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Dual Renewable Power Supply System (Wind & Solar)

Chitte Girish Deelip¹, Vedant Kailas Kalekar¹, Swati Bhanudas Kamble¹, Kasturi Sanjay Jadhav¹,

Prof. Raju Rakshasmare²

U.G. Student, Department of Electrical Engineering, Mahatma Gandhi Mission's College of Engineering and

Technology, Kamothe, Navi Mumbai, Maharashtra, India¹

Assistant Professor, Department of Electrical Engineering, Mahatma Gandhi Mission's College of Engineering and

Technology, Kamothe, Navi Mumbai, Maharashtra, India²

ABSTRACT: In the last 20 years, the average per-person energy consumption has increased almost by 70% And in its newly released International Energy Outlook 2019 has estimated that the world's energy consumption will be growing by nearly 50% between 2018 to 2050. Same case in the Electrical energy. In order to meet the demand for daily consumption of electrical energy, the means of production has to be increased substantially. As we traditionally been using conventional means for the production of electrical energy. As we all are oblivious to the fact that the conventional sources of energy are depleting at a relatively rapid rate. Due to which there has been a great hype in the cost of fuels which directly reflects the upswing in production cost and hence the cost of energy surges. So it's a crucial time to shift the attention from conventional to the non-conventional source of energy. But the output of the electricity produced by the renewable sources of energy solely is insufficient. Renewable energy resources such as wind and solar energy have been widely recognized as alternative source of energy. So in this paper, we have come up with a solution by using a dual renewable power supply system using solar and wind energy. It is a hybrid model of the solar-wind system integration. It will aid in supplying a steady power supply. As in unfavourable climatic conditions, the load can be shifted from one source to another to maintain the constant power supply throughout the day. The switching of the load can be controlled by using a microcontroller circuit. The Charge-controller assures the optimum utilization of the sources and helps to increase the overall efficiency of the hybrid system as compared to the individual source of generation. In actual practising the model, solar panels worked for almost 8 hours a day as a primary source of energy and during the absence of solar energy wind turbines acted as the secondary source of energy. The system is capable of sourcing domestic as well as industrial applications too.

KEY WORDS: Electrical Energy, Daily Consumption, Non-conventional Source of Energy, Renewable Energy, Dual power supply, Solar Energy, Wind Energy, Hybrid system.

I. INTRODUCTION

The escalated demand on the electrical power has been caused by the dramatic rise of population and city urbanization. This has led to a fast depletion of the conventional energy resources such as fossil fuels. Moreover, this has also risen the event of global warming as an urgent issue to be quickly addresses [1]. Renewable sources i.e., energy generated from solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. But the energy generated from solar and wind is much lesser than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the dual renewable power system using both solar and wind energy at the same time that will harness the renewable energies in sun and wind to generate electricity [2]. Among all the feasible possibilities available in the non-conventional sources of energy, solar and wind are the best methods. As tidal energy can be used only on the seashores, ocean thermal energy can be used only on the sea and its setup is also very difficult and costly. While solar and wind are available in all the areas of the world and setting their power plant is also not a massive task. The availability of solar energy is a major concern, as it is available almost 8 hours a day and secondarily the wind is available for almost 24 hours. To overcome this problem both the sources are integrated to provide an uninterrupted supply throughout the day even if the climatic conditions are not feasible [3]. It is worth mentioning that exploiting the green energy resources is not only for production of a clean and reliable electrical power, but it is also more



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economical than that come from the conventional ways as mentioned earlier. Studied the configuration and performance of the PV and WT system accompanied by a storage system. Their results were also compared to a hybrid PV/WT system in terms of technical and economic aspects. The author's results showed that establishing an integrated system of PV-WT and storage system was much more efficient than install these systems individually [4][5].

• SOLAR ENERGY

Solar energy is the energy released by the sun in the form of photon bundles i.e. positive ions which are released throughout the day. And in India where the sun shines for almost 300 days annually. It has been recorded that the earth receives 174 petawatts (PW) of solar radiations in the upper atmosphere. Approximately 30% of the solar radiations are reflected in space whereas the remaining is absorbed by the clouds ocean and landmasses. Therefore, it is the most economical source of energy freely available in nature and that too with causing any kind of pollutants or residuals to be disposed of. Measure amount of investment and research has been carried out to increase the efficiency of the energy produced by this means. Also the existing efficiency of the solar energy system is quite good with advantages like long life span and lowest running cost which makes up for the disadvantage of the high initial investment. It is kind of one-time investment energy source.



• WIND ENERGY

Wind energy is a renewable source of energy that possess kinetic energy which is been converted to mechanical power using wind turbines(WT) and further the mechanical energy is converted to electrical energy using an alternator and couplers. As the wind is freely available in nature, therefore, the cost of generation is quite less than conventional sources of energy. The main advantage of this kind of system is that the wind is available for almost 24 hours a day so an uninterrupted power supply can be provided using such systems. The output efficiency of this system depends upon the speed of the wind.

• DUAL RENEWABLE POWER SYSTEM

Dual renewable power system generates power using both wind and solar energy simultaneously. As the required wind is easily and freely available at open lands, deserts, highlands, and coastal areas. The system is designed to capture energy in a complementary and combined way. At times of no wind or slow wind, the energy is generated by solar PV panels during day times and wind turbines generate the energy whenever a suitable wind speed is available. In such a way both the renewable sources can be used as a source of generation. The generated energy can be there further stored in a battery bank or can be used directly through the batteries by using an inverter circuit for AC loads and directly through the batteries without any inverter circuit for DC loads. The inverter has built-in protections against overload, low battery voltage, short-circuit and overheating. The battery bank is used to provide an uninterrupted power supply throughout the day. The battery bank can be arranged as such that it can supply the load for days in case of a shortage of wind speed or solar power. A charge-controller circuit is used for the switching and



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to maintain the efficiency of the system. The output power of the wind turbines is in AC which further converted into DC using the rectifier and filter circuit which is then supplied to batteries for charging purpose.



Fig 2. Block Diagram of Dual Renewable Power Supply System

II. COMPONENTS USED

2.1 SOLAR PANELS

Solar cells are used to convert solar photon energy into electrical energy, which is also called a photovoltaic cell. It consists of p-n junction diodes which are mainly two layered semiconductor materials, n region and p region. Both the regions n and p are suitably doped with trivalent and pentavalent impurities to create electrons and holes, respectively. A depletion layer is formed within these two-region which needs a breakdown voltage to form electron-hole pair and hence flow of electrons if the circuit is closed. The solar energy reaching the PV cells possess positive ions in form of photons which further tends to make the electron-hole pair, and due to the potential difference, the flow of electron occurs which results in the flow of current through the circuit. The power conversion of a single PV cell is very less, therefore, number of PV cells are connected in series or parallel combinations depending upon the power requirement.

2.1.1 Layers of PV cell;

- 1. Metallic conductor strip.
- 2. Anti-reflecting sheet
- 3. N-type material
- 4. Depletion layer (p-n Junction)
- 5. P-type material
- 6. Metallic back plate



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Fig 3. Layers of PV cell

2.1.2 TYPES OF CONNECTION OF SOLAR CELL:

- SERIES CONNECTED PV CELL
- PARALLEL CONNECTED PV CELL



2.2 WIND TURBINE:

The wind is freely available in nature and it can be said that it is available 24*7 throughout the year. Wind possesses its kinetic energy. Wind turbines are simple structure aerodynamic designed to trap this wind and its kinetic energy and convert that kinetic energy into mechanical energy by rotating the shaft connected to the blades of the wind turbine. Thereafter this mechanical energy is utilised to rotate the alternator or dynamo which further convert the mechanical energy to electrical energy. The output of this system depends upon the speed of the wind and the gear arrangement done in the gearbox. As we are aware of the wind speed is not consistent enough to supply a constant energy, battery bank arrangement is to be done where the generated energy will be stored and supplied to the load.

2.2.1 TYPES OF WIND TURBINES:

- Horizontal Axis Wind Turbine (HAWT)
- Vertical Axis Wind Turbine (VAWT)

Vertical Axis wind turbines is the turbine mostly used in the residential areas as it rotates in the same direction irrespective of the wind direction. This kind of WT is most efficient for low wind speed as it can rotate at low wind speed too. It is a best suitable WT for the domestic as well as the industrial applications too.



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Fig 5. Vertical Axis Wind Turbine

2.3 BATTERY BANK

Battery bank is used to store the energy generated via PV cells and wind turbines. As earlier mentioned the flow of energy is not constant therefore battery bank provides a constant flow of energy in case of storage or fluctuation in energy supply. The capacity of the battery bank depends upon the type of load and size of the WT and PV cells. As per the calculated load the battery bank can be designed, and it can be easily expanded by adding multiple batteries to it. The battery bank should be selected considering the capacity and maintenance charges should be low. Also the leakage charge should be low as possible. The best suitable battery here is the free discharge type battery.

2.4 INVERTER

The main grid supply in India is of 230v/50Hz standard supply hence most of the applications are required to be feed with AC supply. As the energy stored in the battery bank is in DC nature, it should be converted to AC. Inverter circuit is used to convert the DC power to AC power. The output waveform of the invert should be pure sine wave in order to increase the life span and reliability of the system. The invert has built-in protection against overload, low battery power, short circuit, overheating.

III. DUAL RENEWABLE POWER SUPPLY SYSTEM

3.1 BLOCK DIAGRAM



Fig 6. Dual Renewable Power Supply System



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Required of amount of energy can be produced by this kind of system as the means of production are working simultaneous. At the times of absence of solar energy, wind turbines can charge the batteries and while absence of wind the solar PV cells can charge the battery banks in order to maintain the consistence. If in case both the sources are not available battery bank has the capacity to provide an uninterrupted power supply for number of days as the capacity of the battery bank can be varied by adding more batteries in the bank.

IV. CALCULATIONS AND RESULTS

4.1 CALCULATIONS OF WIND TURBINES

By using the dynamo type generator at the alternator of wind turbines **Generated E_v = 4.44*f*\Phi*t Where, Magnetic Flux per pole – \Phi Turns per pole – t**

4.1.1 WIND ENERGY

Performance Ratio - PR

 $P_{W} = (1/2) * \rho * A_{W} * V^{3}$ Where; power in watts – P_W The air density in kg/m3 – ρ The swept area by air in m³ – A_W Wind speed in m/s – V

4.2 CALCULATION FOR SOLAR ENERGY

To estimate the size and number of the PV cells to be installed to reach the energy demand for the load to be connected, the power is calculated as,

$$\mathbf{E} = \mathbf{A} * \mathbf{r} * \mathbf{H} * \mathbf{PR}$$

Where, Energy (kWh) – E Total Area of the Panel (m²) – A Solar Panel Yield (%) – r annual average solar radiation on tilted panels – H

4.3 CALCULATION OF TOTAL POWER GENERATED

The power generated by the complete system is the summation of all the sources of energy. It can be mathematically expressed as,

$$P_{T} = (N_{W} * P_{W}) + (N_{S} * P_{S})$$

Where, Total Power Generated - P_T Power Generated by Wind Turbines – P_W Power Generated by Solar Panels – P_S Number of Wind Turbine – N_W Number of Solar Panels – N_W

4.4 COST OF THE SYSTEM

The overall cost of the system consists of the number of solar PV cells, wind turbines, and the batteries used in the system. Excluding the cost of the inverter, rectifier and charge controller unit (which can be estimated as approximately 30% of the cost of the components mentioned above)

$$C_{T} = (N_{W} * C_{WT}) + (N_{S} * C_{SP}) + (N_{B} * C_{B})$$

Where, Total Cost in INR – C_T The Cost of Single Wind Turbine in INR – C_{WT} Number of Wind Turbine Used – N_W The Cost of Single Solar Panel in INR – C_{SP} Number of Solar Panel Used – N_S



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The Cost of Single Battery in INR $-C_B$ Number of Batteries Used for Battery Bank $-N_B$

V. EXPERIMENTAL RESULTS (PROTOTYPE)

The power developed by the system is provided to the AC loads and the main grid through the inverter circuit. Whereas the DC loads are feed by the Battery banks directly as shown in the Fig 2. The output power is calculated using the simplified formulae as mentioned above. The ratings and the total power output measure till now is as follows:

PV cells power output per panel (during day time 9:00 - 17:50) = 26 watts Wind Turbine/Alternator output per turbine = 5Watts Overall voltage of the System = 48V Batteries used for the battery bank unit = 12V Inverter Rating (VA) = 32 Output waveform of the Inverter circuit is purely sine waveform Output AC voltage (V_{NOM}), +/- 10 % = 230 V/AC Frequency output, +/-0.5 % = 50 Hz.

ADVANTAGES

- Long life span
 - One-time investment
 - Eco-friendly
 - Easy in installation
 - Can support and provide energy to the main grid also
 - Highly reliable
 - Low maintenance cost

DISADVANTAGE

• Higher initial cost

APPLICATIONS

- Mainly designed for Domestic and Industrial purpose
- Urban areas
- Rural areas
- Farms
- Can be designed for main grid too.

VI. CONCLUSION

We have developed the following system on simulator by using the simulator tools for solar PV cells, Wind turbines, inverter unit, charge controller unit, battery banks, etc. we have calculated the figures on simulator and studied their output characteristic and topologies as per requirement. We have developed a hardware model and the practical output of model was approximately the as simulated.

Dual renewable Power supply system is one of the most convenient and low cost solution for the growing population and depletion of the conventional sources of energy. Moreover, it is Eco-friendly and promotes go green moto. And a proper solution for global warming issues.

Dual renewable power supply system can be a solution to supply electricity to the area where main grid supply is quite difficult to reach. Area like villages, hill stations, desserts, where electricity is hard to reach, this kind of setups can be established to provide a cost free electrical supply to those areas. The life span and the less maintenance are the most attractive features of the system which compensates for the disadvantage of the high initial cost.

VII. FUTURE SCOPE

It can be designed to supply hospitals, schools, colleges, government offices were the electricity is supplied from the main grid and have to pay light bills worth lakhs. System can be made more reliable and generate and store more power



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by maximising the capacity of battery banks and increasing the number of solar and wind units. The future expansion of this system is way easier than the conventional sources

REFERENCES

[1] L. Fraccascia and I.Grannoccaro. "Analyzing CO₂ emissions flows in the world economy using global emission chains and global emission trees," Journal of cleaner production, volume 234 no. 22 pp.1399-1420, June 2019.

[2] Nema Parveen, Varsha Sharma, "A review on Hybrid Solar PV and Wind Energy system", International Research Journal of Engineering and Technology (IRJET), Volume 05, Issue: 12, Dec 2018.

[3] Bharat Raj Singh, Bal Krishna Dubey, "Solar-Wind Power Generation System", International Research Journal of Engineering and Technology (IRJET), Volume 05 Issue: 01, Jan 2018.

[4] Q. Tu, R. Betz, J. Mo, and Y. Fan, "The profitability of on shore wind and solar PV power projects in china- A comparative study", Energy Policy, Volume 132, pp. 404 – 417, September 2019.

[5] A.M. Hemeida, M. H. El – Ahmar, A.M. El – Sayed, Et. Al, "Optimum design of hybrid wind/PV energy system for remote areas", Ain Shams Engineering Journal, Volume 11, No 1, pp 11-23, March 2020

[6] Monik M. Dholariya, Barvaliya Aakash, Gondaliya kenil, Pansuriya Prashant, Dhyey R. Savaliya, "A Hybrid Power Generation System by Solar Energy and Wind Energy", International Research Journal of Engineering and Technology (IRJET), Volume: 07, Issues: 06, June 2020.

BIOGRAPHY



Chitte Girish Deelip

Diploma in Electrical Engineering, from A C Patil College of Engineering, Kharghar, Navi Mumbai, Maharashtra. U.G. Student, Dept. of Electrical Engineering, MGM College of Engineering and Technology, Navi Mumbai, Maharashtra.



Vedant Kailas Kalekar

Diploma in Electrical Engineering, from A C Patil College of Engineering, Kharghar, Navi Mumbai, Maharashtra. U.G. Student, Dept. of Electrical Engineering, MGM College of Engineering and Technology, Navi Mumbai, Maharashtra.



Swati Bhanudas Kamble

Diploma in Electrical Engineering, from Government Residence Women Polytechnic, Tasgaon, Sangli, Maharashtra. U.G. Student, Dept. of Electrical Engineering, MGM College of Engineering and Technology, Navi Mumbai, Maharashtra.



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Kasturi Sanjay Jadhav Diploma in Electrical Engineering, from Rajarambapu institute of technology, Islampur, Maharashtra U.G. Student, Dept. of Electrical Engineering, MGM College of Engineering and Technology, Navi Mumbai, Maharashtra.



Prof. Raju G. Rakshasmare Assistant Professor, Dept. of Electrical Engineering, MGM College of Engineering and Technology, Navi Mumbai, Maharashtra





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