

IMPERATIVE ISSUES ASSOCIATED TO MICRO WIND TURBINES

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Abstract— Large wind turbine technology to produce and supply electricity to grid is well developed. On the other hand there are many disputes about the capability of small wind turbine. A micro wind turbine, which is turbine with a power output up to 1000 W, have to date not received attention of researchers. Till date only few manufacturers are involved in micro wind turbine industry. Some of these micro wind turbines are studied and compared. After the comparative analysis some points are suggested to get more power from micro wind turbine systems.

Keywords— Micro wind turbine, Rated speed, Power

I. INTRODUCTION

Environmental consciousness is changing day by day worldwide. Today's consumers are much more concerned about how their electricity is generated and the effect that has on the planet and its stability. Climate change is firmly on the political agenda of many countries. Increasingly electricity bill payers can also choose the color of the power that's delivered to their door, rejecting 'brown' from climate – damaging fossil fuels in favor of 'green' from the climate friendly renewable energy.

Most companies operating in the growing renewable energy market, however are involved in generating power, building wind farms to sell their output to established utilities whose main supply comes from non-renewable sources. At the end of March 2012, worldwide capacity of wind power generation reached about 282,587 MW.

India has made significant progress during the past 30 years in renewable energy applications, mainly in power generation from wind, mini hydro, biomass and solar energy. 'World Watch Institute, Washington' recognizes India as 'Wind Superpower'. [3] Over the last few years, the use of renewable energy to supply electricity for remote homes, clinics and schools has increased tremendously. Small wind turbines and a hybrid wind – solar system can contribute significantly in meeting energy requirements of rural areas.

A. Economy of Wind Energy

Considering fiscal benefits the average cost of generated energy from hybrid system can be estimated at Rs 7 to 8 per energy unit, comparable to fossil fuel generated cost under captive power at present. But this cost is nearly fixed for the next 15 to 20 years where as cost of the fossil fuel produced energy can be estimated as Rs 16 per energy unit five years from now.

The cost of solar electric generating system is Rs 3 to 3.25 lakh/kW, while cost of wind solar hybrid

system is Rs 2.50 to 2.75 lakh/kW, further cost of small wind turbines is Rs 1.70 to 1.80 lakh/kW, and cost of conventional power is Rs 0.80 to 0.90 lakh/kW. With small wind turbines, the cost is only double the cost of conventional power, but the life of the system is 15 to 20 years. Therefore, on a medium to long term time scale this will be economical. Cost of small wind systems is less than half that of comparable solar photovoltaic systems. Wind turbines are efficient when compared with biogas. Thus, small wind turbines offer a promising alternative for many remote electrical uses where there is a good wind resource.

II. TECHNOLOGICAL DEVELOPMENT OF LARGE AND SMALL WIND TURBINE

In recent years, an interest in wind energy has been growing and many researchers have attempted the development to introduce cost-effective, reliable wind energy conversion systems all over the world. For many reasons, wind turbines have been introduced and operated in a wide area. In practice, however, there are many difficulties to introduce the wind turbines into the community because of less wind energy source, profitability or noise emission, etc. So, the decentralization or local clusterization of renewable energy plant make it be attractive not only to developing area, where a lot of people do not yet have access to conventional electricity service, but also to an urban area where one can make better living space for future generations. Many kinds of wind turbines have been introduced into such an area and been examined its performance practically. Small to large wind turbines have been working for meeting energy needs.

The comparatively large-scale wind turbine developed commercially by many researchers, are put into service. On the other hand, although a small wind turbine would be applied to the area where a large-scale wind turbine could not be constructed. The basis for the comparison is the mature technology

available for large turbines which has yet to be fully diffused downwards. After defining and categorizing the important features of small turbines, the paper considers the some issues of the micro wind turbines available in market.

III. CLASSIFICATION OF SMALL WIND TURBINES

Small turbines usually rely on aerodynamic torque for starting, and on a tail fin to point the blades into the wind. These two features are so common that they can be taken as defining a small turbine. As shown in Table I, we have divided small turbines into three categories: micro, mid-range, and mini wind turbines,

Table I summarizes typical operating parameters for our three categories. It is emphasized that the entries in the table are typical values and there are wide variations in them all.

Most turbines manufactured today are horizontal axis upwind machines with two or three blades, which are usually made of a composite material such as fiberglass or carbon fiber. The amount of power a turbine will produce is determined primarily by the diameter of its rotor. The diameter of the rotor defines its "swept area," or the quantity of wind intercepted by the turbine.

TABLE I. SMALL WIND TURBINE CLASSIFICATION

Category	Power (kW)	Rotor Radius (m)	Rotor Speed (rpm)
Micro	Up to 01	Up to 2.0	700
Mid-range	01- 05	02 - 05	400
Mini	20 - 100	05 - 10	200

IV. EVALUATION OF MICRO WIND TURBINES AVAILABLE IN MARKET

In the advertising wars, the high ground on the power curve that manufacturers try to take is the point at which the wind turbine reaches its rated or nominal power. Whether this is important or not relative to how well the wind turbine actually performs in the field is hotly contested. Wind turbines reach their rated or nominal power at their rated wind speed in mph or meters per second (m/s). Rated power is not the same with peak power, though they are occasionally the same.

There are no rules, standards, or norms about what wind speed manufacturers may pick to "rate" their

small wind turbines. Often in the United States it's 12.5 m/s. But manufacturers may pick any speed they choose. If it's less than 12.5m/s, the turbine will have a lower power rating than a wind turbine with a similar sized rotor but with a higher rated speed. Rated power at a rated speed is just one point on a wind turbines power curve, yet many consumers rely on the rated power and the power curve when comparison shopping. But not all power curves are created equal. Some power curves are, to be diplomatic, more aggressive than others.

So here some micro turbines are considered for studying various aspects such as power output with rated speed, number of blades, weight, etc. The systems selected for the because of mainly two reasons: firstly, they are, apparently, the outcome of current turbine technology, and secondly, a description is available on the web. The various micro wind turbines are compared for their specifications.

The evolution of micro wind energy conversion systems over the past few years has been one of increasing efficiency, improved reliability, and lower costs. The current state of the small wind turbine industry is summarized in Table- II, which lists the specific ratings of above selected wind turbines. Fig. 1 plots the specific rating of those machines listed in Table – II.

TABLE II. MICRO WIND TURBINES EVALUATION

Model	Rotor Diameter (m)	Power (W)	Specific Power
AIR-X	1.14	400	0.449843
AIR 403	1.17	400	0.438308
AC- 502	2.4	500	0.545249
500W	2.0	500	0.356125
SP 500 W	1.8	500	0.320513
ACSA-LMW-600	2.2	600	0.549451
700 W	2.2	700	0.34965
Ampair 600 (24 V)	1.7	723	0.407925
AC- 752 / NE	2.4	750	0.267094
ACSA-LMW-1000	2.8	750	0.400641

Cyclon 800W	2.4	800	0.42735
WHISPER 100	2.1	900	0.480769
TA 2.4, 900	2.4	900	0.534188
AC- 1002 H	2.4	1000	0.474834
WHISPER 200	2.7	1000	0.343407
ACSA-LMW-1 500	3.12	1000	0.457875
FL1 – 48 V	3.1	1000	0.413565
SP 1000 W	2.8	1000	0.410914

CONCLUSION

From the comparative analysis of micro wind of different manufacturers some conclusions are drawn for government policy and technical disputes discussed in subsequent paragraphs. Also some suggestions are given to improve policies and technology.

Also Power curves of various wind turbines are shown by Fig. 2. Different power curves patterns are obtained for these turbines.

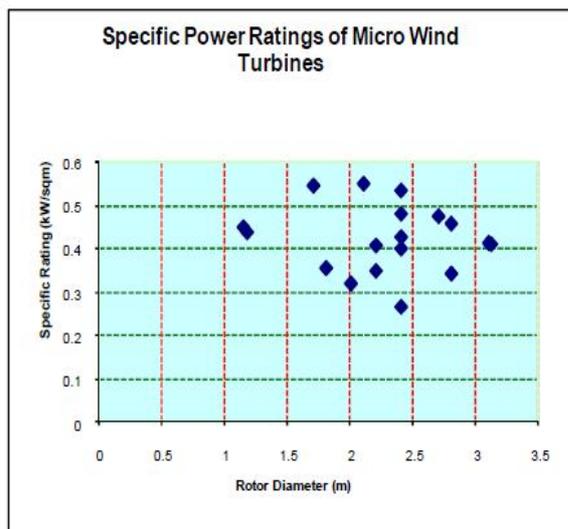


Fig. 1. Specific power ratings of micro wind turbines

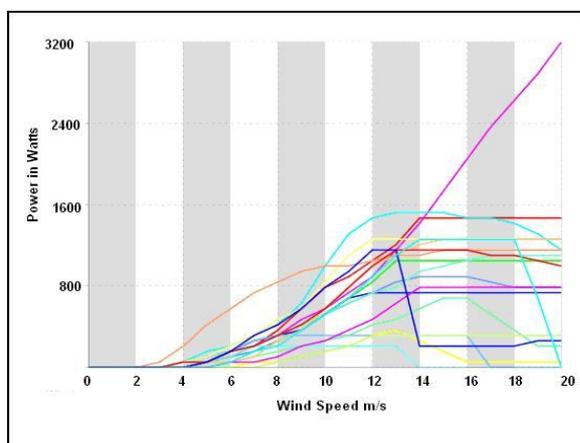


Fig. 2. Power curves for different micro wind turbines

1. There are only few countries like UK, Germany, USA, Japan, Italy, Turkey, Australia, China, and Taiwan in which some manufacturers are manufacturing Micro Wind Turbines.
2. Unfortunately, the India which can be considered as “Wind Superpower” with highest wind power potential of 45000 MW not even single manufacturer is manufacturing Micro or Small wind turbines. There are only few agencies which are importing major wind turbine components (Rotor, Generator and Battery) and only manufacture tower as per need. Here it is expected form Indian industries to manufacture complete MWT systems in India.
3. Government of India having subsidy schemes for using micro wind turbine systems with solar photovoltaic (Hybrid Systems). In this scheme it is compulsory to take hybrid system. Only wind turbine system is not permitted. The solar system increases total cost, which is not affordable to common man even after subsidy. Also sanctioning of the system takes around 6 – 10 months. Also government is not serious about MWT utilization. So here promotion of MWT system is expected from government. Also Only stand alone MWT system should be permitted with subsidy. And sanctioning period can be reduced by giving sanctioning authority to state government instead of MNRE centralization.
4. The power generated by the various systems shown by the manufacturers is not seems true. In some cases manufacturers claims power more than theoretical power. This is because to attracts customers they claims power at higher wind speed (generally above 12 m/s). Generally wind speed is upto 10 m/s and at most windy places average annual speed is only 6 m/s. And also standard testing procedures are not followed by manufacturers. Standard testing procedures should be revised and these should be made compulsory.
5. From the Fig. 1 large variations in specific

power rating (0.26 - 0.54) (Power produced per square meter swept area) is observed. It indicates technological variance. The efficient blade profiles with good material are suggested here for better power generation. Also, permanent magnet generator is not used by all manufacturers. Still some are using induction generators. A PM generator delivers more power.

6. An important aspect observed from few turbines related to output voltage. It is observed that the power generated is also depending on output voltage. Researchers should focus in this field.
7. Some researchers are working on Innovative models of wind turbines. But manufacturers are not showing their interest in these systems because of market demand. So global promotion scheme for MWT is required. Diffuser augmented wind turbines have proved its capability at moderate level. Commercialization of such new turbines is required.
8. It is a fact that there are many disputes about the capability of small wind turbine. However, because of compactness, portability, simple structure, low noise level in driving, and so on, small wind turbine systems can be integrated as a clustered system of renewable energy for the various areas.

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