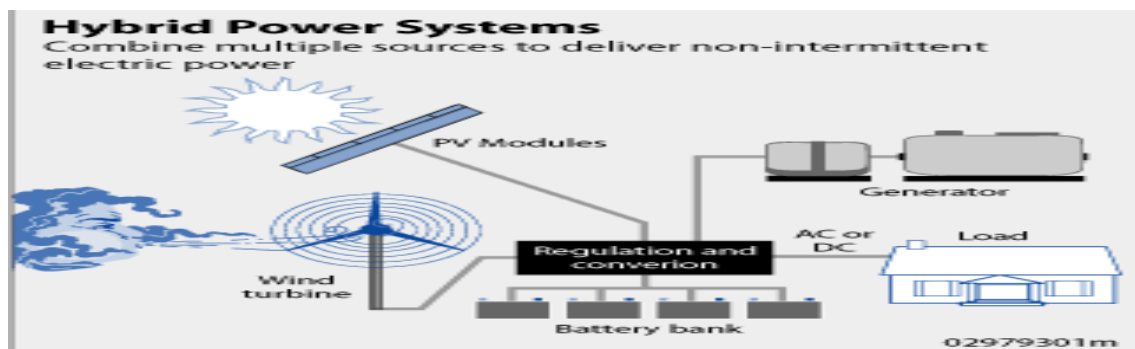


HYBRID POWER SYSTEMS OF RENEWABLE ENERGY SOURCES FOR THE DEVELOPING COUNTRY LIKE –INDIA..!

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ABSTRACT

A hybrid power system can combine two or more options from renewable energy source technologies like P.V, Wind; micro hydro turbine methods can play a vital role in supplying uninterrupted electricity. Intelligent electricity is the prime mover & key driver for the economic, social & all-round development for sustainable technology ecosystem inclusive growth and national priority. The renewable energy sources are the spiritual solution to present energy crunch with Green strategies, concepts & manufacturing, thus achieving greater reliability & continuity of electricity. This article describes the hybrid power systems and their benefits with different types.

I. INTRODUCTION

Basic services like lighting, drinking water supply, health care, education, transportation and communication are essential requirement for prosperity of a nation and must be available at affordable prices to common section of society. Every problem has a spiritual solution and the renewable energy sources is the right and only option to meet the total power demand in the residential, agricultural, irrigation and non-productive categories of consumers in the form of distributed embedded or decentralized generation. It is anticipated that upto 50% share of energy mix of renewable in the days to come, for which proactive & mega initiatives in manufacturing field, R&D field with active participation of utilities, facilities & regulators (stakeholders).

Renewable energy resources in particular solar is the best option and the bridge to future rural electrification so that smart village concept can be implemented & connectivity to remote can be possible to realize digital India dream in true sense, by establishing smart generation, transmission & distribution grids in days to come.

The world has stepped in 21st century & in this technological revolutions & instantaneous communications, significant parts of India cannot get 24*7 electrical power supply. In view of conventional resource crunches, the obvious way is to shift focus to renewable. Therefore, need arises for combination of two or more renewable

energy sources generating electricity with a conventional grid integration to have all the time electricity available.

II. HYBRID POWER SYSTEM

Renewable energy or “green energy” is defined as the energy generated from natural resources such as sunlight, wind, rain, and geothermal heat, which are renewable. Hybrid power systems usually integrate renewable energy sources with fossil fuel based generators to provide electrical power. They are generally independent of large electric grids and are used to feed loads in remote areas. Hybrid systems offer better performance, flexibility of planning and environmental benefits.

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. The load can still be powered using the stored energy in the batteries even when there is no sun or wind. Hybrid systems are usually built for design of systems with lowest possible cost and also with maximum reliability. The high cost of solar PV cells makes it less competent for larger capacity designs. This is where the wind turbine comes into the picture, due to its cost benefit concept.

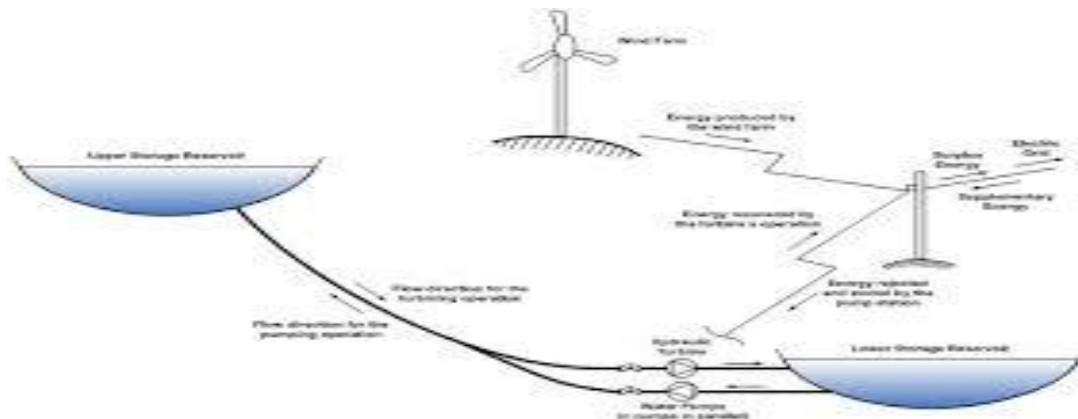
Battery system is needed to store solar and wind energy produced during the day time. During night time, the presence of wind is an added advantage, which increases the reliability of the system. In the monsoon seasons, the effect of sun is less at the site and thus it is apt to use a hybrid wind solar system. In addition to the technical considerations, cost benefit is 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 when wind is taken as a source.

Hybrid power systems cooperate with different primary electricity generating and Heat or both. Mutual penetration between them is accomplished by using modern power electronic systems. However, they are able to supply electricity independently to a house or group of houses, farms and from small scale industrial equipment to large local communities. They can serve as reserve for electric power and exporting surplus power produced by them is fed into the grid.

III. TYPES OF HYBRID POWER SYSTEMS

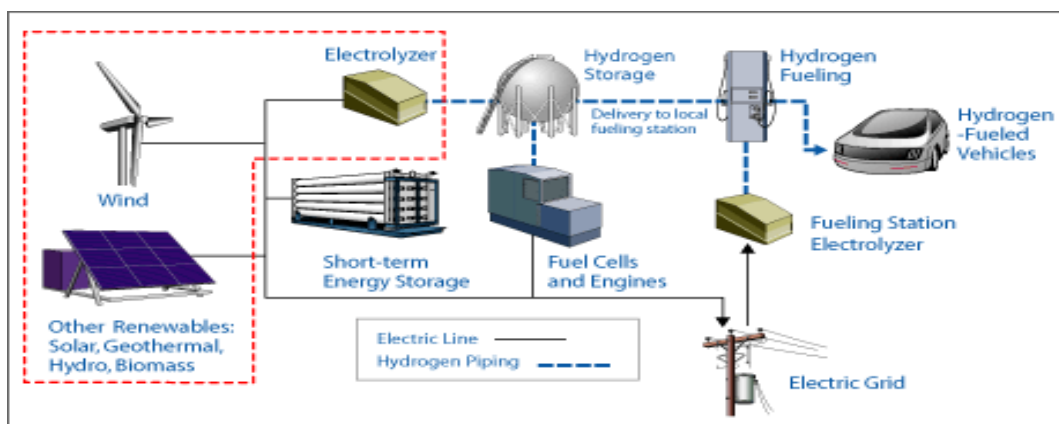
- a. Wind–Hydroelectricity Hybrid Power System
- b. Wind – Hydrogen Hybrid Power System
- c. Wind – Diesel Hybrid Power System
- d. Wind – Compressed air Hybrid Power System
- e. Wind – Solar Hybrid Power System

3.1 Wind–Hydroelectricity Hybrid Power System



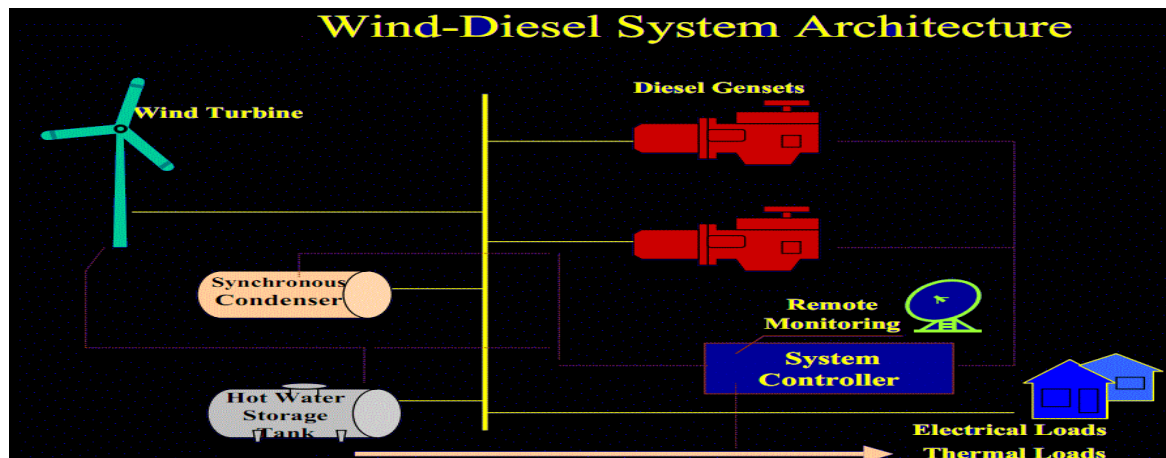
In wind-hydroelectricity hybrid power system, electricity is generated with the combination of wind turbine and pumped storage hydro power plant. Whole wind power potential or major part of it used for pumping water from tail race water reservoir to store head race water reservoir. Water thus pumped in upper reservoir is used to produce electricity during peak power requirement, when wind is not blowing. In pumped storage hydro power plants, reversible units are used. The same machine works as pump while pumping water and turbine while producing electricity.

3.2 Wind – Hydrogen Hybrid Power System



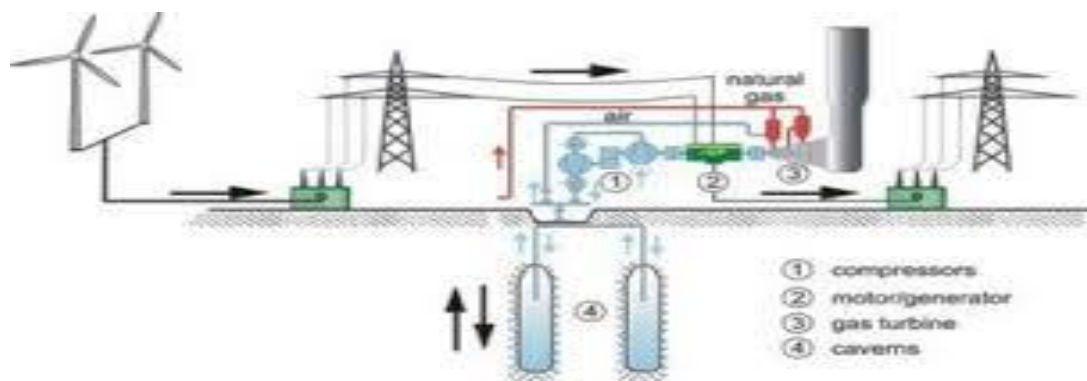
In this system, hydrogen is produced by doing electrolysis of water using electricity produced by wind turbines. Hydrogen thus produced is stored. Stored hydrogen is converted into electricity by using fuel cell technology or with the help of fire engine connected to electricity generator, when wind power is unable to meet demand of electricity.

3.3 Wind – Diesel Hybrid Power System



In a wind –diesel hybrid system, wind electricity generating system is integrated with conventional diesel generator set and works as standalone system or primary source of hybrid electricity supply system. Main objective is to make optimum use of wind energy system for production of green electricity and to reduce the use of conventional diesel generator set in remote/inaccessible locations far from reach of electric grid. By reducing operation time of diesel engine and fuel used in it, harmful effects on environment can be minimized. Based on instant conditions, demand of electric load can be met either using wind electricity or using standby diesel generating set. This system has associated facilities / equipment like energy storage devices, electricity converters and controlling components.

3.4 Wind – Compressed air Hybrid Power System



Wind- compressed air energy hybrid systems use compressed air energy storage system to generate electricity. In these systems, wind energy is used to keep air at pressure and this compressed air is stored facilities created underground such cavern or mines, which are not in use. During peak demand of electricity, air is passed through turbines to generate electricity, generally using supplemental natural gas.

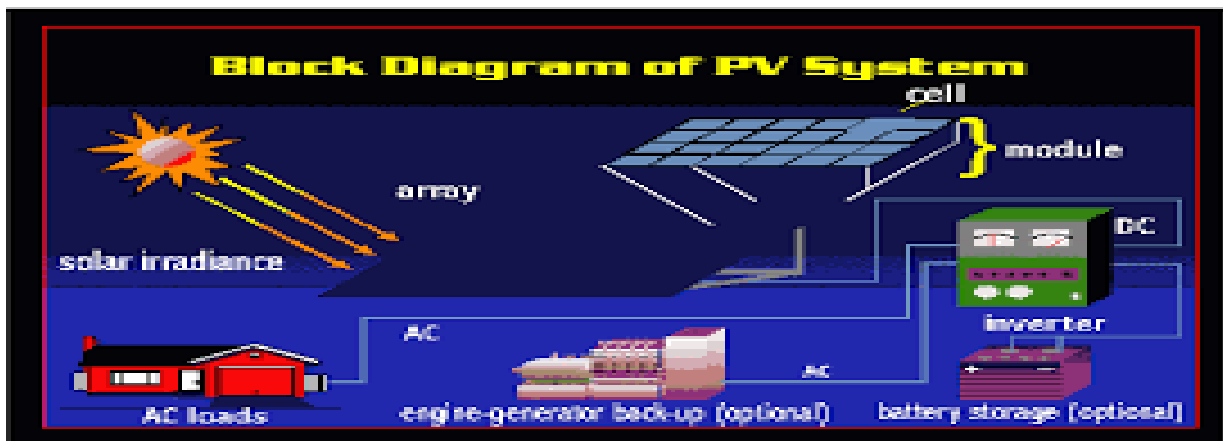
3.5 Wind – Solar Hybrid Power System



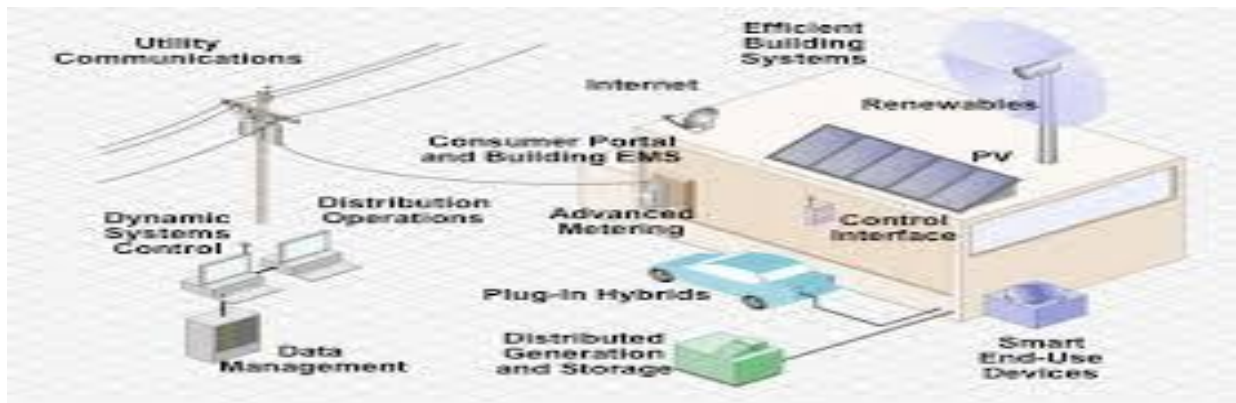
In wind-Solar hybrid electricity generating system, electricity generated from wind parks is synchronized with electricity generated from solar electricity generating system/ photovoltaic modules. Among all renewable electricity generating system with solar/ photovoltaic electricity generating system is considered the best with the point of view of weather changes. Domestic or small scale wind generators can be installed easily on towers and high roofs of high buildings. Due to high moment, this wind generator is able to generate electricity in wind of velocity even lower than 2.5 m/s.

3.6 These above mentioned all hybrid systems can be run by the following methods

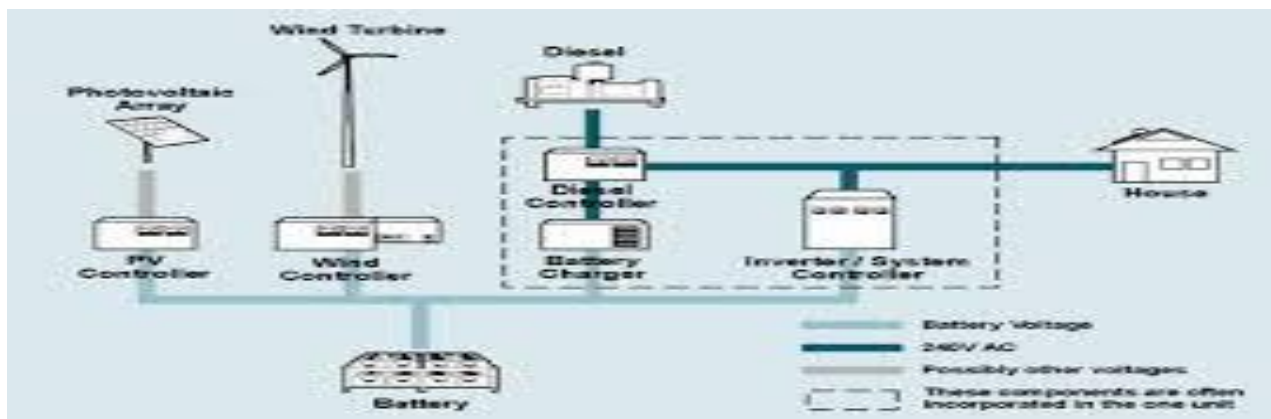
- (1) Stand-alone Renewable Energy Generating System



- (2) Grid connected stand-alone Renewable Energy Generating System



(3) Stand-alone Renewable Hybrid System.



IV. ADVANTAGES OF HYBRID SYSTEMS OF RENEWABLE ENERGY SOURCES

The hybrid system of renewable energy sources are suitable and cost competitive solutions for the developing countries and play an important role to achieve following objectives,

- They provide an access to reliable electricity at any time.
- They avoid long waits for grid extensions
- They reduce dependency from oil price fluctuations
- They increase economic productivity and generate local employment opportunities.
- They help in having productive use of electricity/ generation of income or value linked to direct income generating activities like motive power agriculture, industrial and commercial uses.
- Access to electricity may automatically generate surplus within domestic economies & promote micro enterprises/ small scale industries.
- These type of energy are Eco-Friendly in nature.

V. CONCLUSION

A hybrid system of renewable energy sources generating a electricity plays an important role in developing country. They are independent from oil price fluctuations, and most sustainable, suitable and also reliable. Solar/wind/other renewable sources have now growing energy portfolio so that energy & ecosystem &




environment could be balanced optimally with energy security, energy efficiency & conservation concepts & flexibility in power system. The penetration & integration of renewable and non- renewable to have golden mix by using soft computing techniques is possible with the help of artificial intelligence, artificial neural networks, fuzzy logics, genetic algorithm etc. also the power quality issues, protection issues, reactive power management, metering, operating protocols could be tackled & solved in consultation with regulators & policy makers.

The business process management needs to be thought of by implementing improved existing technologies to achieve sustainable energy supply such as nanotechnology concepts & strategies processes so that cost effective & environment friendly clean green power can be generated. Smart grid system can change the power industry's entire business of renewable and its new paradigmatic relationship with all stakeholders & is perhaps the remedy to India's all power misfortunes.

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