449.61	591.86	718.00
Tapal Energy, Karachi	804.15	490.51	694.53	810.55	819.87
KESC-Gross	**9,401.69**	**8,988.54**	**9,711.37**	**10,111.84**	**10,856.19**
Total gross generation	94,385.00	95,091.00	96,122.00	1,03,670.00	1,06,966.00
WAPDA-Gross	**84,983.31**	**86,102.46**	**86,410.63**	**93,558.16**	**96,109.81**
of which Hydel	31,811.00	28,517.00	29,857.00	31,873.00	32,474.00
of which Nuclear	3,420.00	5,265.00	4,553.00	5,090.00	5,804.00
Share of low-cost/must-run resources	**41.46%**	**39.23%**	**39.82%**	**39.51%**	**39.83%**

Thus, Share$_{LCMR}$=39.97%

Since the Simple OM calculation (option (a)) is selected, the emission factor is calculated by the generation-weighted average emissions per electricity unit (tCO_2/GWh), and averaged over the past three years of all generating sources serving the system, not including low-cost / must run power plants.

The tool provides two options for the calculation of $EF_{grid, OM, y}$;

- *Ex-ante* option - A 3-year generation-weighted average, based on the most recent data available at the time of submission of the VCS-PD to the Validation/Verification Body (VVB) for validation, without the 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, with the requirement that the emissions factor be updated annually during monitoring.

For this Project the *ex-ante* approach is selected. Data for calculating the three-year generation weighted average is obtained from the period 2012 – 2015, the most recent data available at the time of PD submission to the VVB.

Step 4. Calculate the operating margin emission factor according to the selected method
Simple OM
The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must run plants / units. It may be calculated:

- Option A: Based on 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.

In this case:-
(a) Requisite data for option A (fuel consumption and average efficiency data for each power plant / unit) are not available.
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation.
Hence option B is used for simple OM calculation.

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y}$$

Where:

$EF_{grid, OMsimple, y}$	Simple operating margin CO2 emission factor in year y (tCO_2/MWh)
$FC_{i, y}$	Amount of fossil fuel type *i* consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i, y}$	Net calorific value (energy content) of fossil fuel type *i* in year y (GJ / mass or volume unit)
$EF_{CO2, i,,y}$	CO_2 emission factor of fossil fuel type *i* in year y (tCO_2/GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must run power plants / units, in year y (MWh)

For the calculation of the Simple OM, the amount of fuel consumption ($FC_{i, y}$) by WAPDA and KESC grids are taken from the Pakistan Energy Yearbook 2013, 2014 and 2015, the official source of data. Fuel consumption values for the relevant years are listed in Table 2.4.2.

Table 2.4.2: Fuel consumption of generation sources connected to the grid (2012 - 2015)[11]

Fuel type	**$FC_{i,y\ unit}$ [TOE]**		
	2012-13	**2013-14**	**2014-15**
Coal	28,204	71,902	67,638
Furnace/Fuel Oil	7,342,755	8,486,744	8,234,479
Diesel	218,584	304,994	565,953
Gas	7,084,177	6,602,422	6,847,894

The net calorific value (NCV) for fuel oil in Pakistan, as provided by the Ministry of Petroleum and Natural Resources in Pakistan, is 44.95 GJ/Tonne[12].

In above table, all fuel quantities are converted to Tonnes of Oil Equivalent (ToE), and therefore the NCV of fuel oil is used in the calculations.

Energy generation from each fuel type has been calculated by using data provided in table 2.4.2 and net calorific value of fuel oil.

[11] Source: Pakistan energy yearbook 2013, 2014 & 2015
[12] Average of calorific value of indigenous and imported crude oil; Source: Pakistan energy yearbook 2015, Appendix: 7.4 (p145)

Fuel consumption in power plants connected to Karachi Electric Supply Company Ltd (KESC) grid are subtracted from gross to achieve fuel consumption of generation sources connected to the WAPDA grid.

Fuel consumption data from power plants connected to WAPDA has been provided in table 2.4.3.

Table 2.4.3: Fuel consumption of generation sources connected to the grid (2012-2015)

Fuel type	$FC_{i,y\ unit}$ [GJ]		
	2012-13	2013-14	2014-15
Coal	1,267,770	3,231,995	30,40,328
Furnace/Fuel Oil	330,056,837	381,479,143	37,01,39,831
Diesel	9,825,351	13,709,480	25,439,587
Gas	318,433,756	296,778,869	307,812,835

The Emission Factor of fossil fuel types ($EF_{CO2,\ i,\ y}$) is taken from IPCC guidelines for national greenhouse gas inventory, and is presented in Table 2.4.4.

Table 2.4.4: Emission factor for fuels used in Pakistan[13]

Fuel type	$EF_{CO2,i,y}$ [tCO_2/GJ]
Coal	0.0928
Fuel Oil	0.0755
Diesel	0.0726
Natural Gas	0.0543

GHG emission from each fuel type has been calculated in table 2.4.5 for WAPDA grid by using data from table 2.4.3 and table 2.4.4.

Table 2.4.5: GHG emissions from fuels used in WAPDA grid connected power plants in Pakistan

Fuel type	$FC_{i,y\ unit}$ [tCO_2]		
	2012-13	2013-14	2014-15
Coal	117,649	299,929	282,142
Furnace/Fuel Oil	22,744,835	26,720,514	25,640,332
Diesel	713,320	995,308	1,846,914
Gas	15,022,150	13,614,767	14,083,192
Total GHG emissions	**38,597,954**	**41,630,519**	**41,852,580**

The electricity generated and supplied to the WAPDA grid by all power sources serving the system, not including low-cost / must run power plants / units ($EG_{gross,y}$) is obtained from Pakistan Energy Yearbook 2013, 2014 and 2015.

[13] IPCC 2006, Volume 2, Chapter 1, Table 1.4, available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

Table 2.4.6 illustrates the net electricity production in WAPDA grid by all power sources serving the system, not including low-cost / must run power plants / units ($EG_{net,y}$) is calculated from fossil fuel power sources for 2012 - 2015.

Table 2.4.6: Net Electricity Generated By Fossil Fuel Power Source 2012-2015 $EG_{gross,y}$ (GWh)[14]

	2012-13	2013-14	2014-15
Total gross power generation	96,122.00	103,670.00	106,966.00
KESC-Gross power generation	9,711.52	10,111.80	10,856.30
WAPDA gross power generation	**86,410.48**	**93,558.20**	**96,109.70**
Aux consumption WAPDA Thermal	1,002.63	1,192.59	1,103.08
Aux consumption WAPDA IPPs	1,131.87	1,272.68	1,174.98
Aux consumption WAPDA Hydel	273.60	364.90	498.60
Aux consumption WAPDA Nuclear	243.69	236.78	468.20
WAPDA – Hydro	29,857	31,873	32,474
WAPDA – Nuclear	4,553	5,090	5,804
Renewable	0	0	802
Net Electricity Generated in WAPDA grid without low cost must run plants	**49,348.69**	**53,528.05**	**53,784.84**
Electricity imports (GWh)	375	419	443
Net Electricity Generated in WAPDA grid (including import)	**49,724**	**53,947**	**54,228**

The $EF_{grid, OM ,y}$, for year 2012-13, 2013-14 and 2014-15 has been calculated as per equation (9) of the tool and the results are summarized in Table 2.4.8.

Table 2.4.8: Grid operating margin calculated for WAPDA

Parameter	2012-13	2013-14	2014-15
Emission from fuel consumption in WAPDA grid, tCO2e	38,597,954	4,16,30,519	4,18,52,580
Net Electricity Generated in WAPDA grid (including import), GWh	49,724	53,947	54,228
EF_{gridOM} (tCO_2/MWh)	0.7762	0.7717	0.7718
Weighted Average EF_{gridOM} (tCO_2/MWh)	**0.7732**		

Step 5. Calculate the build margin (BM) emission factor
In terms of vintage 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 VCS-PD submission to the VVB 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 VVB. 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

[14] Pakistan Energy Yearbook 2013, 2014 and 2015

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.

For this project, Option 1 was selected. For the first crediting period, the build margin emission factor ex ante has been calculated based on the most recent information available on units already built for sample group m at the time of VCS -PD submission to the VVB for validation. According to the "Tool to calculate the emission factor for an electricity system", version 05.0, 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 (SET5-units) and determine their annual electricity generation (AEG_{SET}-5-units, in MWh);

Table 2.4.9: Power generation from most recently commissioned 5 units in WAPDA grid

Power Unit	Commissioning Date	Power generation in 2014-15 (GWh)[15]	Source for commissioning date
Uch -II Power	04 April 2014	2415	http://www.ppib.gov.pk/N_uch2.htm
DKHP	01 December 2013	386.83	http://www.wapda.gov.pk/index.php/duber-khwar-hydropower-menu
Jinnah	26 July 2013	190.69	http://www.wapda.gov.pk/index.php/projects/hydro-power/operational/jinnah
New Jabban	23 October 2013	121.37	http://www.nepra.org.pk/Licences/Generation/wapda%20hydel/LAG-23%20WAPDA%20MODIFICATION-III%20GEN%20LIC%2017-01-2014%20684-85.PDF, ng/en/home/pays/asie/geo-asie/agence-pakistan/projets-pakistan/mandat-energie/centrale-jabban
Gomal Zam	01 September 2013	43.86	http://www.dawn.com/news/1039111/gomal-zam-dam-starts-power-generation, http://www.ep-ep.com.pk/component1.html
Total	**-**	**3157.75**	

(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 ≥ 20%) and determine their annual electricity generation (AEG_{SET}-≥20% in MWh);

Table 2.4.10: Calculation for 20% of total net power generation in WAPDA[16]

	2014-15	Unit
Total gross power generation	1,06,966	GWh
Gross power generation at KESC grid	10,856	GWh
Gross power generation at WAPDA grid	96,110	GWh
Auxiliary power consumption at WAPDA	3,244.86	GWh

[15] Pakistan Energy Yearbook 2015
[16] Pakistan Energy Yearbook 2015

Total Net Generation (AEG_{total})	92,864.84	GWh
20% of AEG_{total}	**18,572.97**	**GWh**

Table 2.4.11: Set of most recent power plants generating ≥ 20% of total WAPDA generation in 2014-15[17]

Power Unit	Commissioning date	Gross Electricity Generation GWh	Fuel type	Auxiliary consumption GWh	Net electricity supply to grid GWh
Uch -II Power	4-Apr-2014	2,415.00	Gas	59.16	2,356
DKHP	Dec-2013	386.83	Hydro	1.78	385
New Jabban	23-Oct-2013	121.37	Hydro	1.11	120
Gomal Zam	Sep-2013	43.86	Hydro	0.93	43
New Bong Escape Hydro	23-Mar-2013	488.52	Hydro	1.61	487
AKHP	Mar-2013	461.78	Hydro	0.82	461
Jinnah	31-Mar-2012	190.69	Hydro	5.35	185
Halmore Power	16-Jun-2011	103.20	Gas	-	103
		620.30	HSD	23.46	597
Foundation Power	16-May-2011	1,322.20	Gas	50.87	1,271
		0.40	HSD	-	0
Hub Power, Narowal	22-Apr-2011	1,418.16	FO	25.72	1,392
CHASNUPP-II	27-Jan-2011	2,744.00	Nuclear	NA	NA
Liberty Power Tech	13-Jan-2011	1,515.00	FO	32.07	1,483
KKHP	8-Nov-2010	253.00	Hydro	4.41	249
Sapphire Electric Company	4-Oct-2010	281.50	Gas	-	282
		685.00	HSD	29.83	655
Nishat Chunian Ltd	21-Jul-2010	1,415.00	FO	27.40	1,388
Nishat Power Ltd	9-Jun-2010	1,448.70	FO	38.88	1,410
Orient Power Ltd	24-May-2010	311.50	Gas	-	312
		725.80	HSD	27.19	699
Saif Power Ltd	27-Apr-2010	95.00	Gas	-	95
		675.00	HSD	24.15	651
Engro Energy Ltd	27-Mar-2010	1,429.00	Gas	41.07	1,388
Atlas Power Ltd	18-Dec-2009	1,461.70	FO	36.24	1,425
Attock Gen	17-Mar-2009	1,209.00	FO	27.88	1,181
Ghazi Barotha	19-Aug-2003	6,694.48	Hydro	82.34	6,612
TNB Liberty Power	10-Sep-2001	1,217.82	Gas	23.72	1,194
Altern Energy Ltd	6-Jun-2001	173.00	Gas	9.04	164
Chashma	23-Dec-2000	986.71	Hydro	6.52	980

[17] Pakistan Energy yearbook 2015: Table 5. 2, Table 5.10 , Table 5.11.State of Industry report 2015. (NA represents Data not available)

Uch Power	18-Oct-2000	4,127.00	Gas	NA	NA
		4.20	HSD	NA	NA
Chasnupp-I	6-Jun-2000	2,656.00	Nuclear	NA	NA
Saba Power	31-Dec-1999	35.48	FO	2.55	33
		37,716		**Total**	**27,601**

(c) From SET5-units and SET≥ 20% select the set of power units that comprises the larger annual electricity generation (SET_{sample});

In this case, SET ≥ 20% comprises the larger annual generation compared to SET5-units .
Since none of the power units included in SET ≥ 20% is registered as CDM project activity, and since some of the power units started supplying electricity 10+ years ago, proceed to steps (d), (e) and (f) of para 73 of "Tool to calculate the emission factor for an electricity system", version 05.0.

As per step (d), exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Hence in this case power units commissioned before 2005 will be excluded as it started to supply electricity to the grid more than 10 years ago.

This step further recommends to include the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20 per cent of the annual electricity generation of the project electricity system (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Since there is no power units registered as CDM project activity. Hence the annual electricity generation of that set is not comprises at least 20% of the annual electricity generation of the project electricity system after removing power generation units commissioned before 2004. This step (d) recommends to go for step (e) and (f).

Step (e) recommends to include the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system. This requirement is satisfied after adding power generating units commissioned before 2005 and this becomes the sample group of power units used to calculate the build margin.

Table 2.4.12: Electricity Generated (2014-15) by Power Units included in Build Margin Calculation

Power Plant	Technology	Fuel Type	Auxiliary Consumption		Electricity Generation	
			Plant Total GWh	Fuel wise break up GWh	Gross GWh	Net GWh
Uch -II Power	Combined cycle	Gas	59.16	59.16	2,415.00	2,355.84
DKHP	Hydel	Hydel	1.78	1.78	386.83	385.05
Jinnah	Hydel	Hydel	5.35	5.35	190.69	185.34
New Jabban	Hydel	Hydel	1.11	1.11	121.37	120.26
Gomal Zam	Hydel	Hydel	0.93	0.93	43.86	42.93
New Bong Escape Hydro	Hydel	Hydel	1.61	1.61	488.52	486.91
AKHP	Hydel	Hydel	0.82	0.82	461.78	460.96
Halmore Power	Combined cycle	Gas	23.46	3.35	103.20	99.85
		HSD		20.11	620.30	600.19

Foundation Power	Combined cycle	Gas	50.87	50.85	1,322.20	1,271.35
		HSD		0.02	0.40	0.38
Hub Power, Narowal	Diesel Engine/Open cycle	RFO	25.72	25.72	1,418.16	1,392.44
Liberty Power Tech	4 stroke diesel engines/Combined Cycle	RFO	32.07	32.07	1,515.00	1,482.93
KKHP	Hydel	Hydel	4.41	4.41	253.00	248.59
Sapphire Electric Company	Combined cycle	Gas	29.83	8.69	281.50	272.81
		HSD		21.14	685.00	663.86
Nishat Chunian Ltd.	Reciprocant Engines/combined cycle	RFO	27.40	27.40	1,415.00	1,387.60
Nishat Power	Reciprocant Engines/combined cycle	RFO	38.88	38.88	1,448.70	1409.82
Orient Power Ltd.	Combined cycle	Gas	27.19	8.17	311.50	303.33
		HSD		19.02	725.80	706.78
Saif Power Ltd	Combined cycle	Gas	24.15	2.98	95.00	92.02
		HSD		21.17	675.00	653.83
Engro Energy Ltd.	Combined cycle	Gas	41.07	41.07	1,429.00	1,387.93
Atlas Power Ltd	Combined cycle	RFO	36.24	36.24	1,461.70	1,425.46
Attock Gen	Diesel Engine/Open cycle	RFO	27.88	27.88	1,209.00	1,181.12

The build margin emission factor is the generation-weighted average emission factor (in tCO_2/MWh) of all power units (m) during the most recent year y for which power generation data is available, and is calculated as follows:

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

where:

$EF_{grid,BM,y}$ Build margin CO_2 emissions 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)

As per the "Tool to calculate the emission factor for an electricity system", version 05.0, the CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per guidance from the tool in Step 4 for simple OM, using options A1, A2, or A3, and using for y the most recent historical year for which power generation data is available, where m is power units included in the build margin. As plant specific fuel consumption data is not available for Pakistan, option A2 has been selected for the calculation of the CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) as follows:

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}}$$

where:

$EF_{EL,m,y}$ CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$EF_{CO2,m,i,y}$ Average CO_2 emission factor of fuel type i used in power unit m in year y (tCO_2/GJ)
$\eta_{m,y}$ Average net energy conversion efficiency of power unit m in year y (%)

Where several fuel types are used in the power unit, the lowest CO_2 emission factor for $EF_{CO2,m,I,y}$ has been used.

The average CO_2 emission factor of fuel types ($EF_{CO2,m}$) and the average net energy conversion efficiency of the power plants ($\eta_{m,y}$) used for the calculation of emission factor of the power units ($EF_{EL,m,y}$) in equation (3) are presented in Table 2.4.13.

Table 2.4.13: Emission Factor of the Power Units

Power Plant	Technology	Fuel Type	Fuel $EF_{CO2,i,y}$ (tCO2/GJ)	Efficiency factor (%)	Power unit Emission Factor $EF_{EL,m,y}$ (tCO2/MWh)
Uch -II Power	Combined cycle	Gas	0.0543	60.00%	0.3258
DKHP	Hydel	Hydel	NA	NA	NA
Jinnah	Hydel	Hydel	NA	NA	NA
New Jabban	Hydel	Hydel	NA	NA	NA
Gomal Zam	Hydel	Hydel	NA	NA	NA
New Bong Escape Hydro	Hydel	Hydel	NA	NA	NA
AKHP	Hydel	Hydel	NA	NA	NA
Halmore Power	Combined cycle	Gas	0.0543	60.00%	0.3258
		HSD	0.0726	46.00%	0.5682
Foundation Power	Combined cycle	Gas	0.0543	60.00%	0.3258
		HSD	0.0726	46.00%	0.5682
Hub Power, Narowal	Diesel Engine/Open cycle	RFO	0.0755	39.50%	0.6881
Liberty Power Tech	4 stroke diesel engines/Combined Cycle	RFO	0.0755	46.00%	0.5909
KKHP	Hydel	Hydel	NA	NA	NA
Sapphire Electric Company	Combined cycle	Gas	0.0543	60.00%	0.3258
		HSD	0.0726	46.00%	0.5682
Nishat Chunian Ltd.	Reciprocant Engines/combined cycle	RFO	0.0755	46.00%	0.5909
Nishat Power	Reciprocant Engines/combined cycle	RFO	0.0755	46.00%	0.5909
Orient Power Ltd.	Combined cycle	Gas	0.0543	60.00%	0.3258

		HSD	0.0726	46.00%	0.5682
Saif Power Ltd	Combined cycle	Gas	0.0543	60.00%	0.3258
		HSD	0.0726	46.00%	0.5682
Engro Energy Ltd.	Combined cycle	Gas	0.0543	60.00%	0.3258
Atlas Power Ltd	Combined cycle	RFO	0.0755	46.00%	0.5909
Attock Gen	Diesel Engine/Open cycle	RFO	0.0755	39.50%	0.6881

The data for the electricity generated and delivered to the grid by power units ($EG_{m,y}$) are presented in Table 2.4.13 (above).

The $EF_{grid,BM,}$ which is calculated via equations (15) and (5) of tool by using data from Table 2.4.13, is 0.4575 tCO_{2e}/MWh.

Step 6. Calculate the combined margin emission factor
The combined margin emission factor is calculated as follows:

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

where:

$EF_{grid,CM,y}$	Combined Margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,\ BM,y}$	Build margin emission factor in year *y* (tCO_2/MWh)
w_{OM}	Weight of the operating margin emission factor
w_{BM}	Weight of the build margin emission factor

As the proposed project is a wind farm, the weights for the operating margin and build margin emission factors are 0.75 and 0.25 respectively, by default. Therefore, as per equation (16) of the tool, the combined margin emission factor is:

$EF_{grid,\ CM,y}$ = 0.6943 tCO_{2e}/MWh.

2.5 Additionality

Project developer need to demonstrate the additionality in line with "Tool for the demonstration and assessment of additionality" version 7.0.0. The tool provides a step-wise approach to demonstrate and assess the additionality of a VCS project. These steps are:

(a) Step 0 Demonstration whether the proposed project activity is the first-of-its-kind;
(b) Step 1 Identification of alternatives to the project activity;
(c) Step 2 Investment analysis;
(d) Step 3 Barriers analysis; and
(e) Step 4 Common practice analysis.

The additionality for the project activity has been assessed in stepwise manner:-

(a) Step 0
The first of its kind has been demonstrated in with "Methodological tool-Additionality of first-of-its kind project activities" version 03.0.

Applicable geographical area: The applicable geographical area for the demonstration of first of its kind activity has been taken as Pakistan.

Measure: The applicable measure is switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies.

Output: Power produced from the project activity has been considered as output.

Different technologies: Any technology that delivers same output (power) but differs by at least one of the following is considered as different technology:

(a) Energy source: wind, hydro, biomass, thermal, nuclear, geothermal, solar etc
(b) Feed stock: Not applicable in the present case
(c) Size of installation: Micro (0 to 5 MW), Small (5 MW to 15 MW) and Large (above 15 MW)

Hence any technology delivering power from energy source other than wind and/or with installed capacity of less than 15 MW is considered as different technology compared to the technology used in the project activity.

The first of its kind criteria should be demonstrated before the start date[18] of the proposed project activity.

All wind power projects that have started commercial operation in Pakistan before 14/10/2016 are considered for further analysis as per Methodological tool-Additionality of first-of-its kind project activities" version 03.0. The projects commissioned in Pakistan are listed below:

Project developer	Capacity (MW)	Commercial operation date	Source
M/s FFC Energy Ltd.	49.5 MW	16-May-13	VCS registered project "49.5 MW wind power project by FFCEL in Pakistan"
M/s Zorlu Enerji Pakistan Ltd. – Phase 1	6MW	26-Jul-13	It is a CDM registered project. UNFCCC-9849
M/s Zorlu Enerji Pakistan Ltd. – Phase 2	50.4 MW	26-Jul-13	It is a CDM registered project. UNFCCC-9849
Foundation Wind Energy-I Limited 50 MW Wind Farm Project	50 MW	Not known	It is a CDM registered project. UNFCCC-9268
Sapphire 49.5 MW Wind Farm Project	49.5 MW	Not known	It is a CDM registered project. UNFCCC-8163
Yunus Energy Limited 50 MW Wind Farm Project	50 MW	Not known	It is a CDM registered project. UNFCCC-9039

The above table demonstrates that there are already commissioned wind power project in the project

[18] As per VCS standard, version 3.6, the project start date is the date of on which the project began generating GHG emission reductions (i.e. commercial operation date of the project activity). Therefore the project start date is commercial operation date and first of its kind criteria has been demonstrated accordingly.

capacity range in Pakistan before the project start date. Hence the analysis presented above demonstrates that the proposed project activity is not the first of its kind in Pakistan that applies a technology that is different from any other technologies able to deliver the same output i.e. "power" and that have started commercial operation in Pakistan (selected geographical region) before the start date of the project[19].

Outcome of Step 0: The **proposed project is not the first-of-its-kind.**

Step1. Identification of alternatives to the project activity consistent with current laws and regulations
In sub-step 1a and 1b, it is required to identify realistic and credible alternative(s) that were available to the project proponent or similar project developers that provide output or services comparable with the project activity. These alternatives are required to be in compliance with all applicable legal and regulatory requirements.

The following potential alternative(s) were identified to the project activity:

Sub-step 1a: Define alternatives to the project activity
The following paragraphs illustrate the alternatives:

Alternative 1- Implementation of the project activity not undertaken as a CDM/VCS project activity;
In this alternative, project activity is connected to the national grid. Since the project activity has no project emissions, this alternative would not generate carbon dioxide. This alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline.

MWEL may implement the project activity in Pakistan to generate renewable power. This alternative may be a part of the baseline. However this alternative is a financially less attractive alternative, which is demonstrated in the later sections. The investment analysis has been conducted as per Step 2: Investment analysis of the "Tool for the demonstration and assessment of additionality".

Alternative 2- No project activity; Continuation of current situation

In this alternative, project activity is not implemented resulting in the continued current grid mix of national grid.

In Alternative 2 i.e. in absence of the project activity, an equivalent amount of electricity would be generated by the power plants comprising the national grid, which are predominantly thermal. An equivalent amount of carbon dioxide would be generated at the thermal power generation end.

Outcome of step 1a: Continuation of present scenario of grid-supplied power would be a conservative approach to baseline establishment.

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

- Electricity generation from wind farm is not a legal requirement or a mandatory choice. There are states and sectoral policies which are primarily framed to encourage wind based power project to attract more private investment as there are many anticipated risks under the project and requires good amount of equity to be involved.

Outcome of Step 1b: The alternative scenario, as per Step 1a, to project activity is in compliance with mandatory legislation and regulations taking into account the enforcement in the region and EB decisions on policies of region or sector.

[19] As per Methodological tool-Additionality of first-of-its kind project activities" version 03.0, the first of its kind is applicable if The project participants has selected a crediting period for the project activity that is "a maximum of 10 years with no option of renewal".

Step2: Investment Analysis
Determine whether the proposed project activity is not (a) the most economically or financially attractive; or (b) economically or financially feasible, without the revenue from the sale of Verified emission reductions (VERs). To conduct the investment analysis, the following sub-steps were used:

Sub-step 2a: Determine appropriate analysis method
Since the project activity shall generate financial income from sale of power to the grid, we shall rule out Option I (simple cost analysis) and apply either Option II (Investment comparison analysis) or Option III (Benchmark 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.

As there is no alternative baseline for the project activity and the project proponent is left the option to invest or not to invest. Hence, Option III (Benchmark analysis) is selected as the appropriate method for demonstration of Investment analysis.

Sub-step 2b: Option III - Apply Benchmark analysis

Selection of financial indicator:
For the purpose of carrying out an investment analysis, the prime financial indicator that has been used is the Internal Rate of Return of the project cash flows i.e. the Equity IRR. The equity IRR is one of the most commonly used tools to assess the feasibility and viability of the projects. Though the project is financed by equity only to the extent of 25%, project proponent bares the real risk from the project's uncertainties. Hence, post tax equity IRR is considered as appropriate financial indicator for the present project activity.

Selection of benchmark:

In accordance with "***Methodological tool-Investment analysis***" version-06, paragraph 16, in cases where a benchmark approach is used for financial evaluation of the project, the applied benchmark shall be appropriate to the type of IRR calculated. Weighted average costs of capital (WACC) are appropriate benchmark for a project IRR. Required/expected returns on equity (Cost of Equity) are appropriate benchmarks for equity IRR. Therefore, Cost of equity (nominal) has been considered as the benchmark as equity IRR (nominal) is chosen as the financial indicator for the project.

As per the "***Methodological tool-Investment analysis***" version-06**, para 16,** *Required/expected returns on equity are appropriate benchmarks for equity IRR*. It is also mentioned in Para 18 of the tool "*in the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on parameters that are standard in the market, which can be validated by DOE*".

Further as per **para 17**, of the "***Methodological tool-Investment analysis***" version-06, "*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. 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".*

Project participant has considered the benchmark based on equity indices. Return of equity has been estimated based on the values provided in table -1 under Appendix: Default values for the expected return on equity of "***Methodological tool-Investment analysis***" version-06. As per the values, Cost of Equity (expected return on equity) can be estimated as below –

Return on equity$_{Nominal}$ = (1+ Return on equity$_{Real}$)*(1+Inflation rate$_{Host\ country}$) – 1

Estimation of benchmark

As discussed above, Return on equity has been taken as the benchmark. As per para 18 of the "***Methodological tool-Investment analysis***" version-06*, in cases of projects which could be developed by an entity other than the project participant the benchmark should be based on parameters that are standard in the market.*

As per para 20 of "***Methodological tool-Investment analysis***" version-06, "*If the benchmark is based on parameters that are standard in the market, the cost of equity should be determined either by: (a) selecting the values provided in Appendix A; or by (b) calculating the cost of equity using CAPM.*

As per Appendix of "***Methodological tool-Investment analysis***" version-06, the default return on equity provided for Pakistan for Group I industry is 19.05% in real terms.

Return on equity (in nominal terms):
Appendix of "***Methodological tool-Investment analysis***" version-06 provides the values in percentages in real terms. The real terms is converted to nominal terms by adding up an inflation rate. Since inflation forecast and target inflation rate of the central bank is not available for Pakistan, the average forecasted inflation rate for the host country published by the IMF (International Monetary Fund - World Economic Outlook) for the next five years after the start of the project activity is used.

The average increase in inflation of host country (Pakistan)[20] is 6.54%.

In order to convert it into nominal terms, the 5 year average inflation rate has been added to the return on equity (in real terms) as per the formulae below:

Return on equity$_{Nominal}$ =(1+ Return on equity$_{Real}$)*(1+Inflation rate$_{Host\ country}$) - 1

Therefore, Return on equity$_{Nominal}$ = (1+19.05%)*(1 + 6.54%)-1
= **26.84 %**

Hence **26.84 %** is considered as benchmark for equity IRR.

Calculation of Financial Indicator:

Financial Analysis:
The project proponents have used **Equity Internal Rate of Return (IRR)** as the financial indicator to identify the investment barriers for the project activity. The IRR is then compared to the chosen benchmark. The spreadsheet of the calculations shall be provided to the VVB during validation.

The parameters and assumptions used for calculations are presented below. The IRR has been calculated for a period of 20 years, the expected operational lifetime of the project activity as per para 6 of "***Methodological tool-Investment analysis***" version-06.

As actual parameters are available during validation, two financial analysis have been carried out - 1) applying the input values that were valid at the time when the investment decision was made based on feasibility report 2) Based on actual values.

1) Applying the input values valid at the time of investment decision

[20] http://www.imf.org/external/pubs/ft/weo/2014/02/weodata/weorept.aspx?sy=2015&ey=2019&scsm=1&ssd=1&sort=country&ds=.&br=1&pr1.x=43&pr1.y=17&c=564&s=PCPIPCH&grp=0&a=

Financial parameters:

Parameters	Value	Units	Source
Total Project Cost	133.33	Million USD	Project brief report
Equity	25%	%	Feasibility report page 159
loan (debt)	75%	%	Feasibility report page 159
Interest rate for Loan	8.50%	%	Feasibility report page 160
No of installments	20	Half yearly	Feasibility report page 160
Repayment period	10	years	Feasibility report page 160
Salvage Value	0%	%	Feasibility report page 171
Tariff rate	0.1291	USD/kWh	Feasibility report page 178
Fixed O & M Cost	0.63	Million USD	Feasibility report page 171
Variable O&M cost	0.63	Million USD	Feasibility report page 171
Escalation on O&M cost	6.67%	%	Feasibility report page 169
Total insurance cost	1.33	Million USD	Feasibility report page 171
Depreciation rate	5.00%	%	Feasibility report page 170 & 171. On straight line basis over the 20 years.
Tax rate	0.00%	%	Feasibility report page 170

Technical parameters:

Parameters	Value	Units	Source
Capacity of WTG	1600	kW	As per NEPRA generation license
Number of WTG	33	#	As per NEPRA generation license
Total capacity	52.8	MW	As per NEPRA generation license
Net Saleable energy	138.86	Million kWh/ annum	Feasibility report (Page 83 and 171)

Project cost:

Parameters	Value	Units	Source
EPC cost	105.880	million USD	Project brief report
Project development cost	4.000	million USD	Project brief report
Duties and taxes	0.493	million USD	Project brief report
Insurance	0.800	million USD	Project brief report
Finance cost	4.102	million USD	Project brief report
Debt service reserve account	6.812	million USD	Project brief report
Dollar liquidity reserve	3.684	million USD	Project brief report
Interest during construction	7.562	million USD	Project brief report
Total	**133.333**	million USD	Project brief report

Based on the above parameters and assumptions, the equity IRR for the project activity comes out to be 9.35%.

2) Based on actual values

Financial Parameters:

Parameters	Value	Units	Source
Equity	25.0%	%	DPR; pp 5
Debt	75.0%	%	DPR; pp 5
Loan Amount	100.0	million USD	DPR page 5; 50:50 divided into foreign and domestic loan
Foreign loan interest rate	4.301%	%	3-month LIBOR+3.7% (section 12)+maintenance fee 0.3% (section 19) as per Loan agreement with OPIC; LIBOR rate LIBOR as per upfront tariff determination.
Domestic loan interest rate	12.290%	%	3-month KIBOR+3% as per Loan agreement with a consortium of banks; KIBOR rate as per upfront tariff determination, Annex II, page 21.
Effective loan interest rate	8.30%	%	Average of foreign and domestic loan interest rates
Repayment period	10	Years	DPR; pp 5
Salvage value	10%		Assumed at 4.5% depreciation rate
Depreciation rate	4.5%	%	SLM
Tariff (Year 1-10)	0.1711	USD/kWh	As per tariff determination, Original tariff in PKR, therefore USD exchange rate of 104.75 applied (as in indexed tariff)
Tariff (Year 11-20)	0.0689	USD/kWh	As per tariff determination, Original tariff in PKR, therefore USD exchange rate of 104.75 applied (as in indexed tariff)
Fixed O&M Cost	2.465	million USD	O&M Agreement; pp 43
Company Cost	1.333	million USD	company cost of PKR 140 million p.a., as per company budget and financing plan
Total insurance cost	0.458	million USD	Quotation from Lockton

Technical Parameters:

Parameters	Value	Units	Source
Capacity of WTG	1600	kW	As per NEPRA generation license
Number of WTG	33	#	As per NEPRA generation license
Total capacity	52.8	MW	As per NEPRA generation license
Net Saleable electricity to the grid	151.600	million kWh/ annum	Generation License, Schedule II

Project cost:

Parameters	Value	Units	Source
EPC cost	105.88	million USD	DPR; pp 5
Project development cost	4	million USD	DPR; pp 5
Duties and taxes	0.493	million USD	DPR; pp 5
Insurance	0.8	million USD	DPR; pp 5
Finance cost	4.102	million USD	DPR; pp 5
Debt service reserve account	6.812	million USD	DPR; pp 5
Dollar liquidity reserve	3.684	million USD	DPR; pp 5
Interest during construction	7.562	million USD	DPR; pp 5
Total Project Cost	133.333	million USD	DPR; pp 1

Based on the above parameters and assumptions, the equity IRR for the project activity comes out to be 14.83%.

Sub-Step 2d: Sensitivity analysis

The purpose of sensitivity analysis is to conclude that financial un-attractiveness is robust to reasonable variations in the critical assumptions. For this project activity following parameter is selected as sensitive parameters to check financial attractiveness.

A sensitivity analysis for equity IRR has been carried out for various parameters. As per para 28 of ***Methodological tool-Investment analysis***" version-06, a sensitivity analysis is carried out "*only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation*". The relevance of the selected parameters is explained individually below. Each of the parameters have been subjected to a sensitivity of +10% and -10%, in line with para 29 of ***Methodological tool-Investment analysis***" version-06, which states that "*the sensitivity analysis should at least cover a range of +10% and -10%*". Thus the identified parameters for sensitivity analysis are:

- Project Cost
- PLF
- Tariff rate
- O&M cost

Similar to IRR analysis, the sensitivity analysis is also carried out applying 1) the input values that were valid at the time when the investment decision was made, and 2) actual input values.

1) Results of sensitivity analysis based on input values valid at the time of investment decision

Parameter	Variation		
Tariff	0%	10%	-10%
	9.35%	13.09%	5.76%
PLF	0%	10%	-10%
	9.35%	13.09%	5.76%
O&M cost	0%	10%	-10%
	9.35%	8.94%	9.77%
Project cost	0%	10%	-10%
	9.35%	6.48%	13.06%

2) Results of sensitivity analysis based on actual values

Parameter	Variation		
Tariff	0%	10%	-10%
	14.83%	20.42%	9.52%
PLF	0%	10%	-10%
	14.83%	17.66%	12.06%
O&M cost	0%	10%	-10%
	14.83%	14.20%	15.46%
Project cost	0%	10%	-10%
	14.83%	10.80%	20.13%

Conclusion:

Thus, the financial analysis shows that the project activity is not the most financially attractive, and the sensitivity analysis shows that it is unlikely to be financially attractive compared to the benchmark under reasonable variations of the relevant parameters.

Step 4 Common Practice analysis:
The common practice analysis has been carried out applying Tool24: Methodological tool: Common practice, version 03.1. The present project activity falls under measure (b) defined under para 10 of the tool and hence the following steps have been applied to prove that the proposed project activity is not a common practice within the applicable geographical area. The applicable geographical area has been defined as the host country, Pakistan, as default as defined in para 9 of the tool.

Step 1: Calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.
The design capacity of the proposed project activity is 52.80 MW. Hence, the applicable output range for analysis has been calculated as 26.40 MW to 79.20 MW.

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

a) The projects are located in the applicable geographical area;
b) The projects apply the same measure as the proposed project activity;
c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

(a) The projects are located in the applicable geographical area;	As required in para 9 of the tool, Host country Pakistan has been considered as the applicable geographical area.
(b) The projects apply the same measure as the proposed project activity;	In line with para 10 (b) of the tool, this is a power generation project using renewable energy.
(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;	According to para 12(a) of the tool, as the project activity is a wind power project, therefore only wind power projects have been considered in the analysis.
(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant	All wind power projects considered are power only projects.
(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;	Only wind power projects falling within the capacity range of 26.40MW- 79.20MW have been considered as set in Step 1.
(f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is	The project started commercial operation on 14th October 2016 (which is the project start date) and the date of VCS-PD publication is 16th August 2016. Thus, the date of VCS-PD publication i.e. 16th

earlier for the proposed project activity.	August 2016 is considered.

The projects are:

Project developer	Capacity (MW)	Commercial operation date	Source
M/s FFC Energy Ltd.	49.5 MW	16-May-13	VCS registered project "49.5 MW wind power project by FFCEL in Pakistan"
M/s Zorlu Enerji Pakistan Ltd. – Phase 1	6MW	26-Jul-13	It is a CDM registered project. UNFCCC-9849
M/s Zorlu Enerji Pakistan Ltd. – Phase 2	50.4 MW	26-Jul-13	It is a CDM registered project. UNFCCC-9849
Foundation Wind Energy-I Limited 50 MW Wind Farm Project	50 MW	Not known	It is a CDM registered project. UNFCCC-9268
Sapphire 49.5 MW Wind Farm Project	49.5 MW	Not known	It is a CDM registered project. UNFCCC-8163
Yunus Energy Limited 50 MW Wind Farm Project	50 MW	Not known	It is a CDM registered project. UNFCCC-9039

***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 Nall.**

Explanation: All projects identified under step-2 are either registered with CDM or VCS, therefore, 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 Ndiff.**

Explanation: As per para 12 of the tool, technology is different based on the following criteria:

Energy source/fuel (example: energy generation by different energy sources such as wind and hydro and different types of fuels such as biomass and natural gas);	Since the project is a wind power project, all wind power projects have been considered for analysis.
Feed stock (example: production of fuel ethanol from different feed stocks such as sugar cane and starch, production of cement with varying percentage of alternative fuels or less carbon-intensive fuels);	This is not applicable
Size of installation (power capacity)/energy savings: *(i) Micro (as defined in paragraph 24 of decision 2/CMP.5 and paragraph 39 of decision 3/CMP.6);* *(ii) Small (as defined in paragraph 28 of decision 1/CMP.2);* *(iii) Large.*	Since the project falls under the definition of large scale, all wind projects of capacity between 15 MW to 79.20 MW has been considered for analysis.
Investment climate on the date of the investment	The investment climate for entire Pakistan is

decision, inter alia: *(i) Access to technology;* *(ii) Subsidies or other financial flows;* *(iii) Promotional policies;* *(iv) Legal regulations;*	considered to be same.

Since $N_{all} = 0$
Therefore, $N_{diff} = 0$

***Step 5:* Calculate factor F=1-Ndiff/Nall 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**
For the proposed project activity

F = 1-(0/0)
= 1

As per para 10 of the guideline, *"The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3."*
As calculated from Step 5, Factor F =1 which is greater than 0.2 and hence the project activity is a common practice.

In addition to this, Nall – Ndiff = 0, which is lesser than 3 and hence the 2nd condition is not met. **Hence the project activity is not a "common practice" within a sector in the applicable geographical area.**

Hence as per the tool of additionality version 7, the project is **additional**.

2.6 Methodology Deviations

There is no methodology deviation.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

The baseline emission calculation for the project activity is attributable to the CO_2 Emission that could have been produced by the fossil fuel based power plants in absence of the proposed project activity. Therefore the amount electricity supplied to the national grid will be multiplied by the grid emission factor to calculate the baseline emissions reduced by the proposed project activity.

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

BE_y	Baseline emissions in year *y* (tCO_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 VCS project activity in year y (MWh/yr); equal to $EG_{facility,y}$ - Quantity of net electricity generation supplied by the project to the grid in year *y* (MWh)
$EF_{grid,CM,y}$	Combined margin CO_2 emissions factor in year *y* (tCO_2/MWh)

3.2 Project Emissions

As per para 36 of ACM0002 version 17, for all renewable energy power generation project activities, project emission cab be neglected. Hence,

PE_y = 0 tCO_{2e}

3.3 Leakage

No leakage is identified as the project is a wind project:

LE_y = 0 tCO_{2e}

3.4 Net GHG Emission Reductions and Removals

The project activity will generate GHG emission reductions by avoiding CO_2 emissions from electricity generation by fossil fuel power plants of the grid. The annual emission reductions (ER_y) are calculated as:

$ER_y = BE_y - PE_y - LE_y$

Where:
ER_y Emission reductions in year *y* (t CO2e/yr)
BE_y Baseline emissions in year *y* (t CO2e/yr)
PE_y Project emissions in year *y* (t CO2e/yr)
LE_y Leakage emissions in year *y* (t CO2e/yr)

$EG_{PJ,y}$ = 151,600 MWh/year

$EF_{grid,CMy}$ = 0.6943 tCO_{2e}/MWh

BE_y = 151,600X 0.6943 = 105,255 tCO_{2e}/year (rounddown)
LE_y = 0 tCO_{2e}

PE_y = 0 tCO_{2e}

ER_y= 105,255 – 0 – 0 = 105,255 tCO_{2e}/year

Estimated amount of emission reductions over the chosen 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)
14/10/2016 to 13/10/2017	105,255	0	0	105,255
14/10/2017 to 13/10/2018	105,255	0	0	105,255
14/10/2018 to 13/10/2019	105,255	0	0	105,255
14/10/2019 to 13/10/2020	105,255	0	0	105,255
14/10/2020 to 13/10/2021	105,255	0	0	105,255
14/10/2021 to 13/10/2022	105,255	0	0	105,255
14/10/2022 to 13/10/2023	105,255	0	0	105,255
14/10/2023 to 13/10/2024	105,255	0	0	105,255
14/10/2024 to 13/10/2025	105,255	0	0	105,255

14/10/2025 to 13/10/2026	105,255	0	0	105,255
Total	1,052,550	0	0	1,052,550

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,OMy}$
Data unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor for grid in the year y
Source of data	*Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources*
Value applied:	0.7732
Justification of choice of data or description of measurement methods and procedures applied	Calculated ex ante as per "Tool to calculate the emission factor for an electricity system, ver. 05.0" as 3-year generation-weighted average of latest three years, 2012-13, 2013-14 and 2014-15, data obtained from Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources, Hydrocarbon Development Institute of Pakistan.
Purpose of Data	Calculation of baseline emissions
Comments	Computed once during VCS-PD finalization (ex-ante) and will remain same throughout the crediting period.

Data / Parameter	$EF_{grid,BMy}$
Data unit	tCO_2/MWh
Description	Build margin CO_2 emission factor for grid in the year y
Source of data	*Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources*
Value applied:	0.4575
Justification of choice of data or description of measurement methods and procedures applied	Calculated ex ante as per "Tool to calculate the emission factor for an electricity system, ver. 05.0" based on the most recent year 2014-15 data available from Pakistan Energy Yearbook published by Ministry of Petroleum & Natural Resources, Hydrocarbon Development Institute of Pakistan.
Purpose of Data	Calculation of baseline emissions
Comments	Computed once during VCS-PD finalization (ex-ante) and will remain same throughout the crediting period.

Data / Parameter	**$EF_{grid,CMy}$**
Data unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid in the year y
Source of data	Calculated weighted average combined margin using equation – $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ The default values for w_{OM} and w_{BM} are taken as applicable to wind power generation project activities as $w_{OM} = 0.75$ and $w_{BM} = 0.25$.
Value applied:	0.6943
Justification of choice of data or description of measurement methods and procedures applied	Calculated ex ante as per "Tool to calculate the emission factor for an electricity system, ver. 05.0" as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$
Purpose of Data	Calculation of baseline emissions
Comments	Computed once during VCS-PD finalization (ex-ante) and will remain same throughout the crediting period.

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{export,y}$
Data unit	MWh
Description	Electricity exported to the grid by the project activity in year y
Source of data	Joint monthly meter reading report
Description of measurement methods and procedures to be applied	Energy meters installed at Jhampir 132 kV line measures the export and import of electricity on continuous basis. Meter readings are taken and verified, once in a month, jointly by the representatives of NTDC and the representative of MWEL. Meter readings taken from both feeders will be added to arrive at electricity exported to the grid by the project activity in year y.
Frequency of monitoring/recording	Measured continuously, read monthly, Value Applied is the measured quantity in one year
Value applied:	151,600
Monitoring equipment	Energy Meter
QA/QC procedures to be applied	The data is cross-checked with the invoices raised in case sale of the electricity and electricity bills in case of captive use. As per NEPRA grid code, meters shall be calibrated atleast once in two years to verify meter accuracy. The metering points to record net electricity exported to grid are at the Jhampir -132 kV line. The metering system has an accuracy class of 0.2 or better and is

	located within the substation. Under the provisions of EPA, as part of metering system of wind farm, two independent energy meters have been installed at Jhampir in the substation (i) Metering System and (ii) Back-up Metering System. These meters are of identical type and accuracy class. The Metering System and the Back-Up Metering System is jointly sealed by NTDC and MWEL. Metering system is used for billing purposes. In case the Metering System has a failure, the Back-Up Metering System is used for the same purpose. In case the Metering System has a failure, the data from the Back-Up Metering System shall be used for emission reduction calculation.
Purpose of data	Calculation of baseline emissions
Calculation method	$EG_{export,y} = EG_{export,y,\ Jhampir}$ $EG_{export,y,\ Jhampir}$= Electricity exported to the grid measured at Jhampir 132 kV line
Comments	The data will be archived in electronic and physical form for the crediting period + 2 years

Data / Parameter	$EG_{import,y}$
Data unit	MWh
Description	Electricity imported from the grid by the project activity in year y
Source of data	Joint monthly meter reading report
Description of measurement methods and procedures to be applied	Energy meters installed at Jhampir 132 kV line measures the export and import of electricity on continuous basis. Meter readings are taken and verified, once in a month, jointly by the representatives of NTDC and the representative of MWEL. Meter readings taken from both feeders will be added to arrive at electricity imported from the grid by the project activity in year y.
Frequency of monitoring/recording	Measured continuously, read monthly, Value Applied is the measured quantity in one year
Value applied:	0
Monitoring equipment	Energy Meter
QA/QC procedures to be applied	The data is cross-checked with the invoices raised in case sale of the electricity and electricity bills in case of captive use. As per NEPRA grid code, meters shall be calibrated atleast once in two years to verify meter accuracy. The metering points to record net electricity exported to grid are at the Jhampir -132 kV line. The metering system has an accuracy class of 0.2 or better and is located within the substation. Under the provisions of EPA, as part of metering system of wind farm, two independent energy meters have been installed at Jhampir in the substation (i) Metering System and (ii) Back-up Metering System. These meters are of identical type and accuracy class. The Metering System and the Back-Up Metering System is jointly sealed by NTDC and

	MWEL. Metering system is used for billing purposes. In case the Metering System has a failure, the Back-Up Metering System is used for the same purpose. In case the Metering System has a failure, the data from the Back-Up Metering System shall be used for emission reduction calculation.
Purpose of data	Calculation of baseline emissions
Calculation method	$EG_{import,y} = EG_{import,y,\ Jhampir}$ $EG_{import,y,\ Jhampir}$= Electricity imported from the grid measured at Jhampir 132 kV line
Comments	The data will be archived in electronic and physical form for the crediting period + 2 years

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the project activity in year y
Source of data	Joint monthly meter reading report
Description of measurement methods and procedures to be applied	Energy meter installed at Jhampir 132 kV line measures the export and import of electricity on continuous basis. Meter readings are taken and verified, once in a month, jointly by the representatives of NTDC and the representative of MWEL. The net electricity supplied to the grid is calculated by subtracting the import of the electricity from the export of the electricity.
Frequency of monitoring/recording	Measured continuously, read monthly, Value Applied is the measured quantity in one year
Value applied:	151,600
Monitoring equipment	Energy Meter
QA/QC procedures to be applied	The data is cross-checked with the invoices raised in case sale of the electricity and electricity bills in case of captive use. As per NEPRA grid code, meters shall be calibrated atleast once in two years to verify meter accuracy. The metering points to record net electricity exported to grid are at the Jhampir -132 kV line. The metering system has an accuracy class of 0.2 or better and is located within the substation. Under the provisions of EPA, as part of metering system of wind farm, two independent energy meters have been installed at Jhampir in the substation (i) Metering System and (ii) Back-up Metering System. These meters are of identical type and accuracy class. The Metering System and the Back-Up Metering System is jointly sealed by NTDC and MWEL. Metering system is used for billing purposes. In case the Metering System has a failure, the Back-Up Metering System is used for the same purpose.

	In case the Metering System has a failure, the data from the Back-Up Metering System shall be used for emission reduction calculation.
Purpose of data	Calculation of baseline emissions
Calculation method	Net electricity fed to the grid is calculated as $EG_{BL,y} = EG_{export,y}-EG_{import,y}$
Comments	The data will be archived in electronic and physical form for the crediting period + 2 years

4.3 Monitoring Plan

Monitoring of emission reductions will be carried as per the applied methodology in the project activity i.e. ACM0002, version 17.0, which requires monitoring of the following relevant parameters:

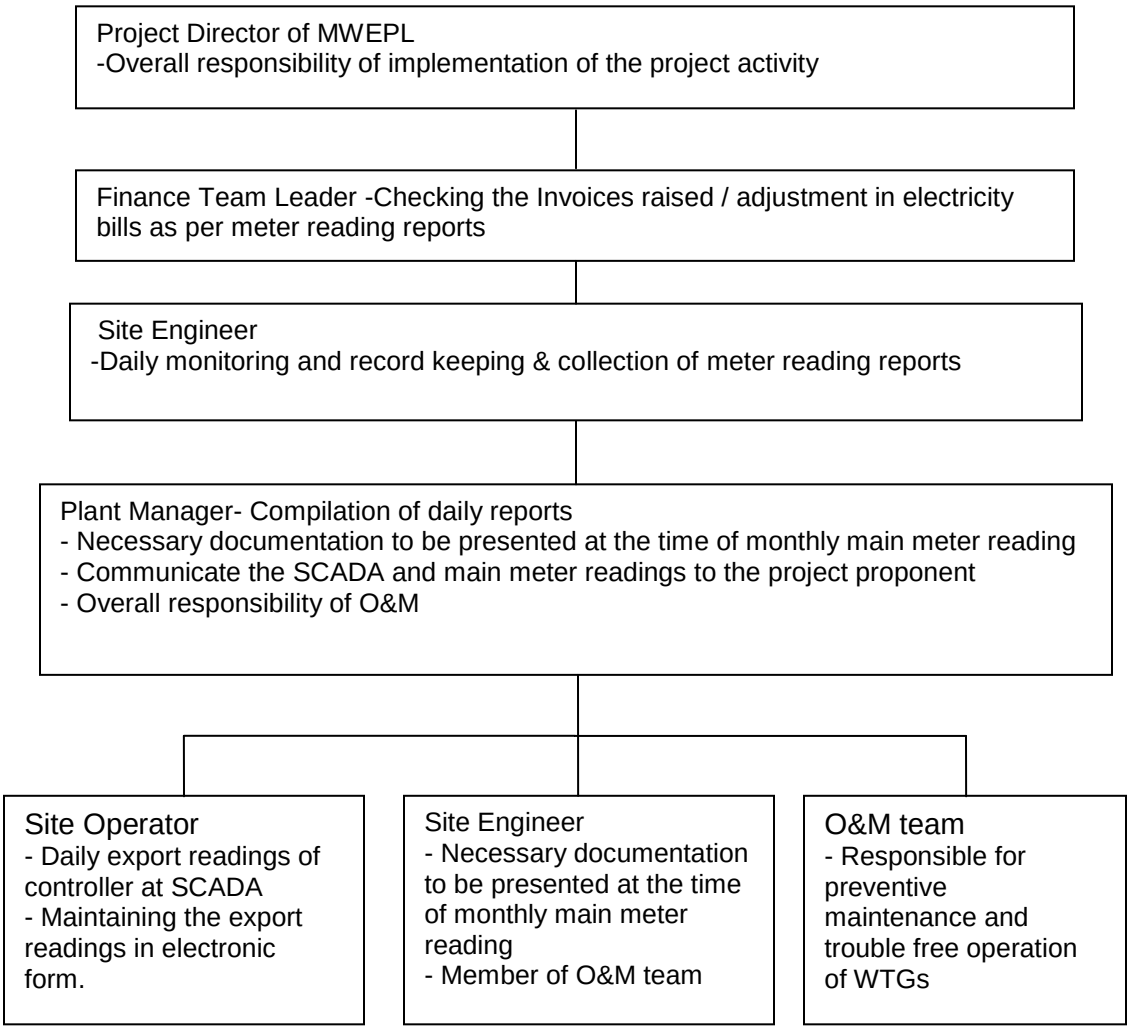
- $EF_{grid,CM,y}$: Combined margin CO_2 emission factor for the grid in the year y
- $EG_{PJ,y}$: Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y

Since the project proponent has chosen ex-ante determination of CO_2 emission factor for the grid, the monitoring of operating margin emission factor and build margin emission factor is not required. Further, wind based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity produced and supplied to the grid by the project activity.

The general conditions set out for metering, recording, meter readings, meter inspections, test & checking and communication shall be as per the Power Purchase Agreement signed by the project proponent with National Electric Power Regulatory Authority.

The personnel appointed by the project owner will be in charge of the monitoring plan.
1. Monitoring objects
The main monitoring object is the electricity delivered to the grid.
2. Management structure
The project owner will appoint personnel to carry out the monitoring plan.

The personnel structure along with assigned responsibility is as follows:



3. Monitoring equipment and installation
The meters are installed at the interconnection point to the grid for monitoring the electricity delivered to the grid. The accuracy of the meters and the calibration is according to National standards.

4. Data collection
The project owner and the grid company are responsible for checking the meters. They will ensure that the meters are sealed and without damages.

5. Meters maintenance and calibration
As per NEPRA grid code, meters shall be calibrated atleast once in two years to verify meter accuracy. The meters must be sealed after calibration. Neither the project owner, MWEL nor the Power Purchaser, NTDC could unseal or change the meters in the absence of the other party.

If any component of the metering system is found to be outside acceptable limits of accuracy, or otherwise not functioning properly, it shall be repaired, recalibrated or replaced as per requirement.

6. QA/QC procedures:
The meters shall be jointly inspected and sealed and shall not be interfered by either project owner, MWEL or Power Purchaser, NTDC without the presence of the other party.

7. Data archiving:

Data from monthly metering reports shall be archived in electronic and physical form for the entire crediting period plus two years.

5 SAFEGUARDS

5.1 No Net Harm

There is no negative environmental and socio-economic impacts arise from the project activity.

5.2 Environmental Impact

As per Environment Impact Assessment (EIA) report[21], there will be no impact on the flora & fauna of the area since there is no established grazing land, national parks, protected wild life zones or bird sanctuary present near the wind farm.

The site has also been examined from Noise, Shadow Flickering and Visualisation impact angle in the EIA report. The results show that there would be no adverse impact of Noise, Shadow Flickering and visualization on the Jhampir dwellings.

The land is also free from resettlement issues since it is the property of Government of Sindh who provided it to AEDB for wind power generation and AEDB has allocated the land to MWEL.

Since the wind farm requires no fossil fuel in the entire project life cycle for its operation, it will be a 100% Green Power Generation Plant without emitting a single gram of Green House Gases. Further no environmentally dangerous liquid / solid waste will be produced by the wind farm. So the wind farm will not be polluting the environment of the surroundings and hence will not have any adverse impact on the air or water of the area.

The other issues during equipment transportation and plant construction are of minute and temporary nature and will not cause any environmental concern. However, MWEL, with its vast experience in controlling environmental issues, will ensure through its contractors that it will be minimised for the extent possible.

In view of above, EIA report concluded that development of MWEL Wind Power Project in Jhampir will have no adverse environmental impact and the project can be regarded as an Environmental Friendly Green Project.

5.3 Local Stakeholder Consultation

Local stakeholders' consultation meeting was conducted as part of the initial environmental assessment to get the comments and suggestions of the local stakeholders on the project activity. A questionnaire was developed to assess the general concerns of the local resident of nearby villages about this project. A survey was conducted by Mr. Salman Ahmed of Alternative Energy Engineering Services. He himself filled the questionnaires after asking the questions to the native people. Filled questionnaires and snapshots of consultative meeting are submitted for validation.

The representative of MWEL and Alternative Energy Engineering Services presented the salient features of their project activity including the environmental and social impacts of the project activity, sustainable benefits to come from the project activity, and the role of emission reduction programmes to mitigate the GHG emissions from the environment. The stakeholders were requested to make their comments (if any) regarding the project activity. No negative comments received and a positive outlook about the overall impact of the project was anticipated by the stakeholders after it enters in the operation phase.

[21] Initial Environmental Examination report date October 2010 prepared by Renewable Resources (Pvt) Ltd.

5.4 Public comments

No Public comments received.