49.5 MW WIND POWER PROJECT BY FFCEL IN PAKISTAN

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1 PROJECT DETAILS

1.1 Summary Description of the Project

FFC Energy Limited (hereafter referred to as the "FFCEL") is a subsidiary of Fauji Fertilizer Company Limited (hereafter referred to as the "FFC"). FFCEL is incorporated to setup a 49.5 MW wind energy power project at Jhampir, Distt – Thatta, Sindh, Pakistan (hereafter referred to as the "Host Country").

Purpose of the project activity

The purpose of the Project is to generate renewable power from wind energy and supply it to National Transmission and Despatch Company Limited (hereafter referred to as the "Power Purchaser"). The project activity will result in generation of 143.6 GWh[1] per annum from wind energy.

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 49.5 MW equipped with 33 WTGs of 1.5 MW installed capacity each.

FFCEL has an EPC Contract with WTG supplier Nordex, Germany and Descon, Pakistan for installation of wind turbines. The project has been commissioned and it has achieved commercial operation on 16/05/2013[2]. This is the date on which project started supplying renewable power to the grid and began generating GHG emission reductions.

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 0.7625 tCO_2/MWh, a build margin emission factor of 0.2496 tCO_2/MWh and a combined margin of 0.6343 tCO_2/MWh (see section 2.4 for further details). The project activity is therefore expected to reduce emissions of GHGs by an estimated 91,085 tCO_{2e} per year by displacing equivalent amount of the electricity from the grid. The project activity would reduce 910,850 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] As per NEPRA's tariff determination document, reference no: NEPRA/R/TRF-156/FFCEL-2010/1560-1562 dated 10/08/2010, page no 1, para (i)

[2] Letter of notification from National transmission & Despatch Co Ltd to FFCEL dated 02/6/2013. As per VCS standard, version 3.4, this date has been considered as project start date for the project activity.

1.3 Project Proponent

Organization name	M/s.FFC Energy Limited
Contact person	Brig. Muhammad Naeem SI(M) Retd.
Title	Designation: Project Director – FFCEL Wind Power Project
Address	FFC SONA Tower, 156 the Mall, Rawalpindi, Pakistan
Telephone	Work Phone: +92-51-8457501
Email	mnaeem@ffc.com.pk

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 VCS standard, version 3.4, the project start date is the date on which the project began generating GHG emission reductions. The project activity achieved commercial operations date on 16th May 2013 and started supplying power to the grid and thus began generating GHG emission reductions. Therefore, Project Start Date is 16th May 2013 (Day: 16, Month: May, Year: 2013).

1.6 Project Crediting Period

Crediting Period Start Date: 16/05/2013 (Day: 16, Month: May, Year: 2013)
Crediting Period End Date: 15/05/2023 (Day: 15, Month: May, Year: 2023)

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 91,085 tCO_2e per year, which is less than 1,000,000 tCO2e per year. Hence the project scale of the project activity will become "Project" as shown below:

Project Scale	
Project	√
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
16/05/2013 to 15/05/2014	91,085
16/05/2014 to 15/05/2015	91,085
16/05/2015 to 15/05/2016	91,085
16/05/2016 to 15/05/2017	91,085
16/05/2017 to 15/05/2018	91,085
16/05/2018 to 15/05/2019	91,085

16/05/2019 to 15/05/2020	91,085
16/05/2020 to 15/05/2021	91,085
16/05/2021 to 15/05/2022	91,085
16/05/2022 to 15/05/2023	91,085
Total estimated ERs	910,850
Total number of crediting years	10
Average annual ERs	91,085

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 49.5 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. FFCEL has an EPC Contract with WTG supplier Nordex, Germany and Descon, Pakistan for installation of wind turbines. Nordex 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 143.6 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 Nordex S77-rated capacity 1.5 MW machines. The technical details are provided below:

Technical specifications[3]	
Rotor	
Number of blades	3
Rotor speed	9.9-17.3 rpm
Rotor diameter	77 m
Swept area	4,657 square meters
Power regulation	Pitch
Rated power from	13 m/s
Cut-in wind speed	3.5 m/s
Cut-out wind speed	25 m/s
Survival wind speed	50.1 m/s (at 85 m hub height)
Pitch regulation	Individual electromotive pitch
Total weight	c. 35,000 kg
Blades	
Blade length	37.5 m
Material	Glass fibre-reinforced plastic

[3] http://www.nordex-online.com/en/produkte-service/wind-turbines/s77-15-mw/product-data-sheet-s77-15mw.html?no_cache=1

Blade Weight	c. 6,500 kg
Gearbox	
Type	Combined planetary and spur gear
Gear ratio	1 : 104
Weight	c. 14,000 kg
Oil quantity	350 l
Oil change	Semi-annual check, change as required
Main shaft bearing	Self-aligning roller bearing
Generator	
Power	1,500 kW (adjustable)
Voltage	690 V
Type	Double-fed asynchronous generator, air-cooled
Speed	1,000 - 1,950 rpm ± 10 %
Enclosure class	IP 54
Coupling	Multiple steel disc, insulated
Efficiency	Efficiency c. 95 % at full load, (electrical system overall)
Weight	c. 7,000 kg
Power factor	0.9 ind. to 0.95 cap.
Yaw system	
Yaw bearing	Four-point bearing
Brake	Hydraulic disc brake with 10 calipers
Yaw drive	4 induction motors
Speed	c. 0.75 °/s
Control System	
Type	Microprocessor
Grid connection	Via IGBT converter
Scope of monitoring	Remote monitoring of more than 300 different parameters, e.g. temperature sensors, hydraulic sensors, pitch parameters, vibration, speed, generator torque, wind speed and direction, etc.
Recording	Production data, event list, long and short-term trends
Brake	
Design	Three independent systems, fail safe (individual pitch)
Operational brake	Electromotive blade pitch
Secondary brake	Disc brake
Tower	
Type	Modular steel cylindrical tower with upper segment conical, Total 4 Segments
Hub height	Tubular tower 80 m, Class IEC 2a

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 0.7625 tCO_2/MWh, a build margin emission factor of 0.2496 tCO_2/MWh and a combined margin of 0.6343 tCO_2/MWh (see section 2.4 for further details). The project activity is therefore expected to reduce emissions of GHGs by an estimated 91,085 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[4]. The project activity achieved commercial operations date on 16th May 2013 and started supplying power to the national grid. The project activity is expected to generate 143,600 MWh per annum[5] at an annual PLF of 33.11%.

1.9 Project Location

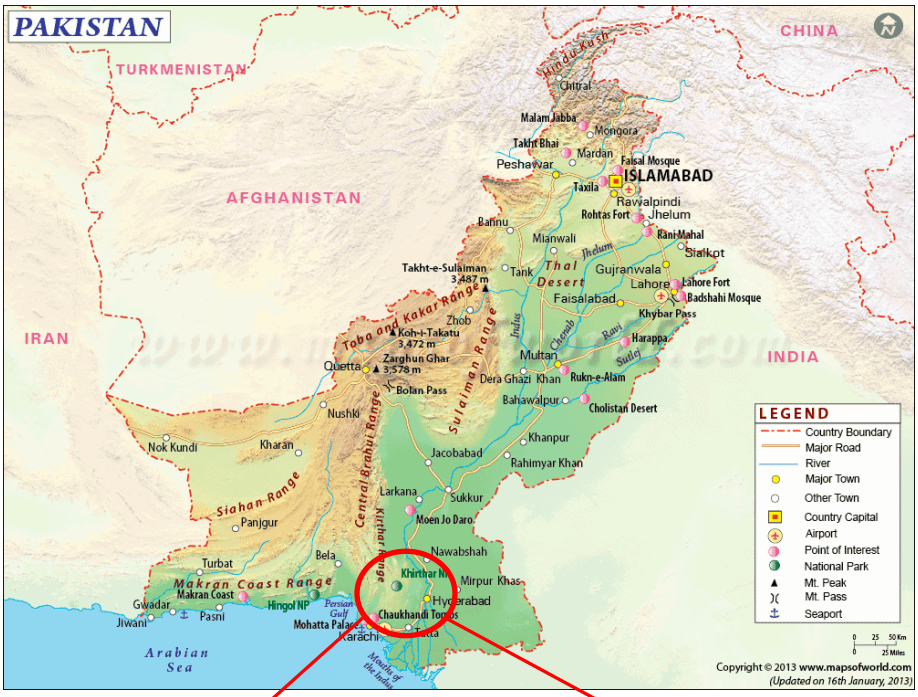
Project is located at Jhimpir, District Thatta, Sindh, Pakistan. Geo-coordinates of individual WTGs are provided below[6]:

Turbine No	Easting 'E' (M)	Northing 'N' (M)
T-01	397089	2773257
T-02	397226	2773647
T-03	396806	2773917
T-04	396621	2774104
T-05	397843	2774073
T-06	397505	2774307
T-07	397367	2773072
T-08	397621	2772897
T-09	396548	2773623
T-10	396936	2774702
T-11	397131	2774562
T-12	398397	2773482
T-13	398881	2773222
T-14	398183	2773155
T-15	398398	2772974
T-16	398657	2772798
T-17	399243	2773093
T-18	400099	2772348
T-19	398288	2772430
T-20	398900	2772607
T-21	398603	2772209
T-22	398891	2772011
T-23	399157	2771828
T-24	399473	2771610
T-25	399758	2771414
T-26	400348	2771824
T-27	399286	2772390
T-28	399583	2772208
T-29	399782	2771962
T-30	399846	2772687
T-31	399534	2772901
T-32	400120	2771238
T-33	397624	2773479

The above mentioned geo-coordinates are provided in UTM system. The applicable grid zone[7] is 42 R.

[4] Agreement for Engineering, Procurement, Supply, Construction, Erection, Installation, Commissioning, Operation, Maintenance & Services between FFCEL and Nordex Singapore Equipment (Private) Limited, Page 124 of 169
[5] No. NEPRA/TRF-156/FFCEL-2010, para 8.9, Determination of tariff petition filed by FFC energy limited
[6] Layout plan dated 7/11/2012 prepared for "49.5 MW wind power project at Jhampir"
[7] http://www.dmap.co.uk/utmworld.htm

The project location has been highlighted on the map of Pakistan[8]:-



[8] 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 and the project activity has achieved commercial operation on 16/05/2013. The list of approvals from nodal agencies is below:-

Date	Activity
31/08/2007	Letter of Intent issued for 50 MW wind power project by AEDB
15/4/2009	Letter of approval from Environmental Protection Agency, Sindh
10/8/2010	Tariff determination by NEPRA
27/8/2010	Generation license by NEPRA
16/5/2013	Commercial operation date

1.12 Ownership and Other Programs

1.12.1 Right of Use

Project Owner: M/s.FFC Energy Limited (FFCEL)

Document(s) demonstrating the ownership of the project:

1. Purchase Orders placed by FFCEL to WTGs supplier
2. Invoices placed by WTG suppliers to FFCEL
3. Land documents in favor of FFCEL
4. Letter of intent issued for 50 MW wind power project by AEDB
5. Letter of tariff determination by NEPRA to FFCEL
6. Generation license provided to FFCEL 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.

Further Information

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

Social Wellbeing

- FFC has launched a community uplift and support program at Jhimpir during 2012, focusing on villages surrounding the Wind Farm at a cost of PKR 9.4million in partnership with NORDEX[9].
- 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 generate an estimated amount of 143.6 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.
- Towers for the wind turbines were manufactured for the first time in Pakistan at Descon's workshop in Karachi; a step towards indigenization of wind power technology in the country[10].

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

ACM 0002 - *Grid-connected electricity generation from renewable sources (Large-Scale)*[11]
Version – 15.0

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

[9] http://www.ffc.com.pk/uploads/docs/ffccsr_sr_2012.pdf, Page 61
[10] http://www.descon.com/cms_newsletter/13/Descon_Newsletter_Final.pdf, page 8
[11] http://cdm.unfccc.int/methodologies/DB/MPY3HVJIMTKE5P0UNTYE827D6Q7EHB

Tool to calculate the emission factor for an electricity system, version 4.0
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.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 15.0 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:1 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 15, is greater than 4 W/m2; or 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	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**.

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 maintenance".	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**.

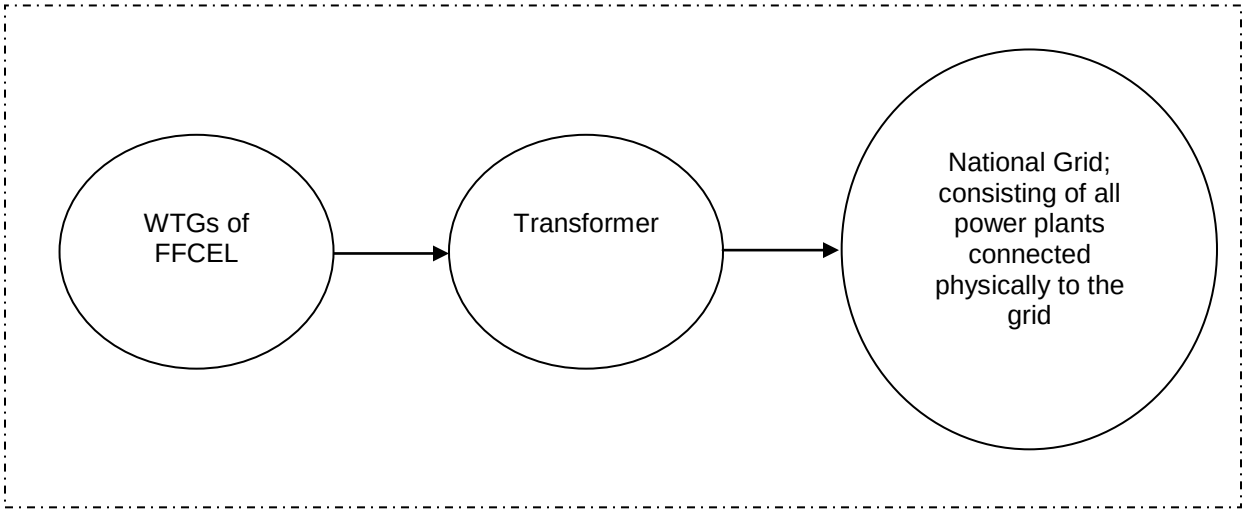
The justification provided in table above shows that the project activity satisfies the applicable conditions of the methodology, ACM0002, version 15.0.0.

As per the requirement of the applied methodology, ACM0002 for demonstrating and assessing the additionality the latest version 7.0.0 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 04.0 is applied in order to estimate the OM, BM and/or 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 steam	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.

Source		Gas	Included	Justification/Explanation
		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, 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 04.0)" 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 04.0, 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 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)[12].
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 04.0, 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[13] 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.

Table 2.4.1: Share of low cost/must run resources in recent years of the Pakistan Grid[14]

Power Plant	**Electricity Generation Gross, GWh**				
	2008-09	**2009-10**	**2010-11**	**2011-12**	**2012-13**
KESC					
TPS Korangi	921.81	222	270.51	163.16	326.6
GTPS Korangi Town	310.08	531.52	675.68	595.34	0
GTPS Site	303.38	508.27	586.31	416.41	155.97
TPS Bin Qasim	6,396.56	5505.73	5068.28	4,704.06	3722.33
Korangi CCP	330.28	1196.55	1225.5	1,010.50	795.11
TPS Bin Qasim II[15]	0	0	0	1,139.91	3567.22
Private sector connected to KESC					
Gul Ahmed, Karachi	473.99	630.87	771.26	468.65	449.61
Tapal Energy, Karachi	663.36	644.84	804.15	490.51	694.53
KESC-Gross	**9,399.46**	**9,239.78**	**9,401.69**	**8,988.54**	**9,711.37**
Total gross	91,616	95358	94385	95091	96122

[12] http://www.ntdc.com.pk/
[13] Low-cost / must run resources include hydro and nuclear in Pakistan.
[14] Pakistan energy yearbook 2009, 2010, 2011, 2012 and 2013
[15] TPS Bin Qasim II got commissioned in year 2012. Pakistan energy year book 2012, table 5.1

WAPDA gross	**82,216.54**	**86,118.22**	**84,983.31**	**86,102.46**	**86,410.63**
of which Hydel	27,784.00	28,093	31,811	28,517	29,857
of which Nuclear	1,618.00	2,894	3,420	5,265	4,553
Share of low-cost/must-run resources	**35.76%**	**35.98%**	**41.46%**	**39.23%**	**39.82%**

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 CDM-PDD to the DOE 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 2011 – 2013, the most recent data available at the time of PD submission to the DOE.

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:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \qquad \text{Equation (7)}$$

Where:

$EF_{grid, OMsimple, y}$	Simple operating margin CO2 emission factor in year y (tCO_2/GWh)
$FC_{i, y}$	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, 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 (2011 - 2013)[16]

Fuel type	**$FC_{i,y\ unit}$ [TOE]**		
	2012-13	**2011-12**	**2010-11**
Coal	28,204	46,800	43,169
Furnace/Fuel Oil	7,342,755	7,206,839	7,827,500
Diesel	218,584	203,072	105,160
Gas	7,084,177	6,732,876	6,493,766

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[17].

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.

Fuel consumption in power plants connected to 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 (2011-2013)

Fuel type	**$FC_{i,y\ unit}$ [GJ)**		
	2012-13	**2011-12**	**2010-11**
Coal	1,267,770	2,103,660	1,940,447
Furnace/Fuel Oil	330,056,837	323,947,413	351,846,125
Diesel	9,825,351	9,128,086	4,726,942
Gas	318,433,756	302,642,776	291,894,782

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.

[16] Source: Pakistan energy yearbook 2013, Table 5.4 (p88)
[17] Average of calorific value of indigenous and imported crude oil; Source: Pakistan energy yearbook 2013, Appendix: 7.4 (p133)

Table 2.4.4: Emission factor for fuels used in Pakistan[18]

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	**2011-12**	**2010-11**
Coal	117,649	195,220	180,073
Furnace/Fuel Oil	22,744,835	22,486,373	23,908,010
Diesel	713,320	662,699	343,176
Gas	15,022,150	13,848,078	13,381,602
Total GHG emissions	**38,597,954**	**37,192,370**	**37,812,862**

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.

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 2011 - 2013.

Table 2.4.6: Net Electricity Generated By Fossil Fuel Power Source 2011-2013 $EG_{gross,y}$ (GWh)[19]

	2012-13	**2011-12**	**2010-11**
Total gross power generation	96122	95091	94385
KESC-Gross power generation	9,711.52	8,988.47	9,401.71
WAPDA gross power generation	**86,410.48**	**86,102.53**	**84,983.29**
Aux consumption WAPDA Thermal	1,002.63	0.94	1.09
Aux consumption WAPDA IPPs	1,131.87	1,210.81	1,050.01
Aux consumption WAPDA Hydel	273.60	281.40	227.90
Aux consumption WAPDA Nuclear	243.69	230.08	264.38
WAPDA - Hydro	29,857	28,517	31,811
WAPDA – Nuclear	4,553	5,265	3,420
Net Electricity Generated in WAPDA grid without low cost must run plants	**49,348.69**	**50,597.30**	**48,208.91**
Electricity imports (GWh)	375	274	269
Net Electricity Generated in WAPDA grid (including import)	**49,724**	**50,871**	**48,478**

[18] 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
[19] Pakistan Energy Yearbook 2011, 2012 and 2013

The $EF_{grid, OM, y}$, for year 2010-11, 2011-12 and 2012-13 has been calculated as per equation (7) 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	2011-12	2010-11
Emission from fuel consumption in WAPDA grid, tCO2e	38,597,954	37,192,370	37,812,862
Net Electricity Generated in WAPDA grid (including import), GWh	49,724	50,871	48,478
EF_{gridOM} (tCO_2/MWh)	0.7762	0.7311	0.7800
Weighted Average EF_{gridOM} (tCO_2/MWh)	**0.7625**		

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 DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

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

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 DOE for validation. According to the "Tool to calculate the emission factor for an electricity system", version 04.0, 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 (AEGSET-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 2012-13 (GWh)[20]	Source for commissioning date
Jinnah	Oct-13	202.01	http://wapda.gov.pk/vision2025/htmls_vision2025/jinnah hydropower.html
AKHP	2013	75.27	Energy year book 2013

[20] Pakistan Energy Yearbook 2013

Halmore Power	16/06/2011	N/A	http://www.ppib.gov.pk/N_commissioned_ipps.htm, http://www.ppib.gov.pk/N_halmore.htm, Power generation data for Halmore power plant for year 2012-13 is not available hence this plant is not considered.
Foundation Power	16/05/2011	1381.3	http://www.ppib.gov.pk/N_commissioned_ipps.htm
Hub Power,Narowal	22/04/2011	820	http://www.ppib.gov.pk/N_commissioned_ipps.htm
Liberty Tech Power	13/01/2011	1438.34	http://www.ppib.gov.pk/N_commissioned_ipps.htm
Total	**-**	**3916.92**	Energy year book 2013

(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[21]

	2012-13	**Unit**
Total gross power generation	96,122	GWh
Gross power generation at KESC grid	9,712	GWh
Gross power generation at WAPDA grid	86,410	GWh
Auxiliary power consumption at WAPDA	2,651.79	GWh
Total Net Generation (AEG_{total})	83,758.69	GWh
20% of AEG_{total}	**16,751.74**	**GWh**

Table 2.4.11: Set of most recent power plants generating ≥ 20% of total WAPDA generation in 2012-13[22]

Power Unit	**Commissioning date**	**Gross Electricity Generation MWh**	**Auxiliary consumption MWh**	**Net electricity supply to grid MWh**
Jinnah	Oct-13	202,010	3,880	198,130
AKHP	2013	75,270	60	75,210
Halmore Power	16/06/2011	N/A	N/A	N/A
Foundation Power	16/05/2011	1,381,301	N/A	N/A
Hub Power, Narowal	22/04/2011	820,000	18,000	802,000
CHASNUPP-II	27/01/2011	1,652,000	N/A	N/A
Liberty Power Tech	13/01/2011	1,468,210	29,870	1,438,340
KKHP	08/11/2010	296,650	4,780	291,870
Sapphire Electric Company	04/10/2010	N/A	N/A	N/A

[21] Pakistan Energy Yearbook 2013: Table 5.2 (p88)
[22] Pakistan Energy yearbook 2013: Table 5.2 (p88), Table 5.10 (p92), Table 5.11 (p93). N/A: Data not available.

Nishat Chunian Ltd	21/07/2010	1,250,250	26,180	1,224,070
Nishat Power Ltd	09/06/2010	1,309,910	33,440	1,276,470
Orient Power Ltd	24/05/2010	573,450	2,030	571,420
Saif Power Ltd	27/04/2010	742,450	N/A	N/A
Engro Energy Ltd	27/03/2010	1,693,410	45,500	1,647,910
Atlas Power Ltd	18/12/2009	1,383,020	N/A	N/A
Attock Gen	17/03/2009	N/A	N/A	N/A
Ghazi Barotha	01/07/2003	7,164,660	81,810	7,082,850
TNB Liberty Power	10/09/2001	891,810	20,660	871,150
Altern Energy Ltd	06/06/2001	N/A	N/A	N/A
Chashma	01/06/2001	1,122,110	6,980	1,115,130
Uch Power	18-10-2000	3,795,840	N/A	N/A
Chasnupp-I	06-06-2000	2,295,000	N/A	N/A
Japan Power	14-03-2000	106,410	4,750	101,660
Saba Power	31-12-1999	90,630	5,630	85,000
			Total	**16,781,210**

(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 71 of "Tool to calculate the emission factor for an electricity system", version 04.0.

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 2004 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 2004 and this becomes the sample group of power units used to calculate the build margin.

Table 2.4.12: Electricity Generated (2012-13) by Power Units included in Build Margin Calculation

Power Unit	Gross Electricity Generation (MWh)	Auxiliary consumption (MWh)	Net electricity supply to grid in 2012-13 (MWh)

Jinnah	202,010	3,880	198,130
AKHP	75,270	60	75,210
Hub Power, Narowal	820,000	18,000	802,000
Liberty Power Tech	1,468,210	29,870	1,438,340
KKHP	296,650	4,780	291,870
Nishat Power	1,250,250	26,180	1,224,070
Nishat Chunian Ltd.	1,309,910	33,440	1,276,470
Orient Power Ltd.	573,450	2,030	571,420
Engro Energy Ltd.	1,693,410	45,500	1,647,910
Ghazi Barotha	7,164,660	81,810	7,082,850
TNB Liberty Power	891,810	20,660	871,150
Chashma	1122.11	6.98	1115.13
Japan Power	106.41	4.75	101.66
Saba Power	90.63	5.63	85

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:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \text{Equation (13)}$$

where:

$EF_{grid,BM,y}$ Build margin CO_2 emissions factor in year y (tCO_2/GWh)
$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (GWh)
$EF_{EL,m,y}$ CO_2 emission factor of power unit m in year y (tCO_2/GWh)

As per the "Tool to calculate the emission factor for an electricity system", version 04.4, 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:

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}} \qquad \text{Equation (3)}$$

where:

$EF_{EL,m,y}$ CO_2 emission factor of power unit m in year y (tCO_2/GWh)
$EF_{CO2,m,i,y}$ 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 $EF_{CO2,m,l,y}$ 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	$EF_{CO2,i,y}$ (tCO_2/GJ)	Efficiency factor (%)[23]	Power unit Emission Factor $EF_{EL,m,y}$ (tCO_2/GWh)
Jinnah	Hydel	Hydel	NA	NA	NA
AKHP	Hydel	Hydel	NA	NA	NA
TPS Bin Quasim-2	Combined cycle	Gas	0.0543	60.00%	0.3258
		RFO	0.0755	46.00%	0.5909
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
Nishat Power	Combined cycle	RFO	0.0755	46%	0.5909
Nishat Chunian Ltd.	Reciprocating Engines/ Open cycle	RFO	0.0755	39.50%	0.6881
Orient Power Ltd.	Combined cycle	HSD	0.0755	46.00%	0.5909
		Gas	0.0543	60.00%	0.3258
Engro Energy Ltd.	Combined cycle	HSD	0.0755	46.00%	0.5909
		Gas	0.0543	60.00%	0.3258
Ghazi Barotha	Hydel	Hydel	NA	NA	NA
TNB Liberty Power	Combined cycle	Gas	0.0543	60.00%	0.3258
Chashma	Hydel	Hydel	NA	NA	NA
Japan Power	Thermal	RFO	0.0755	46%	0.5909
Saba Power	Thermal	RFO	0.0755	37.5%	0.7248

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 (13) and (3) of tool by using data from Table 2.4.13, is 0.2496 tCO_{2e}/MWh.

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

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \text{Equation (14)}$$

where:

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

[23] Default efficiency factors for power plants have been taken from Appendix 1 of Tool to calculate the emission factor for an electricity system, version 4.0

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 (4), the combined margin emission factor is:

$EF_{grid, CM,y}$ = 0.6343 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 line with "Guidelines on Additionality of First of Its Kind Project Activities" version 2.0.

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 atleast 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 of the proposed project activity.

As per VCS standard, version 3.4, the project start date is the date of on which the project began generating GHG emission reductions. In this case, the project achieved its commercial operation on 16/05/2013 and started supplying power to grid and thus began generating GHG emission reductions. Therefore the project start date is 16/5/2013 and first of its kind criteria has been demonstrated accordingly.

All wind power projects that have started commercial operation in Pakistan before 16/05/2013 is

considered for further analysis as per EB 69, Annex 7. The projects commissioned in Pakistan are listed below along with their commercial operation date:

Sl No	Project developer	Capacity (MW)	Location	Commercial operation date	Source
1	M/s FFC Energy Ltd.	49.5 MW	Jhimpir, Sindh	16/05/2013	Letter dated 12/06/2013 from NTDC
2	M/s Zorlu Enerji Pakistan Ltd.	56.4 MW	Jhimpir, Sindh	26/07/2013	Letter dated 21/08/2013 from NTDC

The above table demonstrates that none of the wind power project in Pakistan started commercial operation before the project start date of FFCEL. Hence the analysis presented above demonstrates that the proposed project activity is 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 and project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal[24].

Outcome of Step 0: The proposed project is the first-of-its-kind and as per "Tool for the demonstration and assessment of additionality" version 7.0.0, para 18 the additionality is demonstrated. Hence there is no need to proceed to Step 1.

From the positive outcome of step 0, as documented above, it can be concluded, that the proposed 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 CDM 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)

[24] As per Guidelines on Additionality of "first of its kind" project activities, EB 69, Annex 7, para 5.c, 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".

3.2 Project Emissions

PP has installed back-up diesel generator to provide power supply for wind farm's auxiliary consumption in case of grid failure. It provides back-up power to UPS and its batteries, Direct Current Panel with batteries, SCADA system, VSAT power supply, Fire protection system of power transformers and MV room, security camera, offices and dormitories.

However as per para 31 of ACM0002 version 15, for all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected. Hence project emission has been neglected.

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)

$EG_{PJ,y}$ = 143.6 GWh/year

$EF_{grid,CMy}$ = 0.6343 tCO_{2e}/MWh

BE_y = 143.6 X 1000 X 0.6343 = 91,085 tCO_{2e}/year (rounddown)
LE_y = 0 tCO_{2e}

PE_y = 0 tCO_{2e}

ER_y= 91,085 – 0 – 0 = 91,085 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)
16/05/2013 to 15/05/2014	91,085	0	0	91,085
16/05/2014 to 15/05/2015	91,085	0	0	91,085

16/05/2015 to 15/05/2016	91,085	0	0	91,085
16/05/2016 to 15/05/2017	91,085	0	0	91,085
16/05/2017 to 15/05/2018	91,085	0	0	91,085
16/05/2018 to 15/05/2019	91,085	0	0	91,085
16/05/2019 to 15/05/2020	91,085	0	0	91,085
16/05/2020 to 15/05/2021	91,085	0	0	91,085
16/05/2021 to 15/05/2022	91,085	0	0	91,085
16/05/2022 to 15/05/2023	91,085	0	0	91,085
Total	910,850	0	0	910,850

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:	0.7625
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. 04.0" as 3-year generation-weighted average of latest three years, 2011,2012, 2013, 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:	0.2496
Justification of choice of	Calculated ex ante as per "Tool to calculate the emission factor for

data or description of measurement methods and procedures applied	an electricity system, ver. 04.0" based on the most recent year 2013 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:	0.6343
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. 04.0" 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 and Nooriabad 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 FFCEL. 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	Measured continuously, read monthly, Value Applied is the

monitoring/recording	measured quantity in one year
Value applied:	143600
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 and Nooriabad – 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 each feeders (Jhampir and Nooriabad) 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 FFCEL. 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	$EG_{export,y} = EG_{export,y,\ Jhampir} + EG_{export,y,\ Nooriabad}$ $EG_{export,y,\ Jhampir}$= Electricity exported to the grid measured at Jhampir 132 kV line $EG_{export,y,\ Nooriabad}$= Electricity exported to the grid measured at Nooriabad 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 and Nooriabad 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 FFCEL. 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	Measured continuously, read monthly, Value Applied is the

monitoring/recording	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 and Nooriabad – 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 each feeders (Jhampir and Nooriabad) 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 FFCEL. 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	$EG_{import,y} = EG_{import,y,\ Jhampir} + EG_{import,y,\ Nooriabad}$ $EG_{import,y,\ Jhampir}$= Electricity imported from the grid measured at Jhampir 132 kV line $EG_{import,y,\ Nooriabad}$= Electricity imported from the grid measured at Nooriabad 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 and Nooriabad 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 FFCEL. 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:	143600
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 and Nooriabad – 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 each feeders (Jhampir and Nooriabad) 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 FFCEL. 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 15.0, 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.

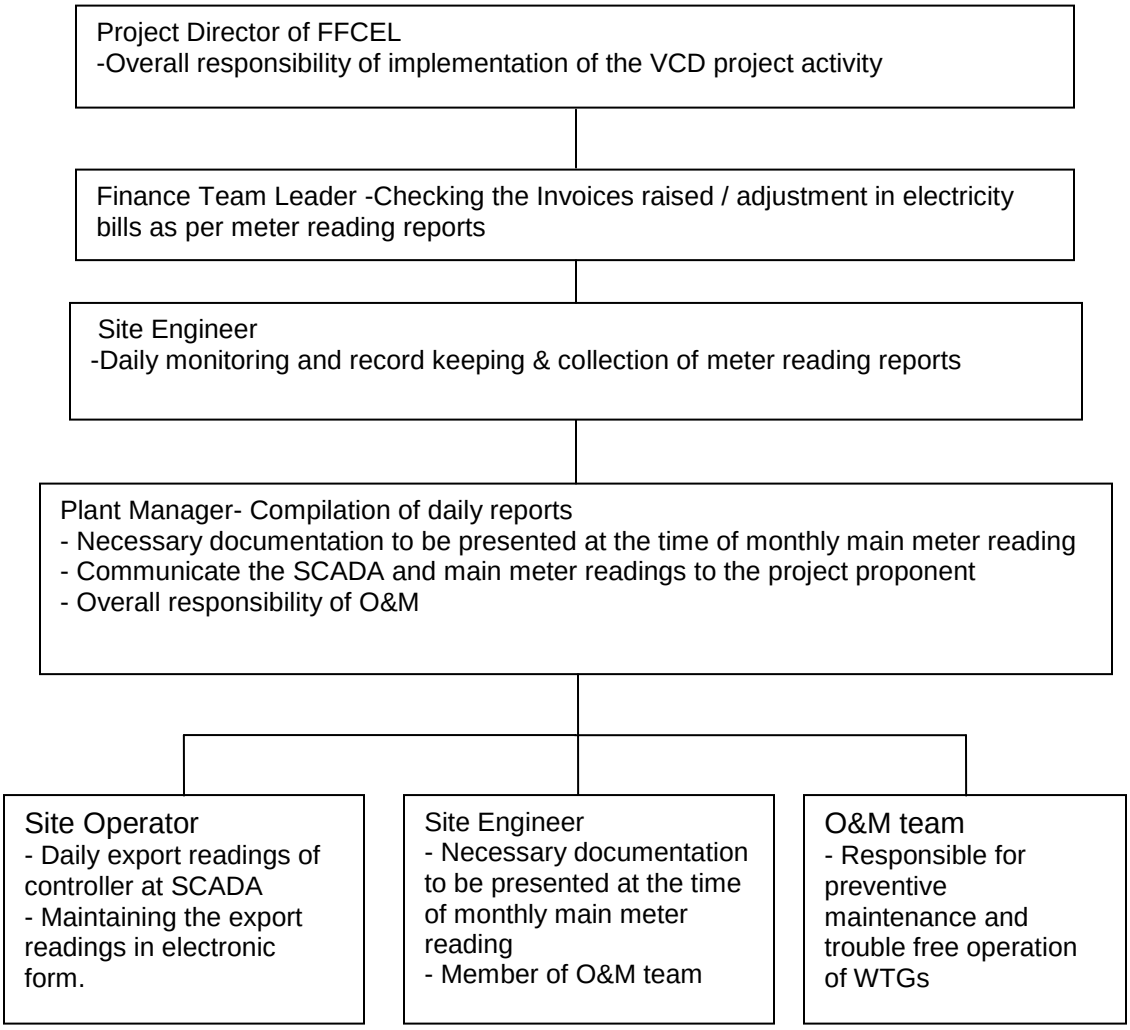
The general conditions set out for metering, recording, meter readings, meter inspections, test & checking and communication shall be as per the Power Purchase Agreement signed by the project proponent with National Electric Power Regulatory Authority.

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, FFCEL 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, FFCEL 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 ENVIRONMENTAL IMPACT

As per EIA report[25], 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 FFC.

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, FFC, 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 FFC Wind Power Project in Jhampir will have no adverse environmental impact and the project can be regarded as an Environmental Friendly Green Project.

6 STAKEHOLDER COMMENTS

Local stakeholders' consultation meeting was conducted on 20/01/2009 at 11.00 am to get the comments and suggestions of the local stakeholders on the project activity. Invitation for stakeholder meeting was published in the national newspaper "Daily News Karachi", Daily Aman Karachi and local news paper Daily Kawish on 20/12/2008.

Questions and comments were solicited in these invitations, and stake-holders were invited to a stake-holder meeting at the site on 20/01/2009.

The project proponent made all the necessary arrangements for the meeting like arrangement for sitting, photography, provision of refreshments etc. The chairperson was elected from among the present

[25] Environmental Impact Assessment report, Revision 04, January 2008 prepared by Lahmeyer International

stakeholders in that meeting. The presentations were made on role of the project activity in mitigating the GHGs emissions etc. in the local language.

The representative of FFCEL 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. This was followed by a brief session on question and answer in which the local villagers raised their queries regarding the project activity and answered by the representatives of FFCEL in local language. In the end, the stakeholders were requested to make their comments (if any) regarding the project activity.

Below is the summary of questions and answers session:-

1) **Mr. Ghulam Rasool Shoro:** Raised concerns about employment and land use compensation for locals.

Response from client side: Locals will be hired during construction and operation of the wind farm on priority. Land has been given to the Wind Power Project by the government of Sindh. Issue for compensation can be raised in front of board of revenue for compensation; we are ready to provide assistance.

2) **Mr. Buksh Brohi:** Impact of Wind Power Project on environment should be known to the locals.

Response from client side: One of the principle reasons of holding today's meeting is to let locals and in fact all stakeholders know the environmental impact of the proposed project. Same subject has been discussed in detail in the presentation given by FFCEL representative. However, in response to the question, Mr. Imran Shah again briefed the locals in local language on the subject.

3) **Mr Abdul Jabbar Memon:** Commented that investment in projects in the area cannot be made without involving locals and gaining their trust.

Response from EPA Sindh: We will watch the interests of locals and gain their trust. In the past, in all Oil & Gas field projects in Sindh, EPA Sindh has watched the interests of locals and now they are benefiting from these projects.

4) **Dr Abdur Rehman:** Expertise of Engineering Universities in Sindh should be utilized for environment impact assessment and climate change studies.

Response from Government of Sindh: We are already in the process of signing MOU's with all 5 universities for acquiring consultancy work.

5) **Mr. Roland DeSouza:** Kinjhar Lake is a wildlife sanctuary and home of migratory birds. Needs to be reconsidered in EIA where you mentioned there will be no effect on wildlife. EIA should be shared on internet for easy access to everyone.

Response from client side: EIA report is already available online on our official web site for public review. Syed Imran Shah shared various studies on Wind Power Project's potential impact on migratory birds and assured that there is no such negative effect.

The local stakeholders overall appreciated the project activity as it generates environment friendly electricity, conserve the scarce natural resources, and also provide the employment opportunities to the local people. All the stakeholders were happy in knowing that the project activity in their locality will be contributing to a global cause and they supported the management of FFCEL for their initiatives in the areas of climate change and sustainable development. No adverse comment was received in the stakeholders' consultation meeting.