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ROLE OF CLEAN DEVELOPMENT MECHANISM TO PROMOTE WIND ENERGY: CASE STUDY, TAMIL NADU BASED WIND POWER PROJECT

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ABSTRACT

Keeping the issue of climate change in mind, wind energy is vital as this has an attractive attribute that the fuel is free of emission and this will be the case for the project lifetime and beyond. The Clean Development Mechanism (CDM) is one process which assists the development of wind energy as well as other renewable energy. The objective of this paper is to focus on the attractiveness of the CDM for a wind power project, which is positioned in Tamil Nadu, India through the calculation of Certified Emission Reductions (CERs).

Keywords: wind energy, clean development mechanism (CDM), climate change, green house gases (GHGs).

1. INTRODUCTION

Global warming is a big issue for present world. There is a big challenge of mitigation of green house gases emission to deal with the effect of global climate change [1]. So it is essential to reduce the concentration of CO_2, the primary green house gas, in atmosphere by giving emphasis on renewable energy technologies for power generation as well as for primary energy sources [2]. The solution to the problem is the "Renewable energy that can be a potential alternative to cop up with this major issue" [3].

Talking about the green house gases, it is necessary to first give attention on CO_2, whose concentration has shoot up and has rising trend for future also [4]. In 2010, top ten countries like China, United States, India, Russian Federation, Japan, Germany, Islamic Republic of Iran, Canada, Korea, United Kingdom have contributed around two-thirds i.e., 19.8Gt CO_2 of the world CO_2 emission whereas world total emission was 30.3Gt CO_2 [5]. Primary source of CO_2 emission is the burning of fossil fuels specifically gas, oil and coal [6]. Excessive burning of fossil fuel has pushed the concentration of CO_2 almost twice in comparison to pre industrialized era [7]. Worldwide CO_2 emission by different sector has been estimated by International Energy Agency Statistics and shown in Figure-1 [5].

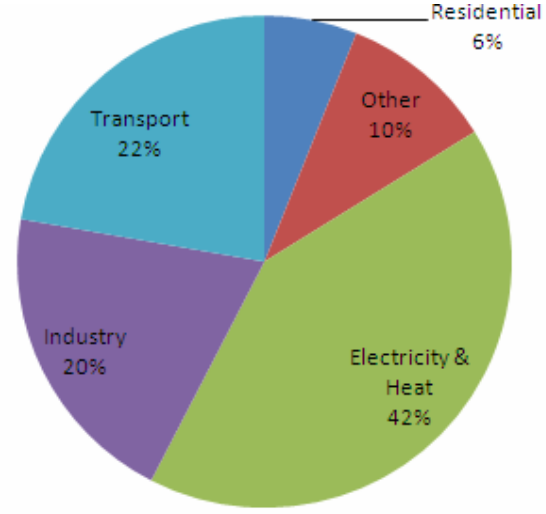

Figure-1. Worldwide CO_2 emission by different sector in percentage, 2010.

Hence, we can articulate that CO_2 plays major role to create negative green house gas effect [8] and that is why it needs special attention to reduce its concentration in the atmosphere. This can only be possible if we reduce our dependence on conventional energy sources and introduce renewable energy such as solar, wind and biomass or biofuel to supply most of the world's energy needs for the foreseeable future.

2. CONTEXT

During 70's and 80's people realized that environmental damage will be the serious problem if present trend continues. To overcome with this big issue there was a need of independent scientific and technical advice and then in 1988 United Nation Environmental Programme (UNEP) and World Meteorological Organization (WMO) came up with the group of scientist called Intergovernmental Panel on Climate Change (IPCC). The groups of IPCC scientists came with their first report in 1990 which revealed the seriousness of

impacts of global warming and gave emphasis on the use of renewable energy which plays major role in subject of green house gas mitigation technologies [9]. Because of this serious problem, at the United Nations Conference on Environment and Development, United Nations Convention on Climate Change (UNFCCC) came into existence [10]. UNFCCC is an international environmental treaty and has aim to stabilize green house gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system in the shade of Kyoto Protocol, which is an international agreement and has feature to set binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions [11].

Increasing threat of global warming pushes us to go for the solution which is sustainable and climate friendly. Use of renewable energy such as wind, solar, biomass etc. instead of conventional energy sources is one alternative to fight with climate change [12]. Wind as a renewable energy is most popular and fastest growing renewable energy. Apart from its superiority, it also has some drawbacks like its intermittent behavior and high power production cost in comparison to production from thermal power plants [13]. To make such renewable energy sources financially viable the Clean Development Mechanism, Article 12 of Kyoto Protocol came into existence [14].

The Clean Development Mechanism (CDM) has two fold purpose: a) to assist developing countries in achieving sustainable development and b) to assist developed countries in achieving compliance with part of their quantifies emission [15].

3. CASE STUDY DESCRIPTION

3.1. Wind power plant details

The present case study is based on 10.5 MW wind power project, the data has been taken from the site of United Nation Framework Convention on Climate Change (UNFCCC). The proposed clean development mechanism project is situated in the state of Tamil Nadu and owned by M/s. Nidhi Mining Private Limited. Total capacity of the project is 10.5 MW. Four wind turbines of capacity 1.5 MW has been implemented at Erode district in Tamil Nadu while remaining three wind turbines of capacity 1.5 MW each at Tirunelveli District of Tamil Nadu. The project activity has been implemented to generate electricity by the use wind energy as a primary energy source. This wind power plant is connected with Southern grid. At the time of planning about the wind power project, southern grid was dominated by thermal based power generation and which is shown by Figure-2 [16].

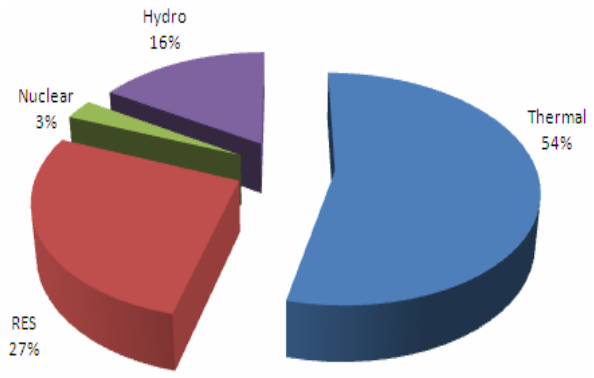

Figure-2. Share of thermal based power production in Southern Grid 2007-08.

To increase the share of renewable energy and less dependence upon the fossil fuel the concept of the project came into existence. As this project was not financially viable so, the only option to increase the attractiveness of the project was to go for clean development mechanism. After so many hurdles this project has successfully got the Host Country Approval from the Govt. of India but was not able to get the positive validation comments from the side of validators, which again was the negative step towards the promotion of use of renewable energies like wind energy. The details of the location Wind Turbine Generator (WTG) installed in above mentioned program is presented in Table-1 where as the technical specification has been presented through Table-2.

Table-1. The location details of Wind Turbine Generators (WTG).

S.N.	SF. No.	Unique Identification no.	Location no.	Latitude	Longitude
1	865/2(P), 3(P)	U1481	Q213	N10°49’05.7”	E77°26’35.3”
2	1366/2(P), 1368(P)	U1482	Q218	N10°48’49.3”	E 77°27’09.0”
3	1373/1(P)	U1480	Q221	N10°48’36.4”	E 77°27’14.4”
4	845/1(P)	U1490	Q392	N10°48’32.2”	E 77°26’53.2”
5	433/1A1(P), 1A3(P)	2483	R217	N8°13’56.9”	E 77°46’02.3”
6	174/3(P)	2472	R321	N8°13’50.1”	E 77°46’29.3”
7	321/4(P),5(P),6(P)	2446	R335	N8°14’53.1”	E 77°47’41.1”

Table-2. Technical specifications of WTGs.

Rotor	
Diameter	82.0 m
No. of rotor blade	3
Orientation	Upwind/horizontal axis
Rotational direction	Clock wise
Rotor blade material	GRP
Swept area	5281m^2
Hub height	78.5
Regulation	Pitch regulated
Operational data	
Cut- in wind speed	4m/s
Rated wind speed	14m/s
Cut- off wind speed	20m/s
Gear box	
Type	Integrated 3 stage 1 planetary and 2 helical
Gear ratio	1:95:09
Manufacturer	Winergy/Hansen
Nominal speed	1650kW
Generator	
Type	Asynchronous 4 pole
Rotation speed	1511 RPM
Rater output	1500kW
Rated voltage	690V
Frequency	50Hz
Insulation	Class "H"
Enclosure class	IP 54
Cooling system	Air cooled
Slip control	Macro slip providing sip up to 16.7%
Operational brakes	
Aerodynamic brake	3 independent systems with blade pitching
Mechanical brake	Hydraulic brakes
Yaw drive systems	
Method of operation	Active electrical yaw motor
Bearing type	Polyamide slide

4. RESULT AND DISCUSSIONS

As per small scale methodology AMS ID "Grid connected renewable energy generation" version 17, emission reduction can be defined as Small scale methodology for "Grid connected renewable energy generation", version 17 [17].

$ER_y = BE_y - PE_y - LE_y$

Where

ER_y Emission reductions in year y (tCO_2/y)
BE_y Baseline emissions in year y (tCO_2/y)
PE_y Project emissions in year y (tCO_2/y)
LE_y Project emissions in year y (tCO_2/y)

Baseline Emission (BE_y): Baseline calculation can be estimated by the use of below mention formula:

$BEy = EG_{BL,y} * EF_{CO2}$

Where
BEy = Baseline emissions in year y; tCO_2
$EG_{BL,y}$ = Quantity of net electricity supplied to the grid by the project activity; MWh
EF_{CO2} = CO_2 emission factor of the grid in year y; tCO2e/MWh.

The project is of 10.5 MW small scale wind power project, which supplies electricity to the southern grid. Emission reduction calculations have been done with the help of publically available Central Electricity Authority (CEA) database version 8 [18] and follows the guideline of CDM Executive Board which is named as Tool to calculate the emission factor for an electricity system version 02.2.1 [19].

As per the small scale methodology AMS ID "Grid connected renewable energy generation" version 17, the project emission based on wind energy will be zero and taking the reference of the same source leakage will also be zero for wind energy projects.

In case of this renewable energy project PE = 0, LE = 0, so ER = BE. The project consist of 7 turbines of 1.5 MW capacity, plant load factor is 29.68% so the net annual generation after the deduction of losses is 26.21 GWh.

Guidelines of Clean Development Mechanism-Executive Board (CDM-EB) i.e., Tool to calculate the emission factor for an electricity system has been used to calculate the combined margin which comes 0.92tCO_2 equivalent/MWh. As discussed above, the baseline emission will be the product of energy generation by the plant and the combined margin which comes around 24192. Emission reduction will be the same in the case of renewable energy.

The generation and selling of 24192 CERs give the considerable monitory benefit which is the positive attitude to cop up with the unattractiveness of the 10.5 MW wind energy project.

5. CONCLUSIONS

If we think about emission free energy then wind energy is the proved best option. Electricity generation by the use of wind energy is in great practice in many developed nations, whereas if we take the case of developing nations, still, it faces lack of technology so more costly in comparison with conventional fuels. Apart

from the higher rate it also has many complications during the period of operation like non equal generation for life time. In that case there must be options which can assist the survival of this kind of energies. There are only two options which can assist this type of renewable energy projects first one is the policies by respective governments to promote renewable energy and second gives focus on revenue earned by the selling of CERs. The option to get register any renewable energy project as clean development mechanism project and earn the CERs is the most feasible case for the promotion of renewable energy. But in the case of above discussed project it was not possible to avail the benefits of CDM because of the firm guideline of CDM executive board. So the flexible guidelines for such renewable energy project should come in existence so that such type of projects can easily get register as a CDM project and to be a viable renewable energy project.

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