National conference on Engineering Innovations and Solutions (NCEIS – 2018)
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 4 | Issue 6 | ISSN: 2456-3307

Modelling and Analysis of Grid Connected Solar Rooftop PV System for Residential Purpose

Rekhashree Patil, Dr. Rajashekar J S
Department of Electronics & Instrumentation, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India

ABSTRACT

The main objective of this study is to explore and move forward to environmental friendly with clean energy production in India. The environmental effects of fossil fuel usage and increasing electricity demand are the main factors driving towards the renewable energy. To achieve the goal this paper proposes the Grid connected solar rooftop PV system for residential purpose first to fulfil the home loads and excess energy if generated is connected to utility grid through net metering. It is easier and cheaper than ever before to install solar panels on the roof! Falling PV module prices and very conducive policy environment has made installation of rooftop PV panels a very lucrative investment for individuals and businesses. Modelling method of system design helps to develop the required equipment's for energy harvesting from the solar system more economically. This method helps predict power interruption, the backup energy storage as they can use the energy stored from the batteries. Therefore, development of system model gives the clean energy for energy conservation and sustainable development of the society.

Keywords: Renewable Energy, Solar Rooftop PV System, Net Metering, Utility Grid Connected System

I. INTRODUCTION

There are number of factors behind the development of a country, electricity is one among them. Nowadays, the main challenge for both developed and developing countries is to produce electricity continuously to meet the demand which is massively increasing day by day. Present-day, the non renewable energy sources, which is obtain from nature as a form of coal, gas ,oil etc, are exhaustive in nature and are depleting rapidity due to increase in population. The energy which is in-exhaustive in nature known as renewable energy which is an alternative to non-renewable energy sources.

Using of fossil fuels to produce electricity causes environment problems and it has significant and harmful consequences such as climate change and greenhouse gas (GHG) emission. Utilisation of fossil fuel also one of the reasons of global warming emissions [6]. Climate change is one of the most critical challenges that mankind are facing.

It is well related to the greenhouse emissions which help to trap heat and to make earth warmer. As a result, weather patterns, people, plants and animals are directly affected [7]. In addition, it is also a concern that conventional resources for electricity generation will not last long, the depletion rate of these resource is very fast.

In contrast with fossil fuels, renewable sources are reliable, environment-friendly, affordable, free, abundant, beneficial for our climate as we as health [9]. Electricity can be produced from a number of available renewable sources such as solar [10],

biomass [11], tides [12], the wind [13], rain, biodiesel, biofuel [14], geothermal heat [15] etc. Production of electricity from different natural resources will reduce stress on conventional sources. Solar is the most promising source of energy among different renewable energy sources. Solar energy has a number of benefits over other forms of renewable energy. It is clean, available in nature, pollution free, have 20 to 30 years of life span, more reliable and can be directly converted to electricity. These advantages have made solar a favorable source of energy for future electricity generation system [16] and [17].

Due to negative impact of conventional energy sources as it leaves harmful gases on environment, Renewable energy resources become popular now a day. Solar energy sources are one of them. Now a days, energy based on photo-voltaic cell has becomes most popular as renewable energy resources Photovoltaic grid integrated system has developed rapidly due to continuous cost reduction and incentives obtained by government in past years.

II. BLOCK DIAGRAM

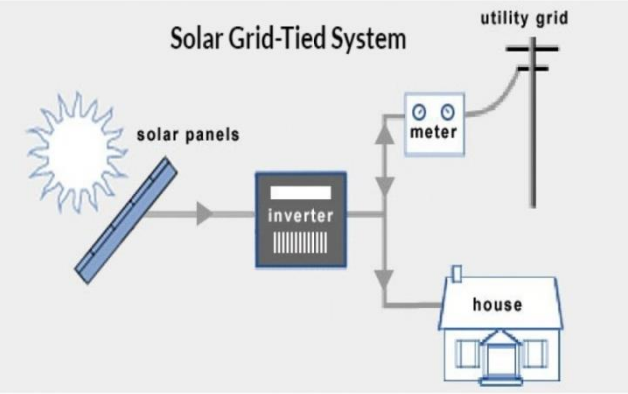

Figure 1. Grid connected solar PV system

A grid-connected photovoltaic power system is an electricity generating solar PV power system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit, net metering and grid connection equipment. They range from small residential and commercial rooftop systems to large utility-scale solar power stations. Unlike stand-alone power systems, a grid-connected system rarely includes an integrated battery solution, as they are still very expensive.

Solar energy gathered by photovoltaic solar panels, intended for delivery to a power grid, must be conditioned, or processed for use, by a grid-connected inverter. Fundamentally, an inverter changes the DC input voltage from the PV to AC voltage for the grid. This inverter sits between the solar array and the grid, draws energy from each, and may be a large stand-alone unit or may be a collection of small inverters, each physically attached to individual solar panels. See AC Module. The inverter must monitor grid voltage, waveform, and frequency. One reason for monitoring is if the grid is dead or strays too far out of its nominal specifications, the inverter must not pass along any solar energy. An inverter connected to a malfunctioning power line will automatically disconnect in accordance with safety rules, for example UL1741, which vary by jurisdiction. Another reason for the inverter monitoring the grid is because for normal operation the inverter must synchronize with the grid waveform, and produce a voltage slightly higher than the grid itself, in order for energy to smoothly flow outward from the solar array.

When conditions are right, the grid-connected PV system supplies the excess power, beyond consumption by the connected load, to the utility grid. Residential, grid-connected rooftop systems which have a capacity more than 10 kilowatts can meet the load of most consumers. They can feed excess power to the grid where it is consumed by other users. The feedback is done through a meter to monitor power transferred. Photovoltaic wattage may be less than average consumption, in which case the consumer will continue to purchase grid energy, but a lesser amount than previously. If photovoltaic wattage substantially exceeds average consumption, the energy produced by the panels will be much in

excess of the demand. In this case, the excess power can yield revenue by selling it to the grid. Depending on their agreement with their local grid energy company, the consumer only needs to pay the cost of electricity consumed less the value of electricity generated.

III. IMPLEMENTATION

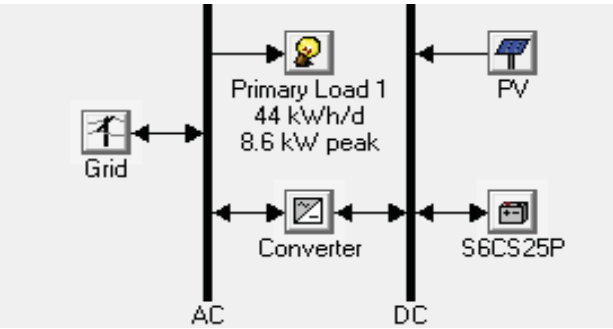

Fig.2. Implementation of On-Grid Solar System

For a case study, we have chosen a house in Kuala Lumpur with daily demand load 44 kWh. The daily load profile of the house is given in Fig.2 and it is considered that the load profile remains same for all months of the year. In this study, a SHS concept with AC grid has been proposed to meet the daily electrical demand of the house. During the bad weather when solar will not get enough sun rays, AC grid will give support to the system. The solar panel is placed at such a place so that more panels can be installed in the same place to support the increase in demand. Generated power from solar panels during day time will supply the load demand, while the excess energy will be stored in the battery bank. The stored energy in battery bank will be used to support the system at night. After satisfying own demand one can sell back the excess energy to the grid. This system is proposed for an individual house power supply. It will be driven by Smart Home Energy Controller (SHEC). If the status of the battery is less than 30% SHEC will be automatically connected to the grid to meet the electricity demand until the batteries charge status reach at 90%. Our aim is to ensure continuous power supplied to the house as required.

IV. ADVANTAGES

a) Systems such as Net Metering and Feed-in Tariff, which are offered by some system operators, can offset a customer's electricity usage costs. In some locations though, grid technologies cannot cope with distributed generation feeding into the grid, so the export of surplus electricity is not possible and that surplus is earthed.

b) Grid-connected PV systems are comparatively easier to install as they do not require a battery system.

c) Grid interconnection of photovoltaic (PV) power generation systems has the advantage of effective utilization of generated power because there are no storage losses involved.

d) A photovoltaic power system is carbon negative over its lifespan, as any energy produced over and above that to build the panel initially offsets the need for burning fossil fuels. Even though the sun does not always shine, any installation gives a reasonably predictable average reduction in carbon consumption.

V. DISADVANTAGES

a) Grid-connected PV can cause issues with voltage regulation. The traditional grid operates under the assumption of one-way, or radial, flow. But electricity injected into the grid increases voltage, and can drive levels outside the acceptable bandwidth of ±5%.

b) Grid-connected PV can compromise power quality. PV's intermittent nature means rapid changes in voltage. This not only wears out voltage regulators due to frequent adjusting, but also can result in voltage flicker.

c) Connecting to the grid poses many protection-related challenges. In addition to islanding, as mentioned above, too high levels of grid-connected PV result in problems like relay desensitization,

nuisance tripping, interference with automatic reclosers, and ferroresonance.

VI. CONCLUSION

The option of Solar PV Rooftop "Grid Connected" system looks quite lucrative for places with fairly regular and continuous supply of electricity. A majority of such places in the country are cities with higher tariffs and reliable electricity supply. It can be a great method to not only reduces electricity bills, but also the generated power can be routed to places which have a shortage of electricity.

VII. REFERENCES

[1] D. P. Kaundinya, P. Balachandra, and N. Ravindranath, "Grid-connected versus stand-alone energy systems for decentralized power—a review of literature," Renewable and Sustainable Energy Reviews, vol. 13, pp. 2041-2050, 2009.

[2] A. Haris, "MBIPV project: catalyzing local PV market," in Finance & Investment Forum on PV Technology, 2008.

[3] Energy Commission, Malaysian Energy Information Hub, "http://meih.st.gov.my/statistics," accessed in Agust 2016.

[4] K. Solangi, A. Badarudin, S. Kazi, T. Lwin, and M. Aman, "Public acceptance of solar energy: The case of Peninsular Malaysia," in TENCON Spring Conference, 2013 IEEE, 2013, pp. 540-543.

[5] M. M. A. M. Bagher, A. Vahid, M. Mohsen, and B.

[6] M. Reza, "Effect of Using Renewable Energy in Public Health," vol. 3, pp. 1-9, 2016.

[7] A. Nugroho, "The impact of solar chimney geometry for stack ventilation in Malaysia's single storey terraced house," Malaysia's Geography, pp. 163-77, 2010.

[8] S. Ahmad, M. Z. A. Ab Kadir, and S. Shafie, "Current perspective of the renewable energy development in Malaysia," Renewable and Sustainable Energy Reviews, vol. 15, pp. 897-904, 2011.

[9] S. Mekhilef, A. Safari, W. Mustaffa, R. Saidur, R. Omar, and M. Younis, "Solar energy in Malaysia: current state and prospects," Renewable and Sustainable Energy Reviews, vol. 16, pp. 386-396, 2012.