

---

**INTER-CONNECTION OF HYBRID SOLAR-WIND POWER TRACKING SYSTEM FOR GRID**

---

**ACHAL KUMAR**M.Tech. Student  
Power System & Control Engg  
SET Noida International University  
Greater Noida**NEELKAMAL SAINI**Associate Professor  
EEE. Deptt.  
Noida International University  
Greater Noida**ABSTRACT**

Basic need of human being is energy. There is different form of energy available on earth which is used by the people but electrical energy is best in 2 all. Renewable energy sources i.e. solar energy, wind energy, biomass energy, hydro power energy, and ocean energy resources are considered as a technological option for generating electrical energy. But the energy generated from solar and wind is much less than the production by fossil fuels, however, the generation of electricity by utilizing PV cells and wind turbine increased rapidly in recent years. This presents the Solar-Wind Integration. Power system that harnesses the renewable energies in Sun and Wind to generate electricity with increased efficiency. System control relies mainly on microcontroller. It ensures the optimum utilization of resources and hence improves the efficiency as compared with their individual mode of generation. Further, to avoid the issue of the solar panels' efficiency, we have been implementing the solar tracking system. In Thus, it increases the reliability and reduces the dependence on one single source. This hybrid solar-wind power generating system is suitable for industries and also domestic areas. The initial cost of the project may be high for standalone system, but if the hybrid generation system is connected to grid, entire generation system can recover its initial cost in 3 to 4 years and per unit consumption charges from grid can be reduced by credit facility provided under the net metering scheme. Battery storage is also provided as an additional backup system which stores the power generated by the solar wind hybrid system for compensating the case simultaneous occurrence of power cuts and the non-availability of hybrid resources. This hybrid system not only encourages the distributed generation system, but also provides some relaxation to the utilities and helps in controlling the environmental pollution which is one of the greatest concerns amongst the world growing with an extreme rate. It also ensures reliable and self-sustainable electricity.

**KEY WORDS:** SOLAR Power, Wind Power, Power system, generation Integration Renewable energy sources

---

**INTRODUCTION**

Energy plays a important role in all the areas of human life. Energy is required to sustain and improve the standard of living. All energy sources are of consuming nature except renewable energy source. For example thermal power generating station consumes coal in huge quantities and Hydraulic power station would not need raw material, but need water flow; it depends completely on water flow and is location specific

**WIND:**

Wind energy is one of the best sources of alternative energy. Wind refers to the movement of air from high pressure areas to low pressure areas. Wind is caused by uneven heating of the earth's surface by the sun. Hot air rises up and cool air flows in to take its place. Wind will always exist as long as solar energy exists and people will be able to harness the energy from till then. Wind power is another source which can be harnessed to generate electric power. Wind power is the use of air flow through wind turbines to

mechanically power generators for electricity

### **SOLAR:**

Solar energy is a very large, inexhaustible source of energy. The power from the sun intercepted by the earth is approximately  $1.8 \times 10^{11}$  MW, which is many thousands of times larger than the present consumption rate on the earth of all commercial energy sources. Thus in principle, solar energy could supply all the present and future energy needs of the world on a continuing basis. This makes it one of the most promising of the non-conventional energy sources.

### **SOLAR TRACKER:**

A Solar Tracker is a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. The Solar Tracker will attempt to navigate to the best angle of exposure of light from the sun

### **SOLAR-WIND HYBRIDIZATION:**

As the wind does not blow all the time nor does the sun shine all the time, solar and wind power alone are poor power sources. Hybridizing solar and wind power sources together with storage batteries to cover the periods of time without sun or wind provides a realistic form of power generation. The system creates a stand-alone energy source that is both dependable and consistent

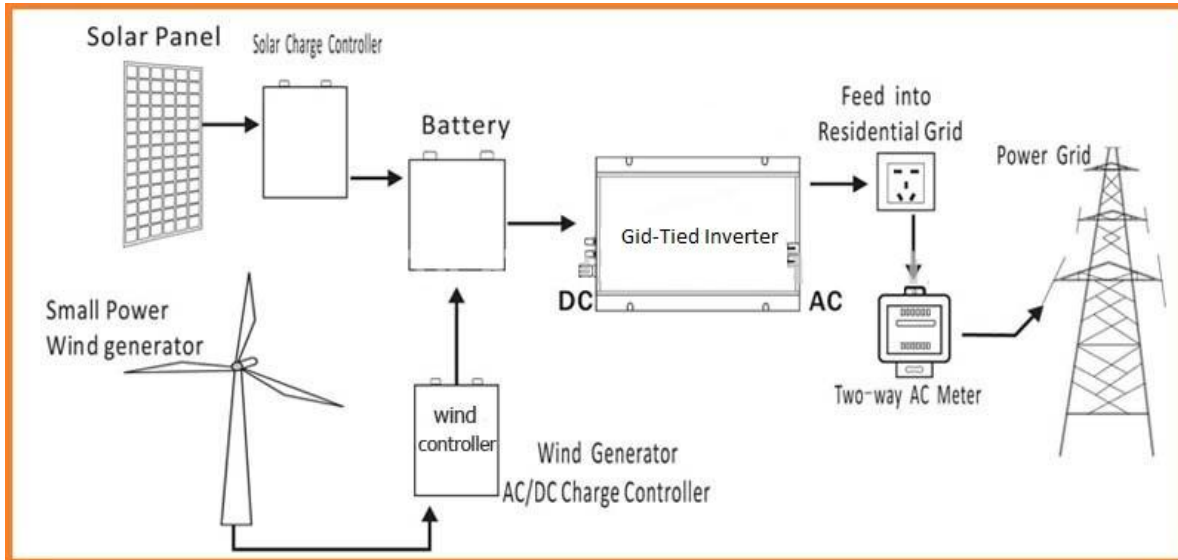
### **MODEL DESIGN**

To achieve the objective in the model following steps are needed to be accomplished:

- To connect the complete system to the grid through solar energy meter.
- To design a circuit, this can automatically calculate the electrical energy transmission to and from the grid and can control its movement
- To construct a battery bank to store generated power.
- To construct an inverter circuit i.e. to operate bulb with the help of charged battery from the solar panel.
- To construct a model prototype solar cell movement system with a mechanical assemble to move the panel from  $180^{\circ}$  E to W.
- To design an electronic circuit to sense the intensity of light and to control DC motor driver for the panel movement.
- To construct a wind turbine generator compatible with the solar system

## ROOFTOP HYBRID POWER GENERATION SYSTEM

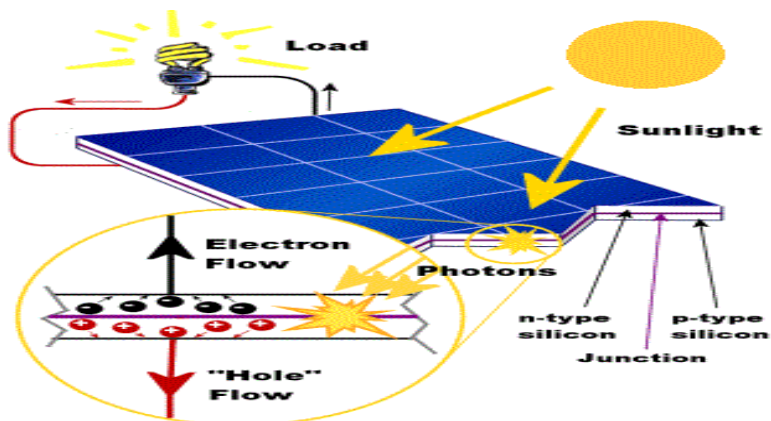
The block diagram of hybrid solar- wind residential power system is shown in the diagram which is then connected to grid to supply the excess generated power. The block diagram consists of wind generator system, solar panel, solar tracking system, charge controllers, charge regulators, solar mosfet inverter,



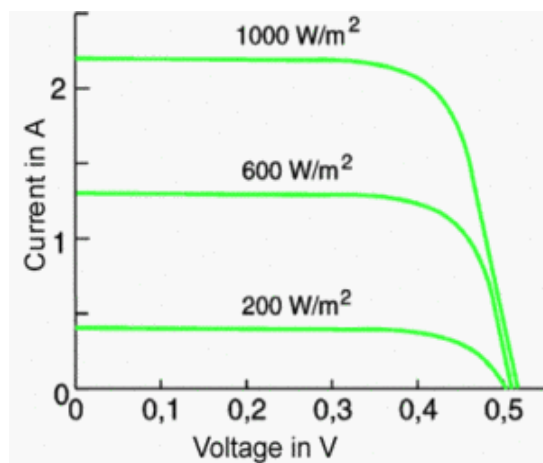
converters (ac-dc), solar energy meter and switch to supply the generated power to grid.

## WORKING PRINCIPLE OF SOLAR CELL

A solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells



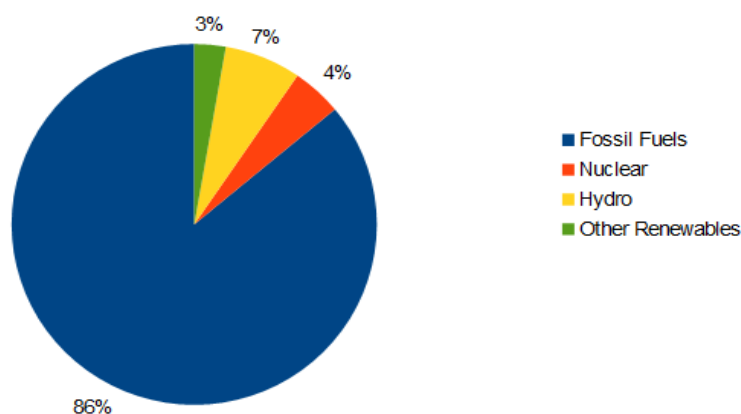
## Characteristics of a solar cell



### NEED FOR RENEWABLE ENERGY:

Energy is a foundation stone of the modern industrial economy. Energy provides an essential ingredient for almost all human activities: it provides services for cooking, space/water heating, lighting, food production, mineral extraction, industrial production and transportation. Modern energy services are a powerful engine of economic and social development. Throughout the world, the energy resources available to them and their ability to pay largely determine the way in which people live their lives. Nevertheless, it is critical to recognize that what people want are the services that energy provides, not fuel or electricity per se. World primary energy use remains dominated by fossil fuels (coal, oil and natural gas), which account for 86% of total primary energy supply. Renewable energy sources, comprising mainly biomass (including fuel wood) and hydropower, currently represent less than 14% of world primary energy use. The consumption of fossil fuels in last few decades has contributed much to the degradation of our environment. Global warming, climate change, extinction of wildlife species, depletion of ozone layer, and increase in air pollution are few of the problems from which our environment is suffering. Global warming is the increase of earth's average surface temperature due to the effect of greenhouse gases. These greenhouse gases such as carbon dioxide and methane absorb heat that would otherwise escape from earth.

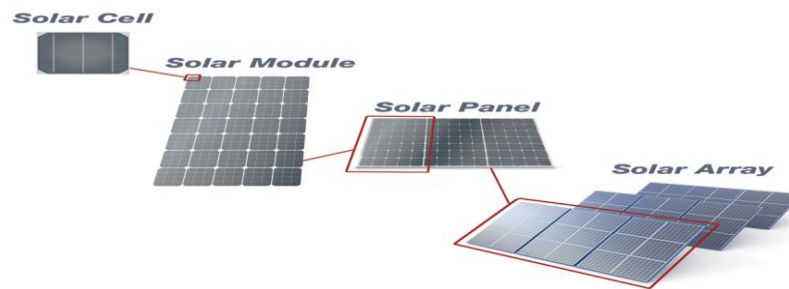
Global Primary Energy Consumption - 2015



### FROM THE CELL TO THE MODULE:

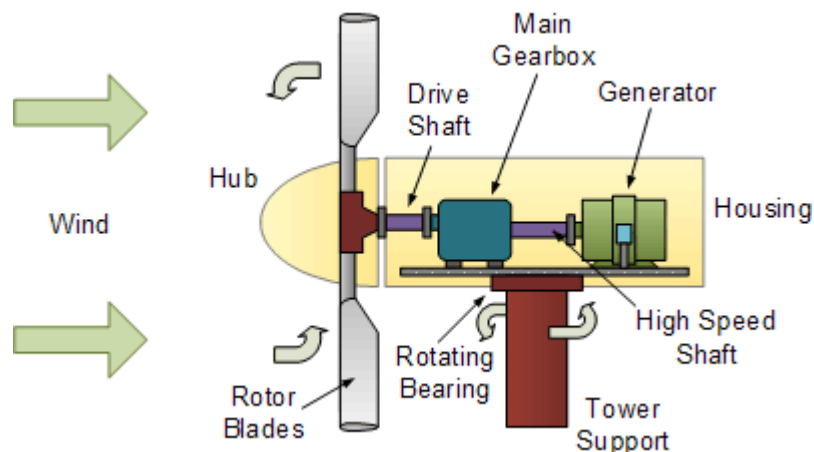
In order to make the appropriate voltages and outputs available for different applications, single solar cells are interconnected to form larger units. Cells connected in series have a higher voltage, while those

connected in parallel produce more electric current. The interconnected solar cells are usually embedded in transparent



### CONSTRUCTION AND WORKING PRINCIPLE OF THE WIND TURBINE:

Wind turbines are designed to exploit the wind energy that exists at a location. Aerodynamic modeling is used to determine the optimum tower height, control systems, number of blades and blade shape. Wind turbines convert wind energy to electricity for distribution. Conventional horizontal axis turbines can be divided into three components



- The rotor component, which is approximately 20% of the wind turbine cost, includes the blades for converting wind energy to low speed rotational energy.
- The generator component, which is approximately 34% of the wind turbine cost, includes the electrical generator, the control electronics, and most likely a gearbox (e.g. planetary gearbox), adjustable-speed drive or continuously variable transmission component for converting the low speed incoming rotation to high speed rotation suitable for generating electricity.
- The structural support component, which is approximately 15% of the wind turbine cost, includes the tower and rotor yaw mechanism.

### HYBRID (SOLAR AND WIND) POWER GENERATION:

The combination of solar and wind energy provides a chance to harness more reliable and ecofriendly system for rooftop power generation system. To generate maximum power efficiently through the hybrid system, we need to understand the geography as well as the climatic variations of the location throughout the year. The approximate amount of sunny days and the average annual wind velocity should be known to install the best combination of the solar-wind hybrid rooftop plant. For example, the coastal areas have descent wind velocity throughout an year to generate a good amount of energy through wind generators, therefore, these

area can be installed with higher number of wind generators.

- There are various designs that can be installed on the rooftop according to the rooftop space available, geographical locations and climate variations which are shown in the fig.



### WORKING OF THE PROJECT:

Solar panels convert the light energy into electrical energy and also the wind turbine converts the wind's kinetic energy into electrical energy. The efficiency of the solar panels is increased by using an automatic solar tracker. The solar tracker is operated with the supply from the grid. Both the outputs are supplied to the charge controller. The charge controller can be used separately or in combined form. The output of the solar panel being DC can be directly fed into the storage system without any requirement of the conversion of dc into ac through the charge controllers. But, the output of the wind turbine, being ac, is rectified using a full bridge converter which is inbuilt in the wind charge controller and fed to the battery system to charge it. The battery bank is interconnected with the battery based grid tied inverter. The Inverter transmits the electrical energy produced by the solar panels and the wind turbine after completely charging the battery bank to the house load. The inverter is also interconnected to the grid, which will supply power to the load when the energy produced by the hybrid system is unavailable, hence working as the backup for the hybrid system. When the supply from the hybrid system is surplus, the excess energy is sent to the grid through a two way meter. In case of failure of both the systems i.e. hybrid rooftop system and the grid, the battery bank will work as the additional backup to the load thus making the system more reliable. Until now, grid-tied solar power systems operated only when utility power was available. When the grid went down, the electricity from your solar panels was not used. Now, specialized inverters enable your grid-tied hybrid system to charge a battery bank from which you can power your home. When the grid is running properly, your home or business will use power generated from your solar panels or pull electricity from the grid. Any excess power generated over and above your needs go back to your utility company for credits on your power bill in areas where net-metering is available. In the event of grid blackouts, these systems will switch to "off-grid mode" drawing power stored in your battery bank to power your home and using your more efficient hybrid system to recharge your battery bank.



## GRID INTERFACING MAIN SERVICE PANEL:

The grid interfacing main service panel is the main component of this project which enables a hybrid rooftop power generation system to be interfaced with the grid. This panel allows the hybrid power system users to supply their excess generated power into the grid and also to use the grid power whenever the hybrid system fails.

### ➤ COMPONENTS USED:

1. Step down transformer: 220V-12V
2. Rectifier circuit: Capacitors 100 uf, rectifier diode 4007, voltage regulator 7805
3. Microcontroller: ATMEG16
4. Amplifier circuit: to amplify the signal of energy meter and forward it to microcontroller
5. LCD Screen
6. Variable resistance: 10K-ohm (LCD brightness controller)
7. I.C. L293 (motor driver IC)
8. Relay driver circuit: transistors 548 (npn), LED reverse biasing diodes (to amplify the supply from microcontroller)
9. Relays: (to operate the transmission of power to or from grid)
10. Toggle switch: to prevent islanding.

## MERITS

- **It save money on electricity**
- Low Maintenance Costs
- **You can get money back**
- **It is better for the environment**
- **Save water**

## CONCLUSION

The amount of energy generated by a 3 kW Hybrid rooftop power system using solar tracker is more than the energy produced by a stand-alone fixed mount solar PV rooftop system.

## REFERENCES:

1. Yang, H., Zhou, W., and Lou, C. "Optimal Design And Techno-economic Analysis Of A Hybrid Solar-Wind Power Generation System", Applied Energy, Vol. 86, pp. 163-169, 2009.
2. Elhadidy, M.A., and Shaahid, S.M. "Promoting applications of hybrid (wind + photovoltaic + diesel + battery) power systems in hot regions, Renewable Energy, Vol. 29, No. 4, pp. 517-528, 2004
3. Mahmoudi, H., Abdul-Wahab, S.A., Goosen, M.F.A., Sablani, S.S., Perret, J., Ouagued, A., and Spahis, N. "Weather Data And Analysis Of Hybrid Photovoltaic-Wind Power generation Systems Adapted To Seawater Greenhouse Desalination Unit Designed For Arid Coastal Countries, Desalination, Vol. 222, No. 1-3, pp. 119-127, 2008.
4. Onar, O.C., Uzunoglu, M., and Alam, M.S. "Modeling, Control And Simulation Of An Autonomous Wind Turbine/Photovoltaic/Fuel Cell/Ultra-Capacitor Hybrid Power System, Journal Of Power Sources, Vol. 185, No. 2, pp. 1273-83, 2008
5. Dhrab, S.S. And Sopian, K. "Electricity generation of hybrid PV/wind systems in Iraq", Renewable Energy, Vol. 35, pp. 1303-1307, 2010
6. Kanase-Patil, A.B., Saini, R.P., and Sharma, M.P. "Integrated Renewable Energy Systems For Off Grid Rural Electrification", Renewable Energy, Vol. 35, pp. 1342- 1349, 2010.
7. J Ekren, O., Ekren, B.Y., and Ozerdem, B. "Break-even Analysis And Size Optimization Of A PV/Wind Hybrid Energy Conversion System With Battery Storage – A case Study", Applied Energy, Vol. 86, No.7-8, pp. 1043-54,2009.