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Estimation of Potential for Hybrid System: A Case Study of MANIT, Bhopal

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ABSTRACT: The aim of an observed wind & solar energy measurementis to provide information to allow the best possible estimate ofthe energy on the site. Wind & solar energy potential isimportant factor in assessingthe uncertainty in the annual energy production for the hybrid energy system at site.The paper provides the status of wind energy and solar energy for designing an off-grid Hybrid System to meet the electrical demand of a residential sector of MaulanaAzad National Institute Technology, Bhopal, India. This system is intended to be cost effective and make building self-sufficient with regard to energy use. Residential sector of Maulana Azad National Institute Technology has 335 houses. Currently they are connected to grid. The connected load of residential sector is 500 kW. The monthly speed wind data has been collected from Synergy Enviro Engineers (India) Private Limited.The monthly solarirradiance data for Maulana Azad National Institute Technology has been calculated by HOMER software.

KEYWORDS*: Hybrid System, MANIT, Residential Sector, Solar Irradiation, Standalone system, Wind speed.*

I. INTRODUCTION

The residential sector contributes 15-20% of total electricity bill of the campus. The campus has a connected electrical load of 1.4 MW (includes campus load as well as residential load) and a contract demand of 1000 kVA. The renewable energy sources have a large amount of advantages, including sustainability, low emissions, and economical benefits. However, most of these energy sources have an intermittent behaviour due to atmospheric conditions. Therefore, it is necessary to combine more than one type of renewable source to improve the robustness of the power system. This is, therefore, a hybrid power system based on renewable energy sources [1]. In order to ensure continuous power generation by renewable energy, a hybrid system including more than one energy source is integrated. In many cases, a PV-Wind system is the more reliable hybrid combination [3]. To increase the reliability of the renewable energy system, the most suitable method is to develop Integrated Renewable Energy Systems (IRES) which rely on multiple generation technologies [2]. Renewable energy sources, such as wind and solar, can power decentralized generation technology with low operating & maintenance costs as well as the added benefit of zero emissions. Renewable energy technologies, however, tend to have significant upfront costs [5]. The power generated from both wind and solar components is stored in a battery bank for use whenever required. A hybrid wind–solar electric system demands a higher initial investment than single larger systems: large wind and solar PV systems are proportionally cheaper than smaller systems [4]. Hybrid renewable energy systems have good potential to provide higher quality and more reliable power to customers than a system based on a single resource. Renewable energy sources can complement each other. Hybrid renewable energy systems are mainly recognized for residential domain power applications and seem, nowadays cost-effective where extension of grid supply is expensive [5].
The paper provides the status of wind energy and solar energy for designing an off-grid Hybrid System to meet the electrical demand of a residential sector of Maulana Azad National Institute Technology, Bhopal, India.

II. SITE CHARACTERISTIC

The institute campus has wide area available for installation of proposed system. 97398.81 square meters vacant area behind Energy centre is chosen for installation of proposed scheme. The selected sites geographical details are as follows.
Latitude 23.213609
Longitude 77.405547

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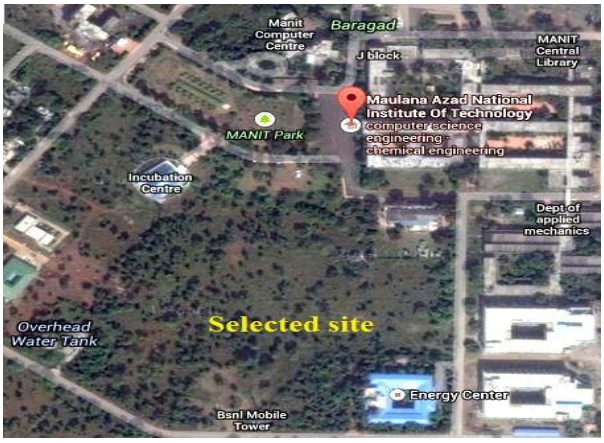
In summers site remains very hot and dry. Season of summer starts from April and lasts until the month of June, while bringing about a steep rise in the temperatures. The maximum temperature may reach to 47.7°C & the minimum temperature is recorded at only 24.9°C. The trees dry down &there is scarcity of water in some places during this season of summers.

In winters site is very cold and damp. The season lasts for four months - November, December, January & February. During winters, maximum temperature rises up to 24.5°C. However, there can be a sudden drop in the temperature during nights. Minimum winter temperature remains around 8°C. normally cold days are accompanied with winter sleets and heavy fog.



Source: Google Earth
Fig. 1 Selected site for installation of proposed hybrid system.

III. WIND ENERGY POTENTIAL

Following table shows the monthly wind speed. Wind speed data has been taken from Synergy Enviro Engineers (India) Private Limited.

TABLE I
Monthly wind speed data

Month	Avg. wind speed (m/sec)
January	3.04
February	3.33
March	3.35
April	3.79
May	4.44
June	4.64
July	4.17
August	3.49
September	3.15
October	2.47
November	2.46
December	2.75

Annual average of wind speed 3.42 m/sec

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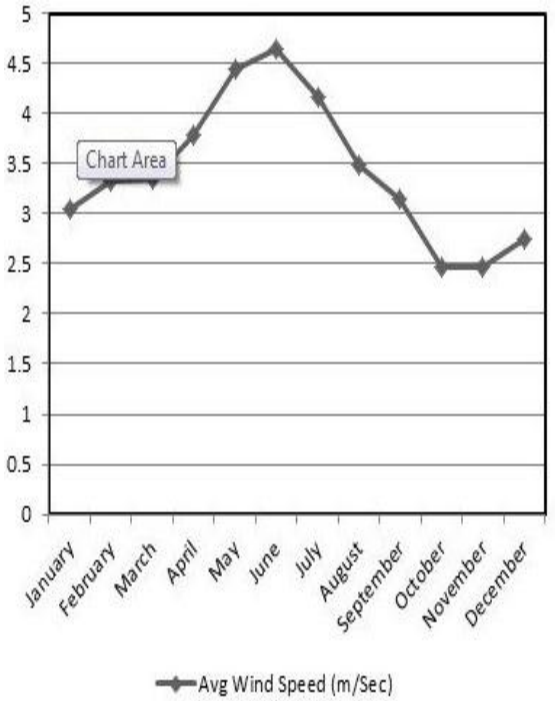

Fig. 2: Monthly average wind speed data (m/sec).

IV. SOLAR ENERGY POTENTIAL

Table II shows the monthly solarirradiation data at selected site (MANIT). The Solar irradiation data has been generated by HOMER software by entering the Latitude and Longitude of the selected site shown in Fig. 1.

TABLE II
Monthly solar irradiation data

Month	Avg. solar Irradiation ($kWh/m^2/day$)
January	4.72
February	5.70
March	6.66
April	7.27
May	7.51
June	6.12
July	4.84
August	4.36
September	5.46
October	5.86
November	5.02
December	4.51

Source- Homer Energy

Annual average of Solar Irradiation 5.67 ($kWh/m^2/day$)

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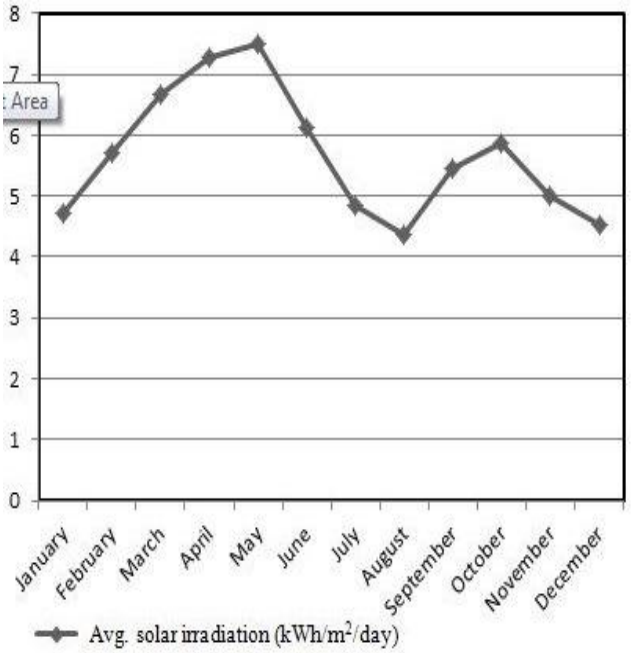

Fig. 3: Monthly average solar irradiation data (kWh/m^2/day)

V. WIND PV HYBRID SYSTEM

Today renewable power systems are becoming more and more popular, with the increase in demand of energy and the concern of environmental pollution around the world. Wind energy and solar energy have complementary characters. Combining wind energy and solar PV in one system (hybrid system) increases the reliability of the system and reduces the storage batteries [1].

VI. CONCLUSION

The study indicates that the available wind energy and solar energy potential at site is sufficient for a wind and photovoltaic hybrid system to fulfil the campus electric load. At present the campus electric load is connected to state electricity grid. The paper provides the status of wind energy and solar energy for designing an off-grid Hybrid System to meet the electrical demand of a residential sector of Maulana Azad National Institute Technology (MANIT), Bhopal, India.

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