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# Load Side Management Using Solar Power System: A Review

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***Abstract:*** *The objective of the present work is to review the solar-based power generation system, which can be used as stand-alone or grid-connected systems. The main goal of the proposed work is to find out demand site management used for domestic households. This work presents an in-depth review to determine how to achieve DSM through advanced metering infrastructure (AMI) and solar photovoltaic (PV) integration on domestic power distribution systems.*

***Keywords:- Load side management, solar power system, renewal energy system, loads.***

## I. Introduction

Electricity use can vary dramatically in short and medium time frames, depending on contemporary weather patterns. Generally, the wholesale power device adjusts to converting demand by dispatching additional or much less era. However, the different generations are typically provided through less efficient ("peaking") resources in height intervals. Unfortunately, the on-the-spot economic and environmental fee of using those "peaking" resources is not necessarily contemplated in the retail pricing machine. In addition, the capacity or willingness of energy clients to modify to charge indicators by altering call for (elasticity of call for) may be low, especially over brief time frames. In many markets, clients (particularly retail clients) no longer face real-time pricing in any respect but pay fees based on common annual prices or different built fees. Energy call for management activities attempts to carry the energy call for and deliver towards a perceived gold standard and assist in delivering energy cease users advantages for lowering their call. In the current system, the incorporated approach to demand aspect management is becoming increasingly commonplaces. IDSM routinely sends indicators to end-use structures to shed load depending on gadget conditions. Let's in for terribly particular tuning of demand to ensure that it matches supply always, reduces capital costs for the utility. Critical machine situations can be peak instances or in areas with degrees of variable renewable energy, at some stage in times when the call must be adjusted upward to avoid over-generation or downward to assist with ramping desires. Demand correction may be achieved by way of various approaches: including permanent differential quotes for evening and day times or occasional particularly priced usage days, behavioral changes accomplished thru home region networks, automated controls including with remotely controlled air-conditioners, or with permanent load modifications with power green home equipment.

## II. Literature review

In the last few years, the popularity of distributed generation systems has been more rapidly growing because of their higher operating efficiency and low emission levels. Distributed generators use several micro sources like solar PV systems, batteries, microturbines, and fuel cells [1]. Authors [2] proposed a Microgrid to understand the promising potential of distributed generation, a system approach that considers generation and related loads as a subsystem. In order to minimize the requirement for central dispatch, these methods implicate local control of distributed generation, and therefore during disturbances by islanding generation and loads, local consistency can be advanced in the microgrid than the whole power system [2] to improve the reliability of small-scale distributed generators and minimize the cost, the microgrid concept can be used. The main purpose of this concept is to accelerate the recognition of the advantage offered by small- scale distributed generators, likeability to supply waste heat for the period of the requirement of the time [3]. The microgrid concept acts as a solution to integrating a large amount of microgeneration without interrupting the utility network's operation. The distribution network subsystem or microgrid will trouble the utility network less than the conventional microgeneration [4]. With the advancement in microgrids and distribution generators, there is a development of different necessary power conditioning interfaces and their related control for tying multiple micro sources to the microgrid and then tying the microgrids to the established power systems. The operation of the microgrid system is very flexible so that we can operate freely in the grid-connected or islanded mode of operation [5]. The installation of distributed generators involves technical studies of two major fields. The first one deals with the impacts caused by using distributed turbines without making large adjustments to the manipulated approach of conventional distribution devices, and the other one is producing a new idea for the usage of distributed turbines. The idea of the microgrid follows the later method. There consists of several blessings with the setup of the microgrid. The efficient microgrid can integrate allotted power assets with masses [6] to advance the system's reliability for each section of the microgrid. A peer-to-peer and plug-and-play model is used with the loss of any component or generator. The microgrid can continue its operation with the concept of peer-to-peer guarantees to diminish the potential of engineering errors, and a Plug-and-play feature implies that without re-engineering the controls, an entity can be placed at any point on the electrical system [7]. A country's economy mainly depends upon its electric energy supply, which should be secure and high quality by distributed energy supply. The requirement of customers for energy supply and power quality is fulfilled. The distribution system mainly includes renewable energy resources and storage systems, which are small-sized power generating systems normally installed near the customer's premises. The advantages of the DERs include power satisfaction with better delivery, higher reliability, and extreme power performance through the utilization of waste heat [8]. Integration of wind turbines and photovoltaic systems with grid leads to grid instability. One of the solutions to this problem can be achieved by the implementation of a microgrid. With several advantages associated with microgrid operation, there are high transmission line losses [9]. In a house, renewable electricity sources and garage gadgets are related to DC bus with extraordinary converter topology from which DC loads can get electricity supply. Renewable energy resources are integrated with the microgrid to reduce the emission of $CO_2$ and consumption of fuel. The renewable assets are very fluctuant, and additionally, the manufacturing and intake of these resources are very difficult. Therefore, new renewable energy turbines must be designed to have more flexibility and controllability [10]. In conventional AC power systems, the AC voltage source is converted into DC power using an AC/DC inverter to supply DC loads. AC to DC and DC to AC converters are used in many industrial applications such as control of motor drives speed. Because of the environmental issues associated with conventional power plants, renewable resources are connected as distributed generators or ac microgrids [11]. The DC grid has the advantage over a conventional AC grid system because the power supply connected with the DC grid can be operated cooperatively. After all, DC load voltage is controlled. The DC grid system operates in stand-alone mode in the case of the abnormal or fault situations of the AC utility line, in which the generated power is supplied to the loads connected with the DC grid. Changes in the generated power and the load consumed power can be compensated as a lump of power in the DC gird [12]. Therefore, the efficiency is reduced due to multistage conversions in an AC or a DC grid. That's why to decrease the multiple processes such as DC/AC/DC or AC/DC/AC changes in a person of AC as well as DC grid, hybrid AC/DC microgrid is proposed, which also helps in reducing the energy loss due to reverse conversion [13]. Mostly renewable power plants are implemented in rural areas far away from the main grid network, and there is a possibility of a weak transmission line connection. The microgrid (MG) concept provides an effective solution for such weak systems [14]. Distributed generation is gaining more popularity because of its advantages like environmental friendliness, expandability, and availability without alternating the existing transmission and distribution grid. Because of this problem, the microgrid concept comes into the feature that clusters multiple distributed energy resources with different operating principles [15].

## III. Photovoltaic system

The photoelectric impact was first cited through French physicist Edmund Becquerel in 1839. He proposed that certain materials property of producing small quantities of electric modern-day while exposed to sunlight. In 1905, Albert Einstein explained the nature of mild and the photoelectric impact, becoming the simple principle for a photovoltaic generation. In 1954 the primary photovoltaic module turned into constructed through Bell Laboratories [16].

### 3.1 Photovoltaic cell

The basic components of PV cells are semiconductor materials, including silicon. A thin semiconductor wafer creates an electric field for solar cells, on one side fine and negative on the opposite. When mild energy hits the solar cell, electrons are knocked loose from the atoms inside the semiconductor fabric. When electric conductors are connected to the positive and poor aspects, an electrical circuit is formed, and electrons are captured in the form of an electric-powered modern, that is, the strength. This power is used to energy a load. A PV mobile can both be round or rectangular in construction.

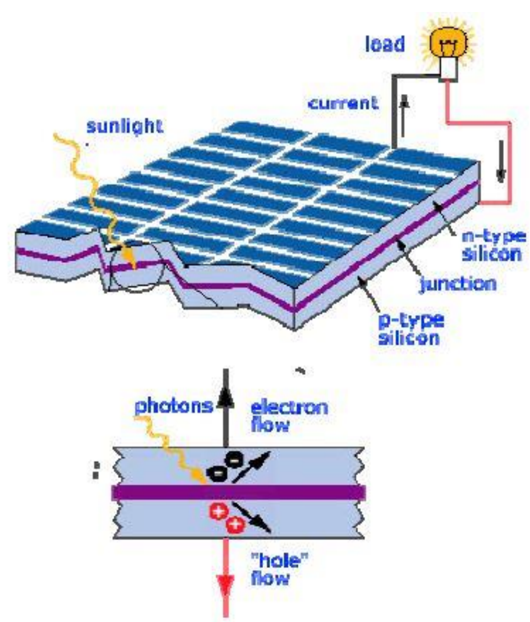


Figure1 The basic structure of PV cell [16]

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### 3.2. Photovoltaic module

Because of the low voltage technology in a PV cellular (around 0.5V), several PV cells are linked in series (for high voltage) and in parallel (for excessive current) to shape a PV module for favored output [17].

### 3.3. Photovoltaic array

A photovoltaic array (PV system) is an interconnection of modules which in flip are made up of many PV cells in series or parallel. The strength produced through the available module is not sufficient to meet the necessities of business packages, so modules are related to form array to supply the weight. In an array, the modules' relationship is equal to that of cells in a module [18].

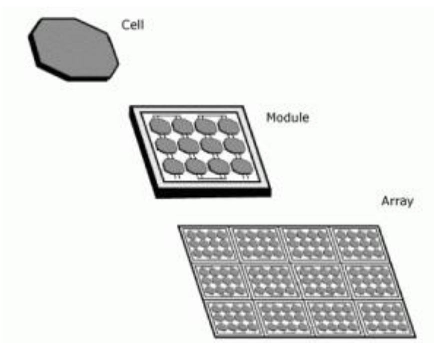

Figure 2 Photovoltaic system [17]

### 3.4. Working of PV cell

The simple precept at the back of the operation of a PV cell is the photoelectric effect that's impact, and the electron gets ejected from the conduction band because of the absorption of sunlight of a certain wavelength with the aid of the problem (steel or non-steel solids, liquids or gases). So, a few parts of the solar electricity are absorbed inside the semiconductor material in a photovoltaic cell while daylight hits its floor.

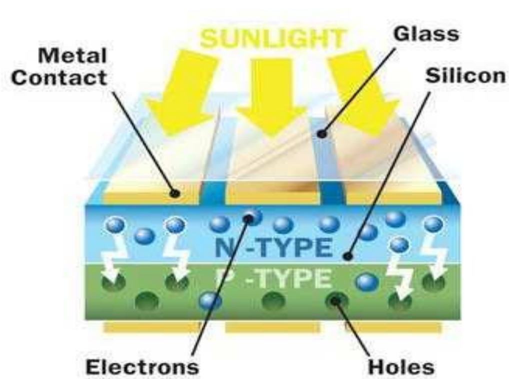

Fig 3. Working of PV cell [17]

The electron from the valence band jumps to the conduction band while absorbed energy is greater than the bandgap power of the semiconductor. By these hole-electrons, pairs are created in the illuminated vicinity of the semiconductor. The electrons created in the conduction band are lost to move. These loose electrons are enforced to transport in a particular direction by the motion of the electrical subject present in the PV cells. These electrons flowing contain present-day and can be drawn for external use through connecting a metallic plate on the pinnacle and backside of PV cellular. This modern-day and the voltage produces required electricity.

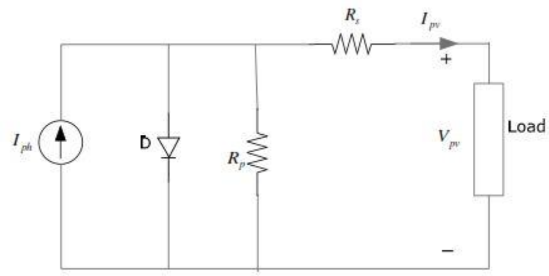

Figure 4 Equivalent circuit of a solar cell

### 3.5. Modeling of PV panel

The photovoltaic device can generate direct cutting-edge strength without environmental effect while it is exposed to sunlight. The fundamental building block of PV arrays is the solar cell, which is essentially a p-n junction that at once converts light power into power. The output function of the PV module depends on the cell temperature, solar irradiation, and output voltage of the module. The figure indicates the equivalent circuit of a PV array with a load [18]. Usually, the equivalent circuit of a widespread PV version includes a photocurrent, a diode, a parallel resistor that expresses a leakage contemporary, and a chain resistor that describes an inner resistance to the contemporary float. The voltage present-day characteristic equation of a solar cell is given as

$$I_{PV} = I_{PH} - I_S[\exp(q(V_{PV} + I_{PV}R_S)/kT_cA) - 1] - \frac{(V_{PV}+I_{PV}R_S)}{R_P} \quad (1)$$

The photocurrent mainly depends on the cell's working temperature and solar irradiation, which is explained as

$$I_{PH} = [I_{SC} + k_1(T_C - T_{REF})]\lambda/1000 \quad (2)$$

The saturation current of the cell varies with the cell temperature, which is represented as

$$I_S = I_{RS}\left(\frac{T_C}{T_{REF}}\right)^3 exp\left[qE_G\left(\frac{1}{T_{REF}} - \frac{1}{T_C}\right)/kA\right] \quad (3)$$

The shunt resistance $R_p$ of the mobile is inversely related to shunt leakage contemporary to the floor.

$$I_{PV} = I_{PH} - I_S[\exp(q(V_{PV} + I_{PV}R_S)/kT_cA) - 1] \quad (4)$$

If $R_s = 0$ and $R_p = \infty$. Then no leakage and losses in the solar array

## IV. CONCLUSIONS

It is concluded that DSM results improve load factors when peak load is reduced and load shifting techniques fill the valley. Therefore, the consumer can adjust their demand by setting their demands and operating time (turn on and turn off), reducing the peak load. This system gives better performance when grid power is unavailable, and customer load is supplied by solar photovoltaic and storage systems.

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