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Significant of Smart Grid Technology in Power System

Sonal Baghel[1], Hemendra Khedekar[2], Manisha Gaur[3]

PG Student [POWER SYSTEM], Dept. of EE, Swami Vivekanand College of Engineering, Indore, India[1]

Assistant Professor (HOD), Dept. of EE, Swami Vivekanand College of Engineering, Indore, India[2]

Assistant Professor, Dept. of EE, Swami Vivekanand College of Engineering, Indore, India[3]

ABSTRACT: The Indian population are increasing day by day and energy demand are also increasing exponentially but the conventional energy sources are limited and exhaustible, not eco-friendly and more power loss in conventional Grid Technology, power supply also interrupted due to dependency on one source of energy.Today the time of new innovations in the field of technology because one of the primary needs for socio-economic development in any nation & all over the world is the provision of reliable electricity supply systems. The modernization of traditional Grid system is requirement of modern era because uninterrupted electricity is the basic need of development.

The main objective of my research work is to analyse the need of modernization of Grid technology by smart grid technology. To modernize the all Grid system first we proposed the small solar-wind On Grid Hybrid system. Using HOMER software for simulation & optimization of the Solar-Wind On-Grid hybrid system and cost analysis significant of smart grid, comparison between conventional & Smart Grid system. MATLAB software is used for simulation of modified boost converter for variable input.

KEYWORDS: Smart Grid, HOMER, Hybrid System, On-Grid, Smart Meter, MATLAB.

I.INTRODUCTION OF SMART GRID

Energy is the basic requirement to do any type of work without energy nothing possible in present. There are many types of energy in which one type of energy Electrical Energy, before generation of electrical energy all work based on mechanical system but after invention of electric power generation everything based on electric power.

India is a developing country, there are total 6, 38,596 villages in India, in which 5, 93,732 villages are inhabited. Out of 5, 93,732 villages, 5,127 villages are electrified only for some hours & rest 38605 villages are using kerosene lamp for lighting their houses.Rural areas receive only 5-10% of electricity to meet their demand. The total installed capacity for electricity generation in the country has increased from 16,271 MW as on 31.03.1971 to 370106 MW as on 31.03.2020. There has been increase in generating capacity of 18,654 MW over the last one year, which is 10% more than the capacity of last year. For full filling their demand, rural areas use renewable energy resources.

The adoption of SMART GRID Technology in India is the demand of modern era to compute at international level.

The "smart grid" is a term used to describe the rapid infrastructure replacement of the electrical wiring system in the United States. When the advanced system is completely implemented, it will allow for communication features across the grids that are not currently available--hence the term "smart"[1]. A “smart grid” is simply an advanced electrical distribution system that has the capability to balance electrical loads from diverse, and often intermittent, alternative energy generation sources. One key component of the “smart grid” is the capacity to store electrical energy; this allows the demand from consumers.

In this paper, we proposesthe solar-wind on grid hybrid system and using HOMER software analysed the modernization of grid technology by smart grid system.

II. SMART GRID ROAD MAP FOR INDIA

India has already established the India Smart Grid Task Force & India Smart Grid Forum to develop the framework and national policy. In this regard roadmap for future activities has already been released. Govt. of India has approved 14 pilot projects across the country for demonstration of different functionalities. Govt. of India has projected an outlay of about Rs. 9500 Cr. for Smart Grid development during 12th plan period (2012-17).

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POWERGRID has taken a leading initiative in developing Pondicherry as pilot smart grid project through collaborative efforts. Around 57 organizations have joined their hands for the project, where different attributes of Smart grid are being implemented in a holistic manner."A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both - in order to efficiently deliver sustainable, economic and secure electricity supplies."

III. RENEWABLE ENERGY SOURCES

Now-a-days global warming is the most burning issue found in many of the climate summit. Many researchers, scientists are working their own relevant areas to reduce the Effective mitigation of climate effect due to global warming by using different techniques. Change will require deep reductions in greenhouse gas emissions.
Political and economic crisis, limitation of fossil reserves, environmental concerns, population and economic growth resulted in an increase in the use of renewable energy resources. However, the main problem of renewable energy is dependence of these sources to the weather conditions [35]. Therefore, there are oscillations in their outputs. To solve this problem, these generation units are used together. Therefore, there are oscillations in their outputs.
In the recent year, various combinations of renewable and non-renewable energy sources have been considered. Some of these combinations can be expressed as [14]:

- wind – solar – battery
- wind – micro turbine
- wind – solar – diesel
- wind – fuel cell
- solar – biomass

Wind and solar energy has become a common, because a requirement weather condition is available in many locations and technology needed to use this energy is provided [15].

IV. SIMULATION OF SOLAR-WIND HYBRID SYSTEM

The Hybrid Optimization Model for Electric Renewable (HOMER) software is used as a tool to carry out the research. The HOMER energy modelling software is a powerful tool for designing and analysing hybrid power systems. The proposed hybrid renewable energy system comprises of wind turbine and Photovoltaic (PV) array system.

The solar-wind hybrid system design for village Borganw (MP).Village Borganw isolated from city khandwa, so many time villagers face power cut problem and electric bill problem also, therefore as a small project we study here for uninterrupted power supply and low cost availability of electric power.

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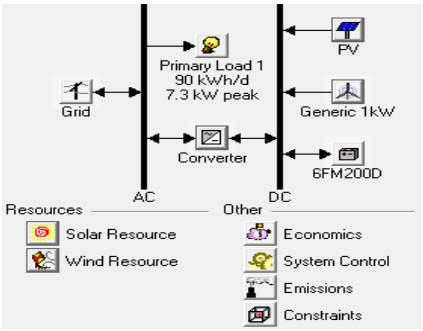

Fig. 1.1 Grid connected Solar-Wind Hybrid Model

In HOMER software first used component data input, software build a hybrid model after simulation software show the result as shown next chapter.

V. RESULT AND DISCUSSION

In optimization operation different combinations of the components are used and different feasible models are show as a result. In those results the best combination result is show in sensitivity process as shown in blue background.

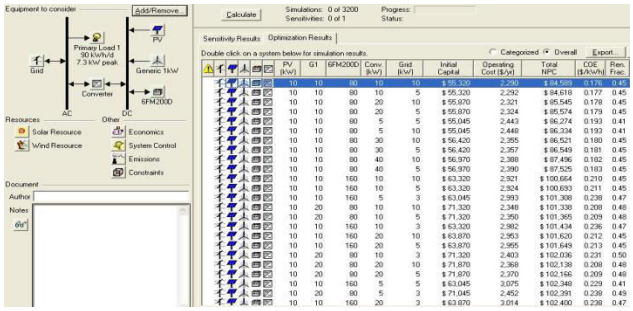

Fig. 1.2 Simulation & Optimized result of Grid connected system

In grid-connected Hybrid system to fulfil the electric load 90 kWh/d, 10 kW PV array system, 10 kW wind turbine system and 10 kW grid connection are proposed for a feasible Hybrid system. The production of power by PV array is 17060 kWh/yr (43%), by Wind turbines 1648 kWh/yr (4%) and 20681 kWh/yr (53%) power required to purchase from grid to continuous supply. The total production of power is 39389 kWh/yr in which 32741 kWh/yr (87%) power is consumed by load and 4756 kWh/yr (14%) power is sale back to gird in excess power production situation.

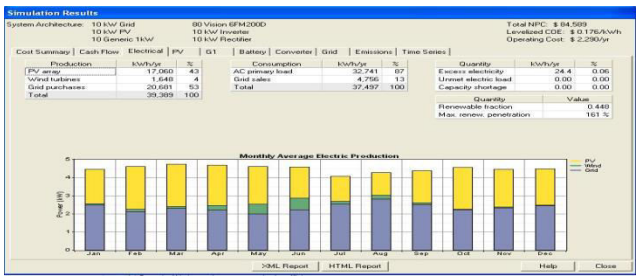

Fig. 1.3 Bar graph of electric production by hybrid system (On-Grid)

The results obtained for ON Grid (solar-wind) hybrid system, the optimized COE (cost of energy) is $ 0.176/(kWh)[Approx. 10.9 Rs/kWh] for above described load and designed system.

The total production of electricity is 39389 kWh/yr and unmet electric load and capacity shortage is 0% achieved as shown in figure. There is only 0.06% excess of electricity which can be saved and used by increasing further no of storage i.e. battery.

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VI.CONCLUSION

The solar-wind hybrid system cost on installation year is high approximately Rs. 11/Unit but after installation year only operating and maintenance cost and grid sellback/purchase cost have to spend on the grid connected hybrid system therefore cost of energy per unit decrease up to Rs.4.22/Unit.

In "SMART GRID'' system the cost of energy vary with variation in device cost variation and current data reading. Smart Grid technology calculates the cost of energy on the basis of current cost of devices and electricity charge calculated on real time consumption of energy.

In smart grid technology all system are operated according to requirements. Unlike conventional energy sources, renewable generations are highly intermittent and variable type. Large Scale Integration of renewable generation requires special balancing mechanism to deal with the uncertainty and variability to maintain grid stability & security.

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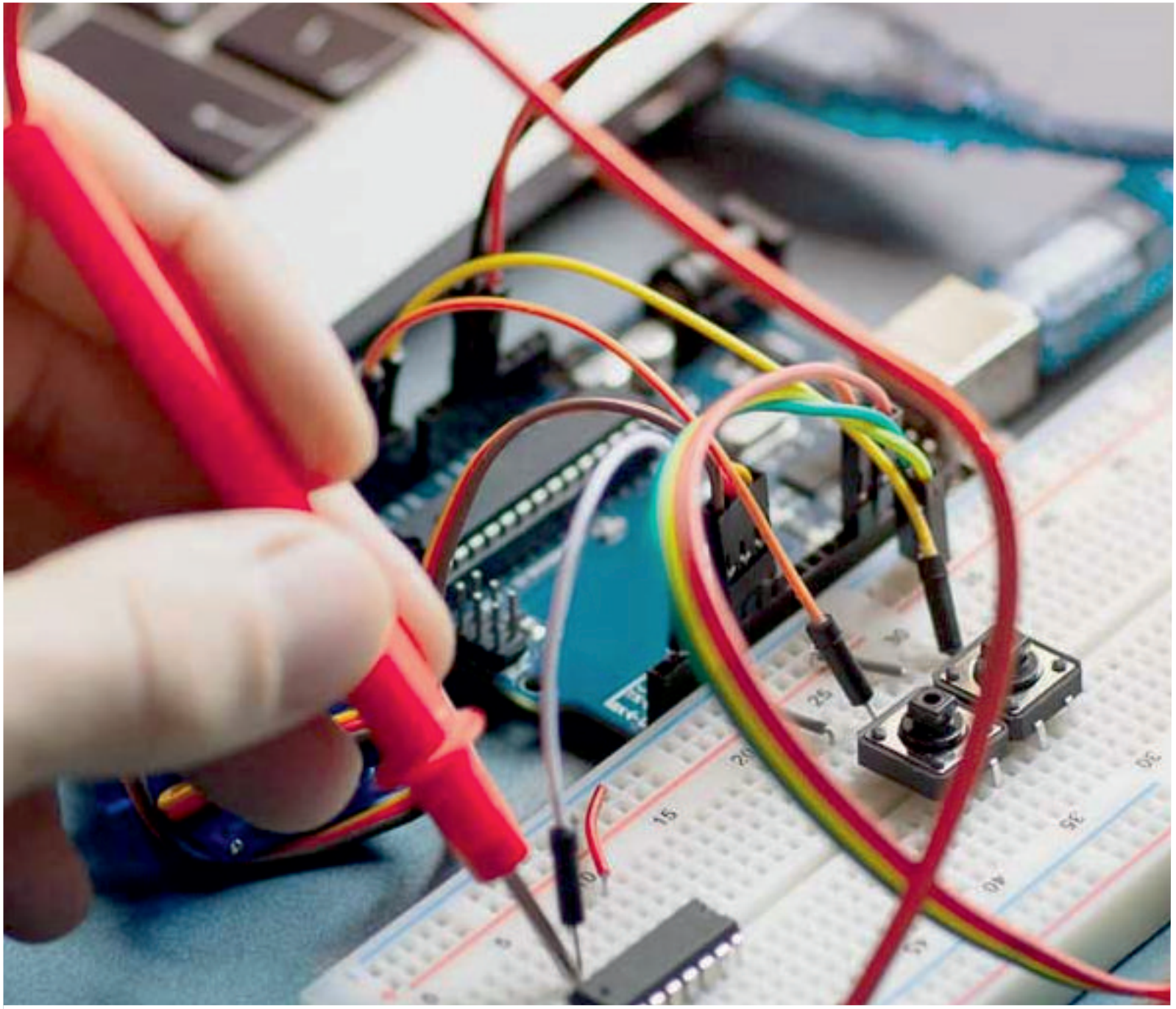

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