

Analysis of Wind Energy as a Widely Preferred Green Energy for both Attributes of Eco-friendliness and Economical Feasibility

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Abstract

A wind turbine model is developed to meet higher Energy output, Eco-friendliness and Economical feasibility and given a name as E³ Wind turbine model. This E³ wind turbine model aims in promising a sustainable future in terms of wind energy. Wind energy is a prominent energy among other green energies. It is shown that the wind energy can more likely be used and can overtake other renewable energies with respect to time of production, area under use and setting up expenditure. The only ignition required to make wind energy as a popular and successful energy used in all spheres of human dwelling is knowledge and awareness among the public. The E³ wind turbine model is studied for various parameters related to design and working. This research paper aims in educating the people in topics as mentioned above.

Practical experimentation is also done using the developed E³ wind turbine that gives higher energy output with ecofriendly and economical features. Preference is given in achieving "Sustainable Development" along with three E factors such as Energy, Eco-friendliness and Economic-feasibility named as E³. Various data is collected from Indian Meteorological Centre, Karnataka State Disaster Monitoring Centre and from few other sources too. Based on both technical and theoretical observations there are recommendations and conclusions given in this paper that help in protecting green environment of mother Earth and in promoting Green Energy.

Keywords: Energy, Eco-friendliness, Economical feasibility Sustainable Development.

1. INTRODUCTION

"Development that meets the needs of the present without compromising the future" is the objective of sustainable development. Reaching this objective universally is the matter of concern to most of the researchers today. To meet this objective, the only way is to protect the naturalist qualities of environment without disturbing its proactive phenomenon. Thus non-renewable energy dependency is day by day increasing though there are renewable energy systems because of lower efficiency and higher maintenance cost. But the only drawback lies in implementing any renewable energy systems is that, meeting the factors of higher Energy output, Eco-friendliness and Economic-feasibility. E³ Wind turbine model is successful in achieving all three factors such as Energy, Eco-friendliness and Economic-feasibility than other green energy systems available today. It has the advantages similar to electricity and crude oil dependent systems. The intervention to this non-renewable energy dependency and to

the systems associated in all spheres of human endeavor is time consuming and economically high. If this trend and dependency is not rectified now it will destroy the future and damages the dream in achieving sustainable future. However, the UN is striving in promotion and making policies aiming global sustainability. One among its efforts in the light of the above topic was highly popular in 1992, UN conference "Our Common Future" that had various agendas over energy, environment etc.

Observation of the wind energy availability to utilize it to the fullest. Thus states such as Andhra Pradesh, Gujarat, Karnataka and Tamil Nadu have the maximum possibility of harnessing it.

Table: 1
MNRE Government report of 2016-17 State wise list of Higher Renewable Energy (Wind and Solar) Potential (in MW)

Sl. No	States/UTs	Wind	Solar
1	Andhra Pradesh	14497	38440
2	Gujarat	35071	35770
3	Jammu & Kashmir	5685	111050
4	Karnataka	13593	24700
5	Madhya Pradesh	2931	61660
6	Maharashtra	5961	64320
7	Orissa	1384	25780
8	Rajasthan	5050	142310
9	Tamil Nadu	14152	17670
10	Uttar Pradesh	1260	22830

2. WIND TURBINE MODEL

It is a unique model with acquainted appearance. Here are various features and parameters that deal with design, Principle and Working of E³ wind turbine, Advantages of E³ wind turbine, Disadvantages of E³ wind turbine and Application of E³ wind turbine.

2.1 Design

E³ wind turbine model is designed in such a way that, even a little wind speed can generate a considerable energy. This energy can be stored and used. Considering the availability of resources this wind turbine was constructed. Materials such as aluminum sheets as wings for turbine, Dynamo as a generator of electricity from wind and a stand to make the wind turbine

structure to stand still are used. The blades are bent at *semi-circular* shape at the bottom 180° and are at *uniformity-straight* at 180° to the corresponding blades on the top. (Fig.1-Fig.4)



Fig.1. E³ Wind Turbine Model



Fig.2. Dynamo



Fig.3. Permanent magnet generator



Fig.4. Generic wind power driven DC generator

2.2 Principle and working of E³ wind turbine

Usually wind turbines operate on a simple principle. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. This is implacable for all electricity generating bodies such as permanent magnet generator, generic wind power driven DC generator and so on including a dynamo. However here we have considered a dynamo powering 6V for E³ wind turbine model's practical work-ability. However, Table 2 gives an proportional increase in energy output by replacing dynamo with permanent magnet generator, generic wind power driven DC generator.

Table 2: Energy output of permanent magnet generator (P M G) and generic wind power driven DC generator (G W P D DC G D)

Sl no	Device Name	Rpm	Volts	Current
1	P M G	4200 rpm	36V	30mA
2	P M G	2800 rpm	24V	20mA
3	P M G	1200 rpm	12V	18mA
4	G W P D DC G D	Higher energy output compared to both permanent Magnetic Dynamo		Generator and

The Efficiency can be calculated by Power Coefficient (C_p)

$$C_p = \frac{\text{Actual Electrical Power Produced}}{\text{Wind Power into Turbine}}$$

2.3 Advantages of E³ wind turbine

- It is easy to construct and develop it
- It is easy to make it work at relatively low wind speeds
- It works 24/7 unlike solar panels. However wind speeds matter.
- It ensures economic feasibility, since its cost of construction is relatively low.
- It ensures environmental friendly features since biodegradable materials are used and re-cyclic too
- Easily accessible by the middle and the lower classes

□ A national product that is a design and idea of this nation, ensures patent rights within. This reminds us policies such as 'Make in India' and 'Skill India' that ensures prosperity and self-dependency of the nation in all spheres of society.

□

2.4 Disadvantages of E³ wind turbine

1. Since this wind turbine is easy to construct and develop there are high chances to duplicate this model. Thus affects its output benefits.
2. Energy can be produced only by the wind speeds and thus if there is a failure of wind moments with respect to speed it hampers the energy output.
3. Betz's Coefficient is also important since if the wind speed is low and only 16/27, 59.3% is used, then its output is lesser.

2.5 E³ wind Application of turbine

According to annual report of 2016-17 wind energy is the most abundant green energy available in India after solar energy. Therefore E³ wind turbines have greater application because of its E³ features such as, higher energy output, eco-friendliness and economical applications in any place with lower wind speed too. Here are some applications that are newly applicable and suggested uniquely in this paper.

2.5.1 Implementation of E³ (vertical) wind turbines in transmission towers: - The E³ wind mills are efficient and prizewinning if they are incorporated in the transmission towers at cage and tower body region(Fig.5 and Fig.6). However, the space allowance for any repair, rectification in structure should be allowed and made. If this is focused and dealt in detail and if there is a vision in using this space as a resource for generating electricity from wind energy, then energy crises associated with regions and areas closer to these transmission ways will be benefited brightly. There may me words of opposition in-terms of implementing this fruitful idea. But consideration of proper wind and other climatic data, insulating techniques, earthing, grounding, providing vibration dampers, calculating load capacity, insulation and other safety factors will help us in bringing this idea into a reality. This area demands further study and research in getting the maximum output from this fruitful idea. Transmission towers are of different types and can be installed in few feasible types.

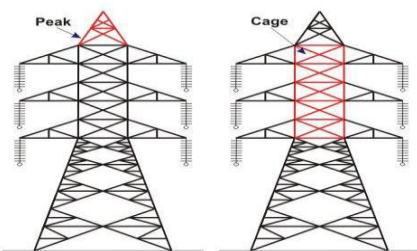


Fig.5. Cage in a transmission tower

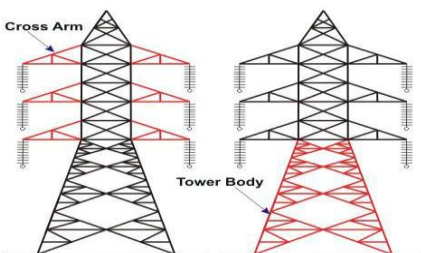


Fig.6. Body in a transmission tower

2.5.2 Implementation of E³ (both vertical and horizontal) wind turbines in highways: -

The secret behind generating electricity from wind energy is wind speed factor. Firstly when there is moment of vehicles in highways it ignites artificial wind moment. Secondly when the highways are flat and obstacle free the natural wind itself is enough to rotate the wind turbines. Thus both natural and artificial wind energy ignitions happen on highways for which we can recommend vertical E³ wind turbines in the sides of the highways and grounding, providing vibration dampers, calculating load capacity, insulation and other safety factors will help us in bringing this idea into a reality. This area demands further study and research in getting the maximum output from this fruitful idea. Transmission towers are of different types and can be installed in few feasible types.

Table 3: Data From KSNDMC - Average Wind Speed (Km/Hr)

State	Karnataka
District	Urban Bangalore
Month	Date: 1 st to 30 th
January	12.16
February	11.28
March	12.57
April	13.60
May	17.13
June	26.59
July	23.93
August	23.48
September	16.2
October	11.65
November	11.96
December	12.98

Horizontal E³ wind turbines horizontally above sign boards and in regular energy generating interval points. This implementation can fulfill the electrical energy demands of highways in-terms of lights, sign board lights, signals in certain junctions and also in facilitating electricity to electricity bunks. The electricity bunks are those similar to petrol bunks where vehicles using electricity as fuel, refill their vehicles with this green fuel i.e, electricity. Though electrical vehicles are not commonly used in developing countries and developed countries are also lacking in its successful implementation, thus these measures conflagrate the use of electrical vehicles usage.

2.5.3 Implementation of E³ (both vertical and horizontal) wind turbines along railway tracks: -

When trains move in high speed, they also create the air movement velocities. This idea can be applied and thus wind energy can be used even in the railway systems.

2.5.4 Case study over implementing E³ wind turbines at Presidency University

It is observed that there is favorable wind speed available in Bangalore where Presidency University is located. Presidency University is located exactly in 13.1682*N 77.5354*E. The wind speed data is also obtained for the same from KSNDMC. A organization named ‘Hero Future Energies’ was interested to fund, install and maintain a rooftop solar power plant for Presidency University. According to ‘Ministry of New Renewable Energy Rating’ it has designed a matrix named ‘Grading Matrix’ for factors of performance capability v/s financial strength, which was suggested for the same. However the total energy consumption of Presidency University per month is 34,000 units per month. On average, monthly electricity bill is being paid is likely to be Rs.3,50,000. The whole electricity demand of the university campus is 190kW per month. This is a great demand of electricity, thus it is very important for the University to depend on green energy systems at the earliest. Wind speed in Bangalore is taken into account for the installation of wind turbines in University campus since the University is setup is a pa generating electricity from the green energy i.e, wind energy. However it is in a isolated environment from the city hub. Therefore there is a greater chance forced that during monsoon period there is greater energy output since the wind speed is high.

Table: 4 Grading Matrix: -Financial Strength v/s Performance Capability Grading Matrix

		High	Moderate	Low
PC	Highest	SP1A	SP1B	SP1C
	High	SP2A	SP2B	SP2C
	Moderate	SP3A	SP3B	SP3C
	Weak	SP4A	SP4B	SP4C
	Poor	SP5A	SP5B	SP5C

Therefore from the above data we can tell that it can run E³ wind turbine model efficiently compared to solar energy’s productivity too. According to HFE and Ministry of new renewable energy a solar energy ‘Grading Matrix’ is provided. However in practical solar energy is efficient only during the bright sunlight (Day). But Wind energy based E³ wind turbines are successful working 24/7 both day and night, thus its output “soars to the sky”.

3. CONCLUSION

“Of all the forces of nature, I should think the wind contains the largest amount of motive power - that is, power to move things. Take any given space of the earth’s surface - for instance, Illinois; and all the power exerted by all the men and beast, and running water-water, and steam, over and upon it, shall not equal the one hundredth part of what is exerted by the blowing of the wind over and upon the same space. And yet I has not, so far in the world’s history, become proportionally valuable as a motive power. It is applied extensively, and advantageously, to sail-vessels in navigation. Add to this a few windmills, and pumps, and you have about all. ...As yet, the wind is an untamed, and unharnessed force; and quite possibly one of the greatest discoveries hereafter to be made will be the taming and harnessing of it.” - Abraham Lincoln. In the light of these motivating words its remarkable to conclude by appreciating the fruitful works and efforts of certain organizations both government and private sectors. Organizations such as World Wind Energy Association, Global Wind Energy Council, Ministry of new renewable energy-India, BEEJ - Green (R) evolution and many more are aiming in creation of green world with green energy ideas and innovations. Firstly awareness must be created among youngsters. For this we remark the efforts of the program GREEN(R) EVOLUTION - action against climate change. This was a program in educating and evaluating the youth in terms of environment, energy, global warming and steps to resolve the damage already caused and to avoid the future damages to the environment.

It is also important to mention that as this work is the start of a huge bonanza in the field of green energy systems and especially wind energy. This basic E³ wind turbine model had high chances of non-achievement of its expected outputs and goals in the first attempt. It was because of the perfection-errors due to lack of time and expertise. However these can be collectively rectified and redefined in further works of this research. Though there is relatively lower energy output, it is capable of generating energy that helps us to at-least charge a mobile phone, when the generated energy is stored in a battery. However higher energy generating devices such as permanent magnet generator, generic wind power driven D C generator and so on can be used instead of a dynamo and similarly the output of each is depicted above . Energy demanded in all spheres of human dwelling is so high such that E³ wind turbines can possibly help in facilitating and fulfilling 100% energy demanded by proper application and installation at all practical places.

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