International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878 (UGC Approved, Sr. No. 48096)
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

Economic Feasibility Analysis of Repowering a Wind Farm in South India

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Abstract: ***This paper presents an economic feasibility analysis of a wind farm in Thirunelveli district of Tamilnadu State in Southern India. The Data'swere collected from three sites of the same farm to find whether repowering is an economically feasible solution and has been analyzed under two situations. These are the Cost Benefit Analysis of current situation and government wind power subsidy on wind power price for the given wind farm. Results shows that repowering the wind farm is the right move to save energy aswell as to generate a higher profit from the existing wind potential.***

Keywords: Windfarm; Economical Feasibility; Cost Benefit Analysis; Subsidy; Higher Profit

1. Introduction

India has become the 7th largest economy with rapid economic developments since 2010. However almost all of this is fostered by the intensive fossil fuel consumption which now threatens the declining resource storage and environment capacity. Renewable Energy has always been a solution to the day to day energy needs of our country, but to meet with the ever-increasing requirement, this sector needs great development in utilizing the maximum from the available resources at hand.

Repowering or replacing the old wind machines with new, higher sophisticated and higher power wind machines is one way to boost the production as well as to bring in higher productivity. Although the cost incurred in this process is a factor and has to be studied in detail for any flaws before implementation.

Economic Analysis is crucial in determining the success rate of a wind project as well as to identify the amount of subsidy required to make it more attractive over the alternatives. Many previous studies have already been done on analyzing economic feasibility of wind farm from various aspects. Munksgaard and Larsen found the external production cost incurred from the emission of CO2, So2 and NOx generated from combustion of fossil fuel, and from noise and visual effects from wind mills to identify cost effectiveness of wind power plants [1]. In a report by the European Wind Energy Association, the economics of wind energy is analyzed in details [2]. Munksgaard and Morthorst figured out the effect of modified traffics on the prices of Danish liberalized power market and assessed whether the new tariffs make naincentieve to invest in wind power [3]. Ozerdem et al. investigated three different scenarios namely, Independent Power producer, auto producer group and auto producer cases and compared them with respect to net present value (NPV), Internal Rate of Return (IRR) and payback period (PBP) criteria [4]. In this paper, the economic criteria of NPV, IRR and PBP are employed to analyze the economic performance of different scenarios and thereby determine the optimal pathway.

Location based Study
The three wind farm sites are located around 08°17'14.9"N 77°35'42.1"E , 8°15'43.5"N 77°39'04.6"E and 8°13'16.1"N 77°36'25.7"E. The altitudes generally varies between 50 to 90 meters above sea level with an average wind machine elevation of about 73 meters. The temperature here averages to about 27.7 Degree Celsius with an annual precipitation of about 919 mm. Wind velocity changes on an yearly baus with a larger velocity during the months of May to September. The wind farm under study has 122 working wind machines of 410 KW each. The study on repowering this wind farm has been done in three stages. In this paper, the third phase of analyzing whether repowering of wind machines at this is economically feasible is conducted. The stage one cluster analysis based on the production, availability and maintenance cost has ultimately figured the number of machines that could be replaced to yield higher profit as well as higher production capacity for the company. This completed first stage was later followed by a financial feasibility study considering the various financial aspects and loan availability considering the debt equity coverage ratio, hence proving this proposal to be financially feasible aswell. This completed the second stage. It was proposed out of the results from stage 1 and stage 2 that the existing 410KW wind machines can be successfully replaced with new 1500 KW wind machines for higher profit and lower cost of maintenance.

The scheme proposed the installation of ten 1.5MW wind machines replacing 23 of the older machines.

2. Methodology

Economic Feasibility Analysis
Because of the high initial investment, the economic feasibility analysis of a wind plant plays a very important role in determining the viability of a project [5-7]. Three financial metrics such as the Net Present Value (NPV),

Internal Rate of Return (IRR) and Payback Period (PBP) are used in this study.

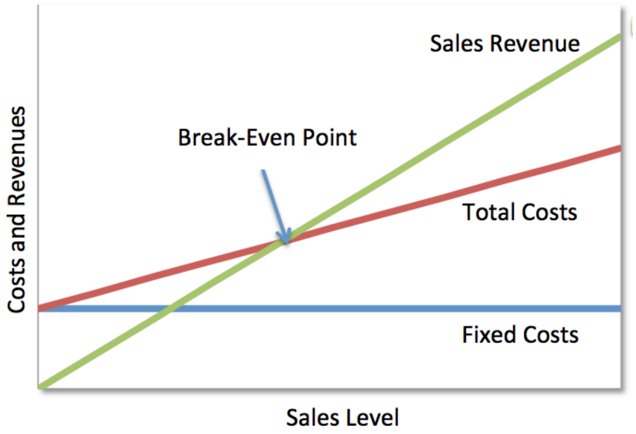
The NPV is the present value of future cash flows. The acceptance criteria of NPV is that when the value of NPV is greater than zero, the project will be accepted; if not it has to be rejected [25]

$$NPV= \sum (B-C)/(1+r)^n$$

Where NPV is the net present value, B is the benefit, C is the cost, n is the period and r is the discount rate. The greater the NPV of a project, the more profitable it is.
The discount rated for which the value of NPV becomes equal to zero is called IRR. It is calculated according to the following equation.

$$\sum[C/(1+r)^n] = \sum[B/(1+r)^n]$$

Payback period is the time required to recover the total investments by profit gaining. This indicator is obtained using the Break Even Analysis Chart, where the payback will be completed once it crosses the breakeven point.



Cost Benefit Analysis of two scenarios

This repowered wind machines are assumed to have a lifetime of 25 years as per the machines standards. It is estimated the the total static investment required for ten wind machines comes about INR 60.00 Crore.While considering the cost incurred in the construction, the total dynamic investment comes to INR 60.561 Crores. An operation and maintenance cost of 1.1% on 85% of capital investment with an escalation of 5% yearly is also included. This cumulative value is added on an yearly basis. Using the above mentioned factors, the economic feasibility of two scenarios is analyzed and the results are listed in Table below.

Scenerio	NPV	IRR	PBP	Remarks
Normal Case	485,391,404.9	19.52%	4.38 Years	Economically feasible
Subsidizing scenerio	683,018,460	26.64%	3.78 Years	Economically feasible

In the normal case the electricity connected to the grid is purchased by a normal tariff of 3.2 INRby the Tamilnadu Government. On the basis of the cost and data series, the annual net profit and economic indicators such as the NPV, IRR and PBP are hence calculated.

From the above, the NPV of this project is485, 391, 404.9 IRR is 19.52% and payback period is 4.38 years or 52 months and 56 days. These results satisfy the presumption that wind power is economically feasible.

The Indian Central government had announced tax free for the first year and a Wind energy production incentive of 50 paise for every unit generated. According to this announcement, the subsidizing scenario is set to monitor the changes of economic factors. Results shows a significant improvement in NPV and IRR. They payback period is also shortened to 3.78 years or 45 months 36 days. It can be inferred from these results that the government subsidy on wind power may generate great incentive for investors to turn into wind power.

As one of the best clean energy sources, the substitution of wind power for any other fossil fuel based power generation can drastically reduce the CO_2 emission aswell as that of other such pollutants.

With this repowering possibility the company will also be able to increase its profit as the maintenance expenses incurred will be very less with higher energy production as compared to the older machines.

3. Conclusion

Harnessing and using renewable energy is an important way that the India can reduce its dependence on foreign oil and slow the pace of global warming. Repowering of the wind farms will lead India as an emerging wind power generator in the world as it has the potential but isn't put to its best use because of the outdated machinery and approach.

One of the biggest barriers in the accelerated development of wind energy in our country is the lack of an updated policy system and outdated machines. The policies the wind energy producers have to follow even at present are the ones that were drafted from the beginning of implementation. The factor that concerns the time value of money also acts as a very crucial factor here. Apart from these, there has been the lack of proper technologies for accurate wind prediction which would mean that the power generation would not be a continuous process as the wind flow might fluctuate from time to time.

Taking into consideration the great range of potential that India holds on, with its South East and South West currents, it is hoped that this study will help level and realize the issues faced by sectors trying to harvest wind energy and to show how economically feasible it is,to invite more parties to take up wind energy generation and let our country achieve energy security

4. Acknowledgment

This study was supported and facilitated by Aban Energies Limited and has been under the guidance of Rajiv Gandhi Institute of Technology Kottayam.

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