GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

INTELLIGENT SWITCHING OF ELECTRICAL VEHICLE WITH RENEWABLE TO MEET THE LOAD DEMAND

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ABSTRACT

The world getting thin and roads getting narrow the demand of electricity is increasing beyond the prediction expectation of power system engineers. So to overcome the load demands the renewable source as an alternate clean source for generating electricity has been considered from last few decades and have provided the excellent results till present. Now the focus is mainly to develop a hybrid system in which theses renewable can be combined with vehicles so as to reduce the stress on power grid without affecting the load demands. This paper focuses on the intelligent switching of electric vehicle with PV system in order to fulfill the load demand and benefiting the consumer at the maximum. In this proposed work a simulink model has been developed which clearly shows how this intelligent switching take place with minimum/ least human interference. Apart from this it has shown that if proper synchronization between renewable source and EV is done, then we can easily take care of the load demand and also vehicles charging/ discharging can be effectively done.

Keywords: *EV-Electric vehicle; Grid integration, V2G-vehicle-to-grid; G2V-grid-to-vehicle; Renewable, PV Array.*

I. INTRODUCTION

Now a day the non-renewable resources have become a serious problem which has attracted much awareness from the entire world. Regarding transport, vehicles not only consumed huge fossil fuel, but also released frequent greenhouse gases to the atmosphere. For this truth, a number of research institutions and automobile company have regularly devoted their interests on researching and increasing alternative energy source to change or control the fuel consumption in conventional vehicles. As a substitute of conventional vehicles, Electric Drive Vehicles (EDVs) have gradually been accepted by the public in past years.

The importance of electric vehicles has increased quickly over the past few years. An essential milestone was reach in 2012 with more than 1, 00,000 hybrid and all electric vehicle sold worldwide and sales figures are about doubling each year [18]. Many automobile manufacturers have at this point developed and commercialized their first modern electric models, proving that the electric drive is technically possible, environmentally friendly and affordable. Manufacturers are now approaching a subsequent phase in their development effort that entails building powerful, long-range, fast-charging, more efficient and cheaper electric vehicles. and to make intelligent choices for the next-generation electric drive technologies that once and for all give electric vehicles its correct place in the transportation market. worry with all-electric vehicle (EV) is their restricted driving range on a completely charged battery, also known as range concern. The range is usually between 100km to 500km for a modern EV. At the same time, the refuel time for an electric vehicle is time-consuming, ranging from 30 minutes to 10 hours or more. Therefore, users feel this is too restraining and attach with their conventional fuel vehicle (Petrol) that can be refueled almost anywhere in 5-10 minutes or less. Power grids are getting transformed into smart grid having digital control by using advanced sensors, information and communication technologies. There are many advantages of smart grid [19]. In smart grid, there is two-way communication between consumer and electric utility and also energy flow is two-way between grid and the consumer with renewable energy generation. This is monitored and controlled by sensors, smart meters and digital controls. There are several issues that motivates power sector to go for smart grid [20]. Some of those factors are- greenhouse gas emission and climate change, reliability as there will be more generation problem with transmission infrastructure, economics as utilities and service providers pay high price for electricity that is imported from grid connected neighbors at the time of transmission congestion [21].

Smart grid assure an ability to reduce peak demand and financial saving, energy security gets improved as the electrification of road transportation through electric and plug-in vehicles can helps us to reduce import of foreign oil [23].

II. RELATED WORK AND BACKGROUD INFORMATION

The serious event that rose up concerns about the reliability of electric grids is gap between peak and off peak loads. Demand management, Distributed electricity generation and Transmission & Distribution grid management are some steps to reduce this gap. The existence power grid has a one way electricity flow and aging design. Because of grid communication system is time-consuming in response and need to be upgraded by allowing two-way communication and two way flow of electricity between generators and consumers. We also need to integrate the highly developed communication technology and fit in IP based communication architectures. Smart gridsare complex systems. A smart grid is a system of delivering energy to consumers. Smart grid stores, transports and manages energy. Consumers can generate their own electricity with the help of renewable sources like solar PV or wind power. Plug in Hybrid Electric Vehicles are also a part of smart grid as they can store electricity during off peak hours and can supply during peak hours. For this various intensives is also paid to the consumer.

Electrical Vehicle

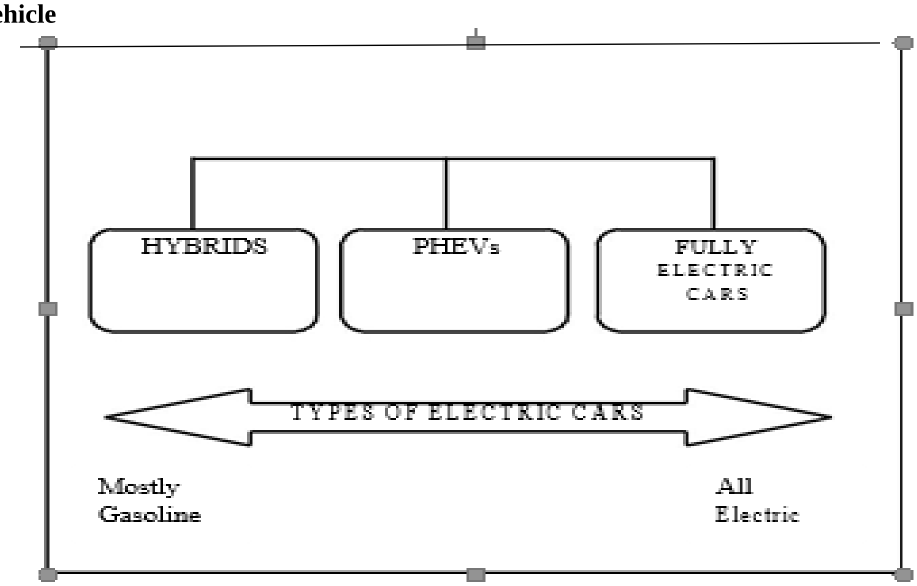

Fig. 1 Different types of Electric Vehicle

aFirstly hybrid vehicles are those in which electric motor assists the gasoline motor. These vehicles are directed more towards gasoline. Another type of electric vehicle is plug-in hybrid electric vehicles. These PHEVs are like hybrid electric vehicles but their electric battery can be recharged. There are also fully electric vehicles that run only on rechargeable electric battery. These vehicles are all electric and do not have gasoline option and gasoline engine. These vehicles are most eco-friendly and cause minimum noise pollution. The internal structure of hybrid, plug-in hybrid electric vehicles and battery operated electric vehicles are shown in fig.1. As shown PHEV's has both electric motor and gasoline engine as it can run both on gasoline and electric battery. Battery of PHEVs can be recharged from power supply. Electric vehicles does not have engine, it only consists of electric motor and rechargeable battery. Battery size in BEV is larger as compared to battery size of PHEV which makes it bulkier as compared to PHEVs.

PV SYSTEM

A photovoltaic system, also known solar PV power system, is a power system planned to supply effective solar power by means of photovoltaic. It consists of a number of components, including solar panel to take in and exchange daylight into electricity, a solar inverter to alter the electric current from DC to AC, as well as mounting, cabling and additional electrical accessories to set up a functioning system. It may also use a solar tracking system to develop the system overall performance and comprise of an integrated battery solution, as prices for storage device is expected to reject. A solar array only encompasses the group of solar panels, the visible piece of the PV system and does not contain all the other hardware, often summarize as balance of system (BOS). Moreover, PV system convert sun light directly into electricity and should not be puzzled with additional technology.

Smart Grid

A serious event that rose up concerns about the reliability of electric grids in North America was the blackout in August 14, 2003, which affected 55 millions of consumers in the North east of United States and in some areas of Canada causing an economic impact estimated between 7 to 10 billion US dollars. By that occasion, U.S. government realizes the essential and the importance to improve the national energy infrastructures and policies. It is based on communication and information infrastructure that can integrate and coordinate generation, transmission and distribution intelligently. Smart grid mainly consists of three components:

1. Distributed electricity generation with the help of renewable power sources.
2. Demand management to monitor and manage consumption through smart meters and appliances.
3. Transmission and distribution grid management to control power grid in real time.

III. PRESENT WORK

Vital role played by electrical vehicle to avoid gap between peak and off peak period of load curve. An intelligent switching of electrical vehicle is proposed as a load curve shaping tool to reduce the peak demand and lead the flat load curve profile. This strategy also takes into account a PV distribution system for charging the EV battery and supplying the load during day time.

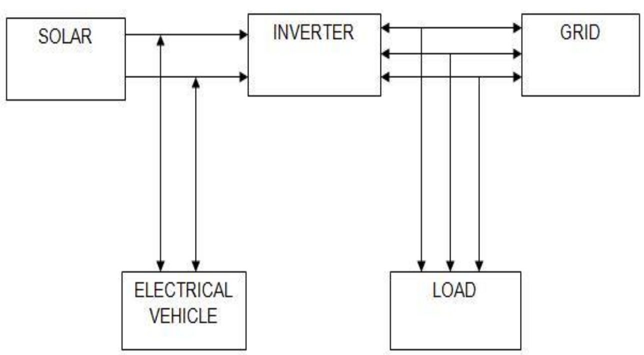

Fig. 2 Block Diagram of System

Proposed Intelligent Switching Strategy

For implementation of proposed intelligent switching strategy there is a need of modern infrastructure upgrade at distribution level, PV system and charging station of EV. We have two power stations i.e. PV station and grid. From PV station load 1 is connected which is ≤ 50 KW and EV is also connected with PV. When load is increased on the system i.e. above 50 KW (load 2 connected) then the supply is feed to the load 1 and load 2 is by PV, grid and EV is also give power to the load for short period of time. PV system gives the power supply only for the day time i.e. 8AM to 6PM, after that the power is feed to all the loads including the charging of electric vehicles is only by grid.System flow chart that is used in this dissertation is to implement intelligent switching strategy is shown in fig. 3.

ISSN 2348 – 8034
Impact Factor- 5.070

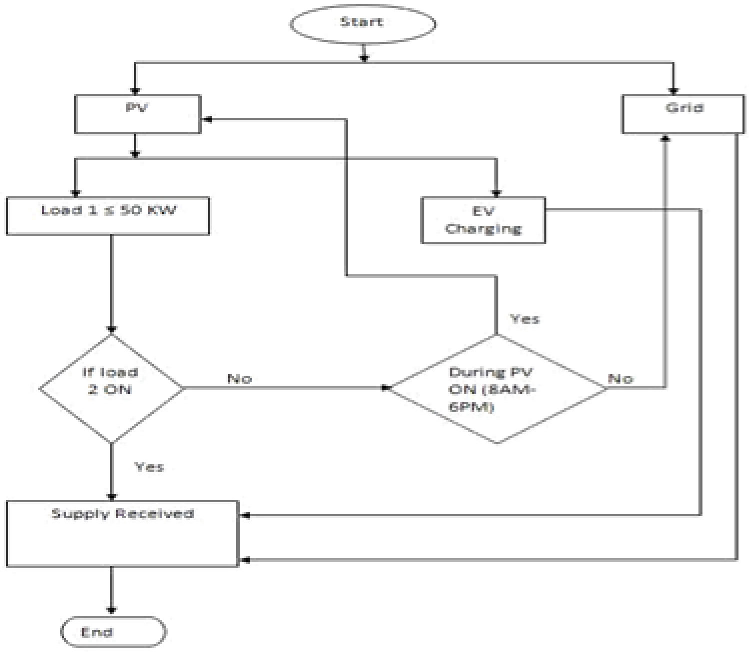

FIG.3 SYSTEM FLOW CHART

Power Description

The solar PV is designed for 100kW grid connected system. At the maximum irradiance the maximum power is around 98.7kW.The voltage generated by solar is quite less which isboost up using boost converter to around 500V.During the charging the battery power used to vary between 2kW-5kW, since the rate of charge is exponential in nature. As a result the power varies on DC bus accordingly. At the time of discharging the battery gives the power of around 20kW.

The load1 initially consumes 45 kW which further increases to 50kW with the irradiance. The outputs of the inverter are around 80kW with battery discharging. When the load2 is connected, both the load demands total of 100kW.As a result the grid provides the additional power to both the loads of 50kW each. The grid is designed for 200kVA.

Table 1 Infrastructure component description

S. NO.	SYSTEM	POWER RATING
1.	PV Station	100 KW
2.	Electrical Vehicle	5 KW
3.	Grid	200 KVA
4.	Load (Load 1+ Load2)	100 KW

IV. RESULT AND DISCUSSION

This section represents the impact of Electrical Vehicle and Solar PV system on the grid and the different graphs are shown

A. Solar PV Power vs Time

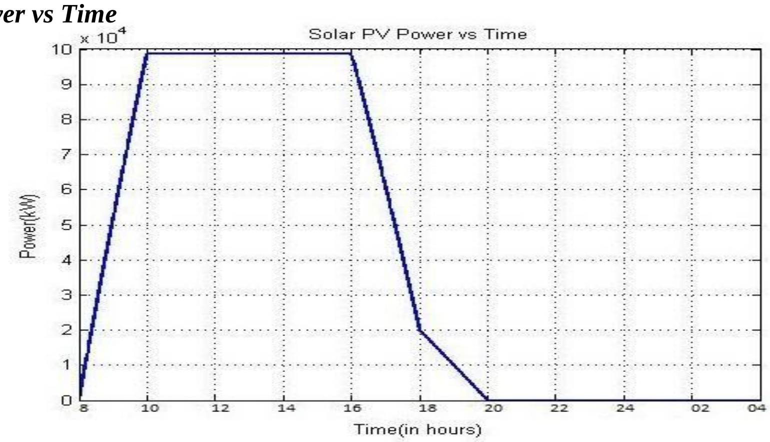

Fig. 4 Solar PV Power vs Time

The variation of Solar PV power with respect to time is shown in this graph. It can be observed that as voltage increases the power also increases. At maximum irradiance, the power of around 98kW can be easily extracted by solar PV systems.

B. Irradiance vs Time

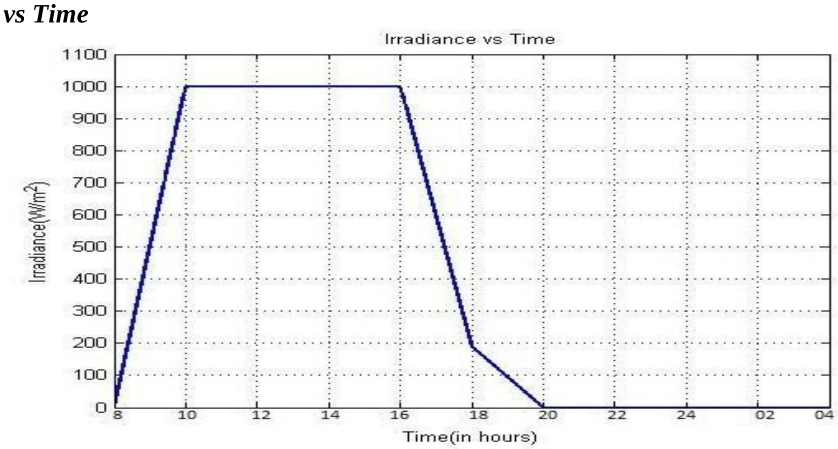

Fig. 5 Irradiance vs Time

The irradiance vs time graph explains the variation of irradiance as the sun reaches at zenith. With the passage of time, the irradiance increases as the temperature increases and as a result maximum irradiance can be seen from 10AM-4PM. As a result the power will be maximum during this interval.

C. Load 1 Power vs Time

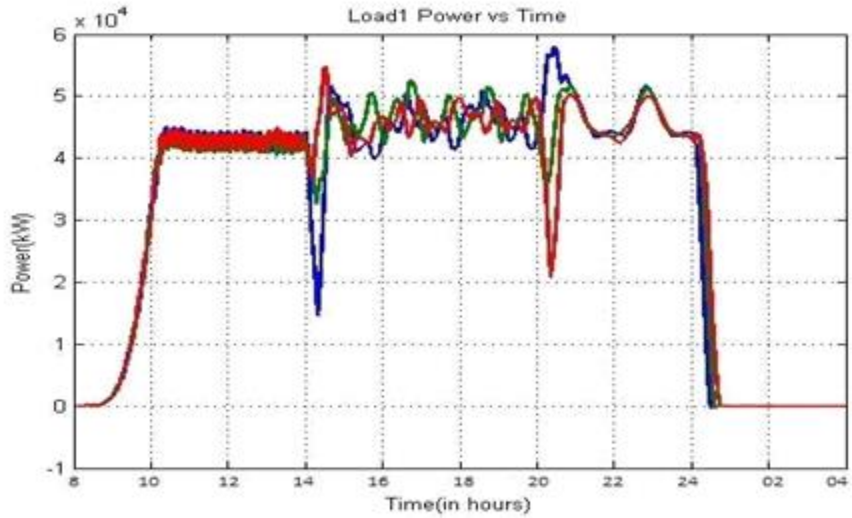

Fig.6 Load 1 Power vs Time

The graph clearly depicts the relation between load demandwrt time. Initially till 1400 hours the load is supplied by PV Array. But after 1400 hours, when the demand reaches towards peak, the load is driven by GRID as well as solar PV so as to maintain the requirements without much loss. The scenario has been considered wrt to load requirement/day from city like Delhi where there is a continuous variation of load during the 24 hours. At 2400 hours, this load has been cut off.

D. Load 2 Power vs Time

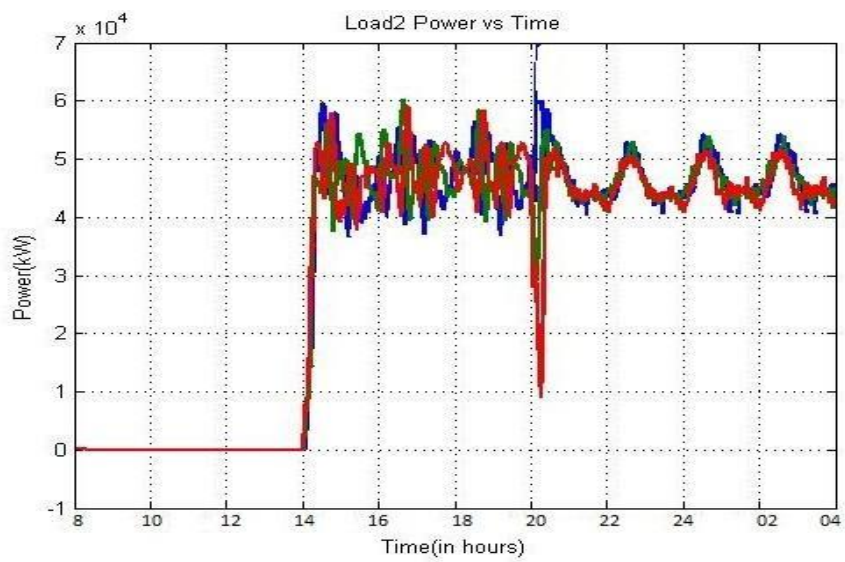

Fig.7 Load 2 Power vs Time

The SOC (state of charge) vs time graph depicts the charging and discharging of battery as the load varies. It can be observed that during the initial morning hours when the load requirement is less, the solar PV is used to supply thepower to load as well as used to charge the batteries of electrical vehicles but after 14:00 hours, when there is an increase in load demand, the battery starts discharging. Since requirements are not met as a result grid also gives the additional supply. The battery charges slowly when peak load is there. After 2200 hours when the load demands becomes normal, the battery start charging fast through the grid.

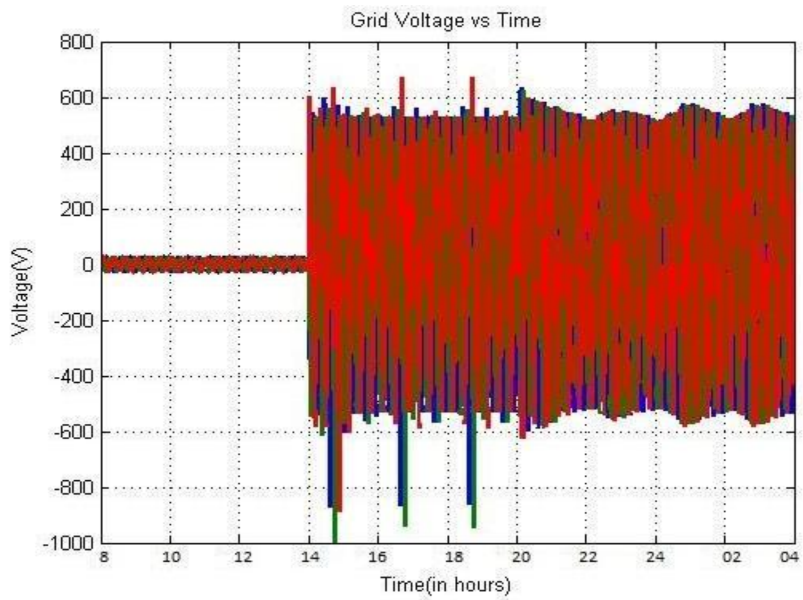

Fig. 9 Grid Voltage vs Time

The graph between grid voltage and time, shows as there is a peak demand requirements after 1400 hours, initially the solar PV system and vehicle batteries try to maintain the load requirements, but when the requirements is not met then the grid provides the required supply so to fulfill the demand. The grid will remain ON till 8 in the morning.

V. CONCLUSION

A wide use of EVs will bring many benefits, but it may cause several drawbacks too. Choosing appropriate EV management strategies will be needed in order to minimize EVs operating costs and their impact on the power system. V2G would come into view to be one of the most promise solutions. In exacting, V2G is especially advantageous in providing additional services, such as load leveling, regulation and reserve. Moreover, RESs support can be a viable choice the other services are flooded. This study of the literature reveals that different ways to perform V2G exist. Hence, the most appropriate one should be carefully selected on the basis of a holistic analysis, which depends on exact goals and local environments and takes into account scientific, cost-effective, planning and mobility aspects

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