

# Hybrid Solar-Wind Power System

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*Abstract – Development, promotion and application of renewable energy resources has certainly become the need of the hour. With exponential increment in demand and usage of non-renewable energy resources, we all are aware that the time isn't very far for complete extinction of these resources, leaving us vulnerable. Nations competing with each other for socio economic development are highly dependent on their energy resources and the source of this energy. Over the past few decades, inclination towards the renewable resources has been continuous, giving scope to a much cleaner source of energy, be it due to global warming or depletion of fossil fuels. This paper concentrates on studying the provision of reliable electric system using solar-wind hybrid power systems that harnesses the renewable energy in sun and wind to generate electricity, taking into account maximum power point tracking. Hybrid nature of the system brings redundancy with it, increasing reliability and reducing the dependency on the single source. Measurement and analysis of the preferred site has been done in order to check availability of the resources. Since the capacity factor of the power systems running on renewable resources is more of a question of availability of wind or sun, as they are random in speed, direction and time, and are mostly affected by weather, hence combining both as a hybrid, to harness power can be much more reliable and realistic power source.*

**Keywords:** Renewable, Solar, Wind, Hybrid, Maximum Power Point Tracking, Sensors, Power.

## I. INNOVATION

Using hybrid power source, requires urgent attention as it brings better opportunity for reliable power source of energy. Because of the availability factors, of solar and wind resources, we now need to get maximum output from the following hybrid system, hence optimising it using sensors such as solar trackers, to track sin direction for solar panel pointing using gimbals, or two axes system for both azimuth and tilt angles, as well as sensors to track direction of wind to manoeuvre wind mill's direction. Also, we will be optimising the hybrid system using maximum power point tracking system for solar panels.

## II. INTRODUCTION

Fuel shortage is soon going to become a major threat to the world, and as per law of conservation of energy, "energy can neither be created nor be destroyed, but it can only be converted from one form to another". Researchers have been evolving technologies and methodologies, to use renewable source of energy, a better option to use for the users, compared

to soon to be extinct non-renewable sources. In the past decade, both the solar and the wind have noticed great development in their fields and are growing with a great pace. Both the sources are remarkably pollution free and can provide abundant power.

India's energy demand continues to rise. India consumes its maximum energy in Residential, commercial and agricultural purposes. Chennai, itself holds a large scope of utilising the renewable resources as it has ample amount of these resources. Using, the hybrid system will only bring own our dependency on fossils, decrease the burden on the grid and make it more reliable to use.

### III. WIND POWER SYSTEM

Wind energy is the kinetic energy associated with the movement of atmospheric air. Wind energy systems convert this kinetic energy into more useful forms of power. Wind turbines transform the energy in the wind into mechanical power, plus windmills are used to [ump water from an ancient time in rural areas. The direction of the wind flow is dependent on the temperature differences of the regions, moving from warmer region to the colder region, carrying enormous quantity of energy. The wind generator units convert wind power into electrical power.

The wind passing creates a torque, which then drives the generator, hence producing the electric power. Wind energy is certainly the least expensive renewable energy technology in existence. Wind is available in abundance, possibly everywhere in the world and it will not get depleted with use. But as we all know, wind is variable in its features, both the speed and direction, in such a case, it becomes our priority to get maximum output of it, so that it can compete with the conventional resources such as fossil fuels, coal etc.

Capacity factor is a common factor used for determining reliability of the power source, as it is the ratio between powers produced over time to the power that could have been produced if the generation source operated at maximum output. Since for a wind power system, it depends upon the availability of the wind, hence it cannot work at its maximum output for the whole time, compared to this, the non-renewable resources, gives us better much better and larger capacity factor.

Two types of wind turbine designs are:

1. Horizontal axis wind turbine (HAWT): their axis of rotation is horizontal, their main rotor shaft and electrical generator at the top of a tower, and are pointed into the wind. It uses gear system that enables a constant speed of rotation to the generator thus enabling constant frequency generation.
2. Vertical axis wind turbine (VAWT): these have the main rotor shaft arranged vertically as the plane of rotation is vertical. Biggest advantage of VAWTs is they don't require a yaw control mechanism to be pointed into the wind. Thus these are useful at sites where

wind direction is random or at places where there is presence of large obstacles like trees, houses etc. one of its drawback is its low efficiency of wind production.

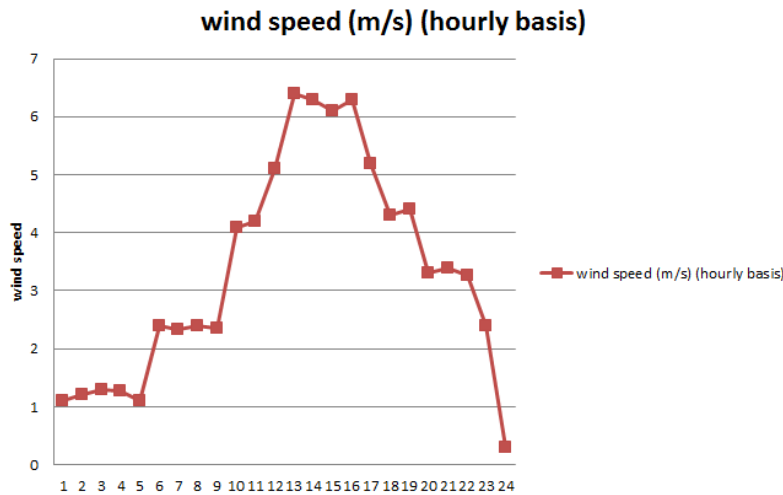


Fig 1. Wind speed (m/s) (hourly basis)

## V. SOLAR POWER SYSTEM

Solar energy is energy from the Sun. It is renewable, inexhaustible and environmental pollution free. Solar energy is expected to be the most promising alternate source of energy. It is becoming difficult to fuel the generators running on conventional power systems, if they are to be used for the commercial purposes. Solar energy is produced by the sun by the process of thermonuclear fusion, the process creates heat and electromagnetic radiations. The solar energy irradiation at the site is a major factor in selection of the implementation of the project.

PV cells or the photovoltaic cells are p-n junction diodes with large areas and the junction positioned close to the top surface, converting sunlight into electricity directly. Because much of the current PV technology uses crystalline semiconductor material similar to integrated circuit chips, the production costs have been high. Its advantage in installation is that it does not need strong tall towers, produces no vibration or noise. Solar power system consists of collector unit and the storage unit, where storage unit (battery bank) holds the excess energy produced during the period of maximum productivity and supplies the backup power whenever required.

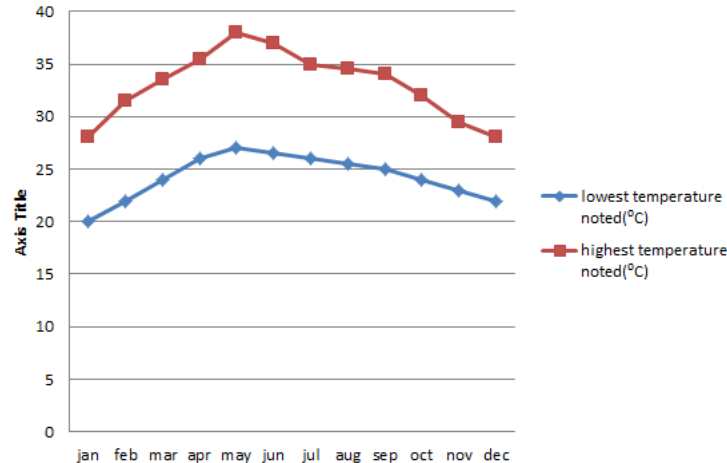


Fig 2. Recorded monthly temperature ranges

## VI. MAXIMUM POWER POINT TRACKING (MPPT)

It is a technique that is used to track maximum amount of energy falling on solar panels. While using sun trackers to track the sun direction for getting maximum output we make use of MPPT algorithms with sun trackers. Here, we will be using two axes sun trackers, providing both azimuth and tilt angles are varied whereas in a single axes system tilt angle is fixed and azimuth angle is varied.

## VII. PROJECT OBJECTIVE

Renewable energies, in the coming future are going to play an essential role in saving the current situation of endangered conventional resources. Using hybrid systems, either having a combination of both renewable resources, or the combination of one renewable and other non-renewable resource, is essential as to increase reliability of the system and decreasing burden from any one particular resource. Hybrid power system consist of a combination of renewable energy source such as wind generators, solar etc. of charge batteries and provide power to meet the energy demand, considering the local geography and other details of the place of installation. The best application for these type of systems are in remote places, such as rural villages, in telecommunications etc. The importance of hybrid systems has grown as they appear to be the right solution for a clean and distributed energy production.

Our project objective is to use solar wind hybrid system installations in the college for running Street lighting around the campus, completely dependent upon the installed system, as well as using it to provide or fulfill low energy demands of some particular areas in the college.

### VIII. HYBRID POWER SYSTEM

Availability of the resources is a big drawback when we talk about renewable resources, as the wind does not blow throughout the day and the sun does not shine for the entire day, using a single source will not be a suitable choice. A hybrid arrangement of combining the power harnessed from both the wind and the sun and stored in a battery can be a much more reliable and realistic power source. Hybrid systems are usually built for design of systems with lowest possible cost and also with maximum reliability. Due to high cost of the PV cells, they cannot be used for larger capacity designs. This is where the wind turbine comes into the picture, the main feature being its cheap cost as compared to the PV cells. By adopting the appropriate technology for the concerned geographical location, we can extract a large amount of power from solar radiations. More over solar energy is expected to be the most promising alternate source of energy. Battery system is needed to store solar and wind energy produced during the day time. During night time, the presence of wind is an added advantage, which increases the reliability of the system. In the monsoon seasons, the effect of sun is less at the site and thus it is apt to use a hybrid wind solar system. Cost benefit is also a factor that has to be incorporated into the process of optimizing a hybrid energy system. In general, the use of wind energy is cheaper than that of solar energy. The solar-wind hybrid system is more cost-effective and reliable.

Block diagram of wind solar hybrid power system:

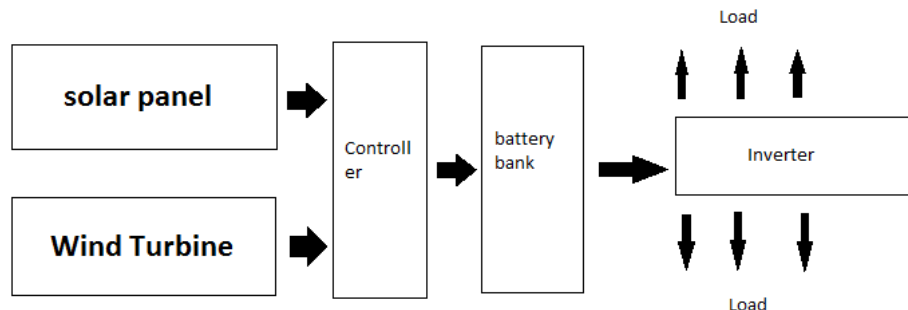


Fig 3. Model Setup (Block diagram)

### IX. SITE ANALYSIS

Project site: Location: S.R.M. university, Kattankulathur

Latitude: 80.0440 degrees east

Longitude: 12.8229 degree north

Located near the sea as well as near equator, Chennai is having its own benefit and opportunities to use wind and solar resources aptly, to its fullest. Hence the site is rich in both the resources, solar as well as the wind. With highest temperature ranging from 28 degrees Celsius

to 38 degrees Celsius annually, and a maximum of 13.64 m/s wind speed, giving us optimistic results for the system installation. We analyzed the wind speed hourly variation near the site as well as the yearly wind speed variation in Chennai, along with that we also have analysed temperature variations along with the sunshine timings differences and have an optimistic approach towards the hybrid system to harness power in more reliable way.

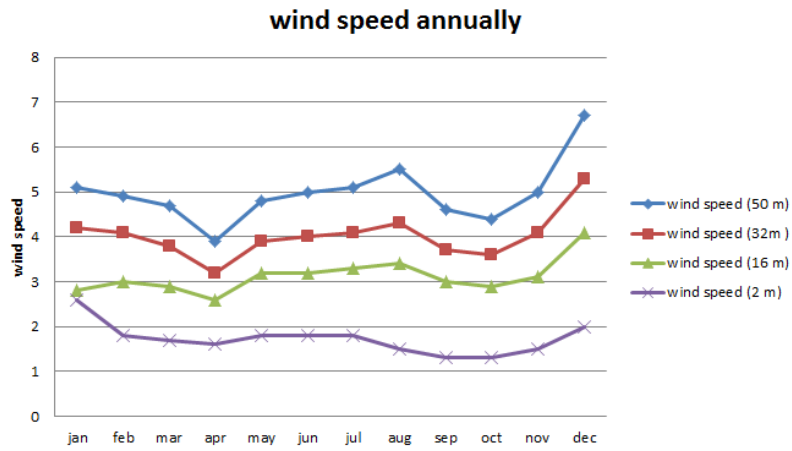


Fig 4. Wind Speed annual

## X. CONCLUSION AND FUTURE SCOPE

Hybrid systems are having a long way to go, and with the evolving technology and help of research in this area, we will be able to reduce our dependency on the conventional non-renewable resources, and it provides a better reliable power system than other standalone systems.

Our analysis of weather in Chennai, near S.R.M. University, to install a hybrid system, has given us an optimistic approach for further working, for future work, we will come up with the calculations such as total power consumption by the battery and the daily depth of discharge(DOD).

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