Review Paper on Hybrid Solar-Wind Power Generator

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ABSTRACT
Energy today, is the need of 21st century. The renewable energy resources therefore are used in tremendous amount as they are easily available and cost free. But these energies in standalone forms have disadvantages such as unpredictability, availability in all time etc. which can be overcome by hybrid energy systems. They are basically consists of combinations of number of renewable energy resources. They provide efficient response against voltage and frequency fluctuations, harmonic measures and power issues in standalone systems.

Hybrid power system provide reduction in complexity, maintain lowest unit cost, energy fluctuations due to DPSP (deficiency of power supply probability), with the help of proper design, advanced fast response, good optimization and control feasibility. This paper provides review of hybrid solar and wind power system. The technical feasibility of PV wind hybrid system in given range of load demand was evaluated and economical evaluation of standalone PV, standalone wind and PV wind hybrid system have been developed using the model.

Keywords
Hybrid, Renewable, Less complexity, Economical, Efficient

1. INTRODUCTION
Since 17thcentury there is rise in energy requirement due to increase in population day by day. Environmental concern and cost are the issues are taken under consideration while discussing various methods and processes of generation of power via hybrid renewable energy resources. There are many such places in India which represents systems with hybrid energy providing increase economy and environmental conditions. Now-a-days in India the central part is found to have generation of electricity by using renewable energy resources such as coal, gas, oil, water or nuclear as fuel in primary order,

The usage of coal and nuclear substrate in primary manner produces risk and creates the dangerous impact over environment. Hence use of hybrid combination of solar and wind combination gives the account of better environment and reduce the usage of existing fossil fuels. Again the standalone system such as wind or solar system can't produce the energy all the time. Hence energy should be generated with the help of combination of renewable energy resources.

The hunger of electricity developed by various areas across the world has been simulated by using renewable way thereby great variety of grid power supply. About 30,000 wind turbines and 1, 00,000 off-grid solar PV panels are installed all over the world. The technical feasibility of PV wind hybrid system in given range of load demand was evaluated and economical evaluation of standalone PV, standalone wind and PV wind hybrid system have been developed using the model. It offers generation of power in rural areas. Hybrid model with proper assembly is keen interest for recent years.

India among fifteen states Rajasthan is one of the most potential states of renewable energy resources.

Non-renewable energies are present in very less amount and can be exhausted after years.

Examples: Natural gas, Wood, Coal, etc.

Renewable energy assets are always available and never will be exhausted as they renew themselves.

The escalation in costs and environmental concerns involving conventional electric energy sources has increased Interest renewable energy resources. Wind, Solar PV and Biomass power generations are viable options for future power generation. Besides being pollution free, they are free recurring costs. They also offer power supply solutions for remote areas not accessible by the grid supply.

Examples: Solar power, Wind power, Biomass, etc.

1.1 Solar Power
The process of converting sun energy into electricity which can be done by following two ways

1) By using photovoltaic (PV)

2) By using concentrated solar power i.e. focusing at intensity of sun thereby using lenses, mirrors and tracking systems.

Solar power systems mainly consist of solar panel made up of PV cells (semiconductors) which emits electrons on absorption of heat and converts solar energy to electrical energy, batteries which store the power generated. The movement of electron produces the electric current.

1.2 Wind Power
Wind power is the use of air flow through wind turbines to mechanically power generators for electricity where speed and direction of wind is important factor. Wind power gives variable power which is very consistent from year to year but which has significant variation over shorter time scales. It is therefore used in conjunction with other electric power sources to give a reliable supply. Wind farms consists of individual turbines connected to electric power transmission network which produces plentiful, renewable, widely distributed, clean, inexpensive.

1.3 Hybrid Energy System
Hybrid energy system is made up of combination of two or more energy resources such as sources at a time like wind, solar, biomass, etc. Wind and solar hybrid combination is concerned to be best module because it is abundant and environmental friendly. Also the stand alone system of this combination has disadvantages that wind cannot floe continuously and solar radiation is present approx. 8to10hours a day. Thus this combination is hybridized with energy storing batteries. Wind speeds are low in the summer when the sun shines brightest and longest. The wind is strong in the winter when less sunlight is available. Beacause the peak operating

time for wind and solar system occur atdifferent times of the day and year, hybrid system are more likely to produce power when you need it.

They also offer power supply solutions for remote areas, not accessible by the grid supply. Today, around 30,000 wind turbines and more than 1, 00,000off-grid Solar PV systems are installed all over the world. Hybrid systems can address limitations in terms of –

1. Fuel Flexibility
2. Efficiency
3. Reliability
4. Emissions
5. Economical

It is efficient way of supplying electricity.

Wind speed and sun shine is different in different parts of the world.

The hybrid system of solar/wind is environmental friendly.

It uses conventional energy resources.

Need of the hour to use conventional energy resource rays to electrical energy

The solar system basically consist of following parts

Solar PV panel, Wind Turbine, Controller, Invertor, Battery, Load

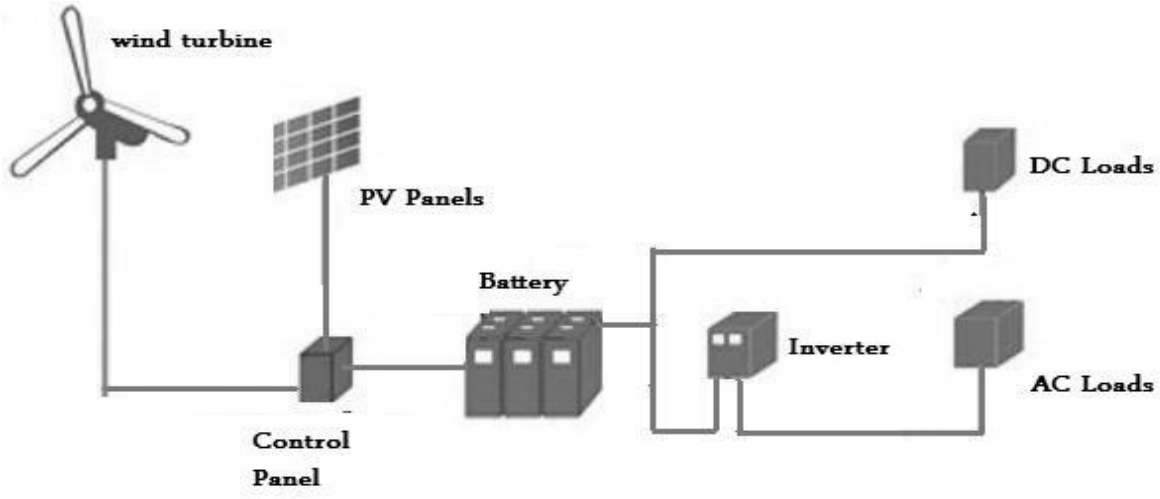

Fig. Solar-Wind Hybrid System

1.3.1 PV Panels

A number of PV panels connected in series and/or in parallel giving a DC output out of the incident irradiance. Orientation and tilt of these panels are important design parameters, as well as shading from surrounding obstructions.

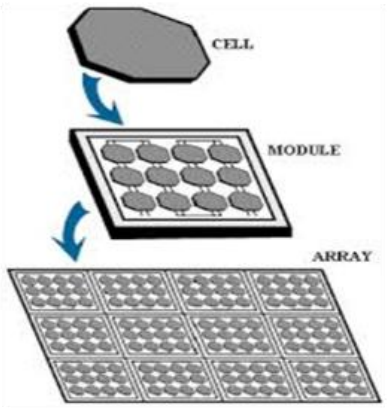

Fig. Solar Cell

1.4 Construction of Photovoltaic (P.V) Tracking Solar Modules

The photovoltaic cells are called as “solar-cell” or “photocell” because they are made up of several solar cells (silicon material) which are whether proof in nature. The solar cell basically is diode which converts incident rays to electrical energy.

1.5 Solar Tracking Control System

Our system basically consists of PV panel which is having dimensions of 34*34cm. It is placed on the triangular shaped stand of height 36cm and base is of 43cm.The 2 LDR sensors are placed on the two corners of the PV module which are placed equidistant from the axial holding of the stand . They control themselves by using the bridge wave rectifier.

Principle of Working:

Whenever the light falls on the LDR sensor, its resistance decreases and thus the large amount of current flows through the diodes .Which results into rotation of the motor and thus enables the tracking of the panel. Thus it adjusts itself to the direction of the intensity of the sun.

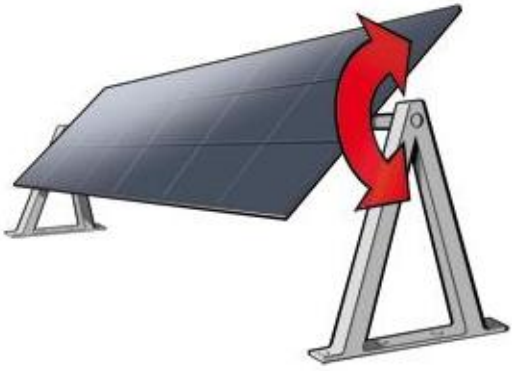

Fig: Solar PV Cell

They are controlled and successfully operated by the controllers.

1.6 Wind Turbines

Wind turbines produce kinetic energy through the rotations of turbines which are installed the on the top of the tower and converts it to the electrical energy .Wind turbines are manufactured on the basis of its wide range of vertical and horizontal axis types. They are becoming an increasingly important source of intermittent renewable energy.

Fig. Wind Turbines

1.6.1 Construction Of Wind Turbines

The wind turbines basically have the rotor blades (generally three rotor blades) which are made up of GRP (glass fiber-reinforced-plastic), steel, CFRP(carbon-filament-reinforced-plastic).They are placed on the long stand of very long height so that the wind energy can be tracked very easily.

We have used the dynamo for generation purpose. The dynamo is pretty interesting little generator which starts generating pure electricity the moment its wheel gets rotated. Basically it works on the principle of electromagnetism where current is induced in the magnetic coils of copper wire under influence of rotating magnetic flux, generated by alternate shifting of magnets to the north and south poles .Thus the electricity is generated at the turbines. The maximum theoretical power output of a wind machine is thus 0.59 times the kinetic energy of the

air, which is passing through the effective disk area of the machine.

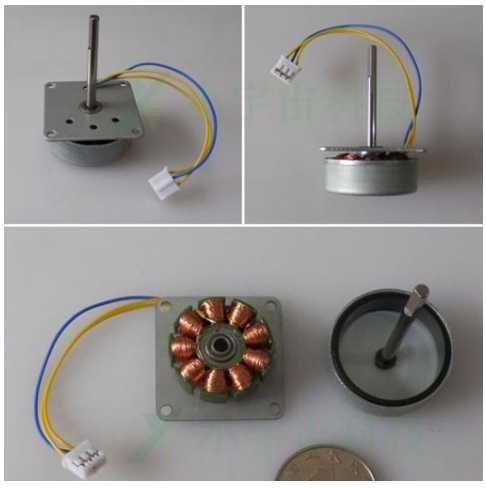

Fig. Dynamo used for wind turbines

1.7 LOADS

They stand for the various AC and DC appliances that get electricity from the power system.

1.8 Solar Controller and Wind Controller

Control battery bank charge and discharge reasonable and safety.

1.9 Invertors

They are used to obtain AC and DC supplies as per need.

1.10 Battery Bank

There can be a single battery or multiple batteries connected together to create essentially one large battery of the required voltage and amp-hour capacity. Battery configuration and capacity are the most important factors to be taken under consideration as per as steady supply and controlling is concerned.

1.11 Working of Solar Wind Power System

Solar and wind hybrid power systems are designed using solar panels and small wind turbine generators for generating electricity.

Generally, solar wind hybrid systems possess small capacity.

Typical power generation cannot exceed more than 1kW to 10kW. Solar power system includes solar panels, solar photovoltaic cells, and batteries for storing the converted energy.

The electrical energy generated by solar panel is in AC form which can be converted to DC using invertors and used effectively. The solar panel output is electric power which can be given by Watts or Kilo watts.

These solar panels are available at the output ratings like 5 watts, 10 watts, 20 watts, 100 watts etc. Hence we can select the solar panel as per our need.

But, in fact, the solar panels cannot resist factors like climate, panel orientation to the sun, sun light intensity, the presence of sunlight duration, etc.

During normal sunlight a panel which has 12 volt 15 watt can produce 1 Ampere current.

The huge wind turbines are rotated and thus kinetic energy is generated by these rotations which can be converted to electrical energy. Minimum wind speed required for connection of the generator to the power grid is known as cut in speed while, maximum wind speed required for the generator for disconnecting the generator from the power grid known as cut off speed.

Generally, wind turbines are accessible to the range of speed between cut in and cut off speeds.

Wind turbine is a device consist three blades which on rotation produces the electricity in such a way that that the axis of rotation must be aligned with the direction of blowing wind.

A gear box is termed as a high-precision mechanical system because it converts energy from one device to another device. Horizontal axis turbines and vertical axis turbines are the most frequently used turbines.

An electrical generator is followed wind turbine; hence it is known as wind turbine generator.

Generate electricity into battery bank with the help of solar charge controller and wind controller.

The DC load which is stored into battery is converted into AC load with the help of inverter.

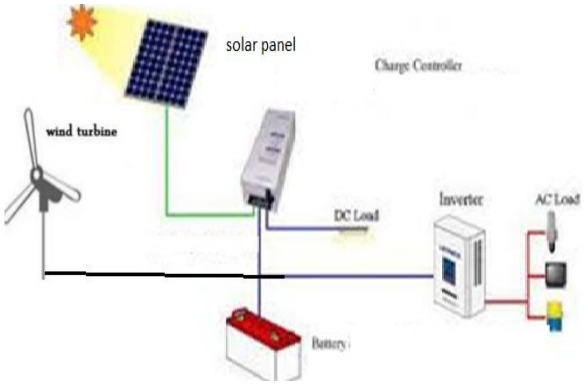

Fig: Hybrid Solar-Wind Power Generator

2. METHODOLOGY

2.1 Proposed Calculation

The total power generated by this system may be given as the addition of the power generated by the solar PV panel and power generated by the wind turbine.

Mathematically it can be represented as,

PT = NW * Pw +Ns * PS

Where,

PT is the total power generated
PW is the power generated by wind turbines
PS is the power generated by solar panels
NW is the no of wind turbine
Ns is the no of solar panels used

2.2 Calculations for wind energy

The power generated by wind energy is given by,

Power = (density of air * swept area * velocity cubed)/2

PW = ½. ρ (AW) (V) 3

Where,

P is power in watts (W)
ρ is the air density in kilograms per cubic meter (kg/m³)
AW is the swept area by air in square meters (m²)
V is the wind speed in meters per second (m/s).

2.3 Calculations for solar energy

To determine the size of PV modules, the required energy consumption must be estimated. Therefore, the power is calculated as

PS = Ins (t) * AS*Eff(pv)

Where,

Ins (t) = isolation at time t (kw/ m2)
AS = area of single PV panel (m2)
Effpv = overall efficiency of the PV panels and dc/dc converters.

The overall efficiency is given by,

Eff(pv)= H * PR

Where,

H = Annual average solar radiation on tilted panels. PR = Performance ratio, coefficient for losses.

C. Cost

The total cost of the solar-wind hybrid energy system is depend upon the total no of wind turbines used and total no of solar panels used. Therefore the total cost is given as follows

Total cost=(No. of Wind Turbine * Cost of single Wind Turbine)

+ (No. of Solar Panels * Cost of single Solar Panel)

+ (No. of Batteries used in Battery Bank * Cost of single Battery)

CT = (NW * CWT) + (NS * CSP) + (NB * CB)

Where,

CT is the total cost in Rs
CWT is the cost of single wind turbine in Rs
CSP is the cost of single solar panel in Rs
CB is the Cost of single Battery in Rs
NW is the number of wind turbine used
NS is the number of solar panels used
NB is the number of Batteries used in Battery Bank**.**

Solar-wind hybrid energy systems needs only initial investment. It will efficiently work with the conventional energy sources. When accounted for a lifetime of reduced or avoided utility costs. The cost of the system is based on the factors such as system chosen, wind resource on the site, electric costs in the area, and the battery bank required. Cost of the Wind-Solar Hybrid system is minimized using non-conventional energy sources.

3. APPLICATIONS

1) Ideal for cell phone recipient station.
2) Farm house, guesthouse, Hospital, Hotels, Laboratories and R&D centers.
3) Remote and Rural village Electrification.
4) Street lighting.
5) Transmission and communication Tower and many more application.
6) High output makes ideal for virtually any remote battery charging application.

4. ADVANTAGES

1) Design for easy to operate, servicing and maintenance where required.
2) Most Eco-friendly & clean source of power.
3) No pollution and no recurring fuel costs, highly reliable and consistent power supply.
4) Long life span for SPV modules & Modular design.
5) Very few moving parts negligible maintenance required.
6) Increases public safety and aids in providing a safe working environment in areas where mains power is risky.
7) Low Height required.

5. DISADVANTAGES

1) The effect of large scale wind farms on the climate is unknown.
2) At night, we can't use solar energy.

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