State of Art on Components Used in a Solar-Based Renewable Energy System

Zurish Khan[1], Sagar Tomar[2], Madhu Upadhyay[3]
Research Scholar, Electrical & Electronics Department, NIIST, Bhopal, Madhya Pradesh, India[1]
Assistant Professor, Electrical & Electronics Department, NIIST, Bhopal, Madhya Pradesh, India[2]
Head of Department, Electrical & Electronics Department, NIIST, Bhopal, Madhya Pradesh, India[3]

Abstract- *Over the years, the discovery, research, and use of renewable energy such as wind, solar, hydro, and tidal power have increased worldwide environmental worries about the quantity of CO_2 released into the atmosphere by human activities. Furthermore, the hybrid system paired with renewable sources is rapidly being employed for the utilization of renewable energy. In this article, we will first look at the global energy situation of the renewable energy system. Following that, provide a review of the component utilized in the solar-based renewable energy system. Also discussed here are the fundamental problem and research motivation in the subject of renewable energy systems.*

Keywords:- RES, MPPT, OCV, CV, SCP.

Introduction

The world now faces the problem of decreasing dependence on fossil fuels. It is not necessary to replace fossil fuels such as carbon oil, natural-gas fuel, etc. and the reserves are rapidly depleted [1]. The need to create alternative electricity sources is particularly important to avoid the rising global air heat due to the impact of fossil fuels [2]. New and renewable energy sources are needed for a long term replacement of fossil fuels and carbon dependency. Electricity usage and requirements are now rapidly developing in the residential and industrial sectors in particular [3].

Social and financial development will require the global electric power equivalent of 32 000 tons of WH. If high carbon dioxide CO2 is produced when fossil fuels are still used as a power source, the economic problem will rise. Climate Change awareness and the need to enforce the GHG plan (as required by the Kyoto Protocol) mean that a large proportion of our energy is generated CO2-free. It should be in the next decade or twenty years for energy protection and global greenhouse gas emissions [4-5].

The target of a reduction in CO_2 emission by the world's rulers of 2030 significantly improves the renewable energy consumption as shown in Figure 1.1. Nonetheless, solar power (PV) has some advantages over the rest; it doesn't have moveable parts, noiseless, less maintenance required and safe than wind turbines. It can recycle its components and supply directly electricity from sunlight. It's easy to construct panels (on roofs, parking and vertical facades on skyscrapers or nearby premises). PV may supply 12% of European electricity by 2020, and according to the European Photovoltaic Industry Association (EPIA), PV is expected to supply more than 11% of world electric energy by 2050.

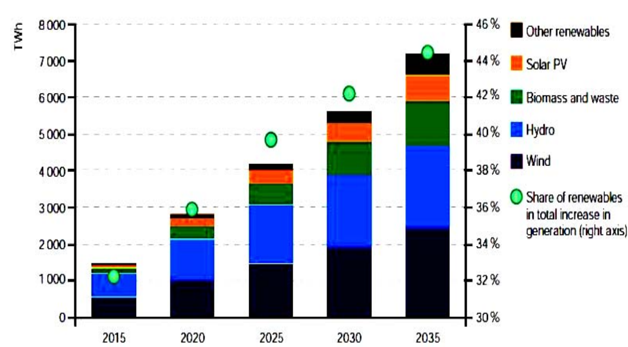

Fig 1.1: Incremental global electricity generation based on renewable sources [6].

The public's reference to understanding of climate change to the critical role played by renewable sources in combating climate change combined with government subsidies and feeding tariffs has led residential and capital enterprises to enhance the PV system[7-8]. The new policy is also projected to rise by more than 26 times as in 2011 from 67 GW in 2011 to 600 GW in 2035[5, 9]. New guidelines were foreseen in 2035. The use of the photovoltaic system in the world by 2035[2] is shown in figure 1.2. Figure 1.2 demonstrates the use of a photovoltaic network worldwide by 2035[9-10].

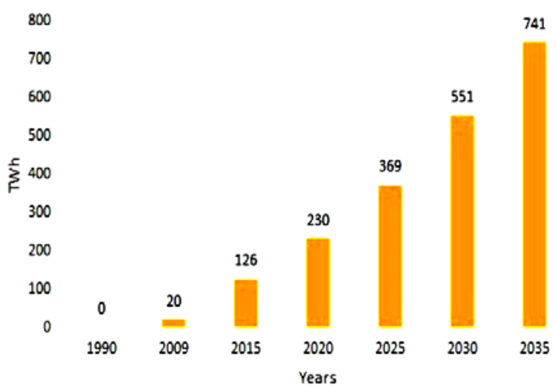

Fig 1.2: Globally, Solar PV energy generation [9].

In this paper here discuss the review of various components which is implemented in energy conversion of renewable energy sources. In the next section here discuss the MPPT algorithm, DC-DC boost topology and the converter system. Also discuss the basic motivation for future research based on renewable energy system.

II. MPPT for PV System

To ensure cost-effectiveness, it is essential to extract maximum energy from renewable energy systems, including PV. This is achieved with the use of a MPPT control system in PV applications. In the past there have been at least nineteen separate MPPT methods [11] created. Constant voltage (CV), which maintains a PV array on a constant reference voltage value (Vref), is defined to provide the max. Power under certain conditions, is simple algorithms. Therefore, the MPPT is estimated and cannot exceed the actual maximum power point (MPP). The implementation is very simple and economical but cannot adapt to changing operating conditions dynamically. The CV method has however proven to be more effective in low radiation algorithms than others, which allows the combination of CV with other MPPT technology [12].

The Open Circuit Voltage (OCV) method is connected to the CV method and the PV range is opened periodically. As the percentage of VOC, usually between 71-78 % [11], is known as a PV output voltage set point. This algorithm can offset temperature effects that affect the PV's output voltage. One downside is that when the PV array is open, no power is generated. Again, only the MPP can approximate this form.

The short-current pulse (SCP) method is another simple method for MPPT. This is similar to the OCV approach, but the panel is short-circuited than open-circuited. A current control loop controls the converter, with the operating current controlled to be about 92 % of the ISC [12]. The current control loop controlled. Just like the OCV process, no power comes from the short circuitry of the PV array. Benefiting from irradiance dependency but fairly temperature tolerant, the SCP system is more efficient to respond to specific irradiance than to module temperature differences. In fact, during the switching processes, the converter can experience a great deal of stress. The SCP model approximates only the MPP, equivalent to the CV and OCV.

More complicated approaches that can evaluate the true MPP are usable. Extremely searching theory of control may be used to set up a feedback system to cause oscillations around the point of equilibrium to create the MPP [13]. The P&O system sets the point of operation regularly and calculates instantaneous power output. If the energy increases, the converter will change its operating point in the same direction, and the shift direction will be reversed if it decreases. It is an effective method but it has a tendency to move around the MPP and cannot adapt to changing situations rapidly [12]. This approach is effective.

II. DC-DC Boost Converter

There are many numerous DC-DC converters that produce a voltage that is larger than the voltage of the input. The typical Boost converter topologies include: boost buck-boost, Cúk and Zeta converters and Single Ended Primary Inductor Converter (SEPIC). A DC-DC boost converter produces a voltage that is always higher than the input voltage [14]. The voltage gain from this converter can be practically understood, in the majority of cases it is no more than 4, particularly when high voltage and power are required. The boost converter works by closing an inductive switch that isolates the production stage. Once the switch is open, the input and the inductor flow energy is used to charge a condensers output [15]. The magnitude of the output voltage can be larger or lower than the input voltage and has opposite polarity for buck-boost converters. This circuit's significant disadvantages include high input-tension rippling and high switching stress [14]. Like the buck boost, Cúk delivers an inverter output that exceeds or falls short of the magnitude of the input voltage. This converter is less efficient than other converter topologies [15] and is used for most applications for the PV system [14]. The SEPIC will produce a voltage that is higher or less than the input but without inverting as with the buck-boost or Cúk converters. Finally, a non-inverter output that can be larger or less than the magnitude input can be provided by the zeta converter.

The voltage increase that is achieved by any topology of DC-DC converters is reduced by element parasites [16]. The increased driving loss (I^2R) will have more effects when power and current increase from a device. New high-value converter topologies are therefore needed to provide the necessary high power voltage gain.

III. Motivation of research

Recent declines in solar technology investments have contributed to a broader deployment of PV power generation plants. Two reports by US energy department of Sun-Shot Vision and Renewable Energy Futures have both predicted persistent, substantial PV development between now and the coming decades. Two studies predicted the increase in solar power (including photovoltaic and solar power) and the proportion of solar technology energy generated by 2050. There were a wide range of results, depending mainly on cost pathways but also on grid flexibility and transmission restrictions. In the study, the installed photovoltaic capacity in 2050 was estimated at between 100 GW and over 600 GW, with the primary driver being the decreasing installed cost. In order to achieve these objectives of increasing installation at lower cost, advanced, high-performance power converters are necessary to maximize power conversion.

IV. Problem associate in renewable energy sources

Solar energy is a potential energy source from the sun. A photovoltaic device is necessary in order to extract this type of energy and the power supply must be effective to optimize its collection. The optimum efficiency is obtained when the PV is operating at its highest power level, depending on the radiation and temperature. Because of irradiation and temperatures change over time, a PV system needs to be developed that can track the maximum power point in order to generate more energy. The major drawbacks of photovoltaic include high systems expense and low efficiency (less than 20%). To order to increase their efficacy, which is always based on solar radiation and temperature, a PV must be operating at the highest power level. Through change in temperature and irradiation the maximum power point is changed and the efficacy of PV is decreased. The Maximum Power Point Tracking (MPPT) is typically used as a circuit with a digital power interface between PV and load.

Perturbation and observation (P & O) methods are well-known methods for tracking the maximum power point in a PV system because they are easy to implement. One of the disadvantages of the method is that it increases with increasing power and decreases power and disorder after the panels. It creates an oscillating location at the maximum point of energy and is not suitable for a rapidly changing and radiant setting. Some alternatives to the MPPT approaches are now implemented for better results.

Other important design considerations are performance and expense. As with every renewable energy project, efficiency is of paramount importance. Price is another important factor in the development of a converter. Therefore, the converter should use the least complicated topology to achieve the necessary goals using less expensive methods when needed.

V. Conclusion

Over the decades, the development, investigation, and application of renewable energies such as wind, solar, Hydro and tidal power have strengthened global environmental concerns regarding the amount of CO_2 emitted into the atmosphere by human activities. Photovoltaic solar systems are a choice of conventional energy sources that contribute significantly to the resolution of energy problems. The adverse effects of fossil fuel on the environment are even mitigated by combining fossil-fuel plants with renewable energies (e.g. photovoltaic system). The need to reduce carbon emissions has affected the price of photovoltaic systems and in particular of solar modules, thus increasing the profitability of photovoltaic. In this paper discuss the review on various component required in the solar energy conversion.

REFERENCES

[1] L. M. W. Leggett and D. A. Ball, "The implication for climate change and peak fossil fuel of the continuation of the current trend in wind and solar energy production," Energy Policy, vol. 41, pp. 610–617, 2012.

[2] C. A. Miller, Energy Resources and Policy: Vulnerability of Energy Resources and Resource Availability - Fossil Fuels (Oil, Coal, Natural Gas, Oil Shale), vol. 3. Elsevier, 2013.

[3] E. L. I. for I. and E. E. Policy, "Job Creation Potencial of Clen Technologies," 2014. [Online]. Available,http://ecologic.eu/sites/files/project/2013/Study_Job_Creation_Clean_Technologies_Oct_2004.pdf. [Accessed: 01-May-2016].

[4] IPCC, "Climate change 2014: Mitigation of climate change," Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, p. 1454, 2014.

[5] A. Luque and S. Hegedus, Handbook of photovoltaic science and engineering. John Wiley & Sons, 2011.

[6] I. E. Commission et al., "Grid integration of large-capacity renewable energy sources and use of large-capacity electrical energy storage," IEC White Paper, Geneva: International Electro technical Commission, www. iec. ch/whitepaper/pdf/iecWP-grid integration large capacity LR-en. pdf (last accessed March 2015), 2012.

[7] A. R. Reisi, M. H. Moradi, and S. Jamasb, "Classification and comparison of maximum power point tracking techniques for photovoltaic system: A review," Renewable and Sustainable Energy Reviews, vol. 19, pp. 433 – 443, 2013.

[8] S. Kouro, J. I. Leon, D. Vinnikov, and L. G. Franquelo, "Grid-connected photovoltaic systems: An overview of recent research and emerging pv converter technology," IEEE Industrial Electronics Magazine, vol. 9, pp. 47–61, March 2015.

[9] Iec, "Grid integration of large-capacity renewable energy sources and use of large-capacity electrical energy storage," IEC, White Paper, vol. 39, 2009.

[10] F. Birol et al., “World energy outlook,” Paris: International Energy Agency, 2008.

[11] T. Esram, and P. L. Chapman, "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques," IEEE Trans. Energy Conversion, vol. 22, no. 2, pp. 439-448, Jun. 2007.

[12] R. Faranda and S. Leva, "Energy comparison of MPPT techniques for PV Systems," WSEAS Transactions on Power Systems, vol. 3, no. 6, pp. 446-455 Jun. 2008.

[13] R. Leyva, et al., “MPPT of Photovoltaic Systems using Extremum-Seeking Control”, IEEE Trans. on Aerospace and Electronic Systems, vol. 42, no. 1, Jan. 2006.

[14] M.H. Taghvaee, et al., “A current and future study on non-isolated DC-DC converters for photovoltaic applications,” Renewable and Sustainable Energy Reviews, vol. 17, pp. 216-227, Oct. 2012.

[15] N. Mohan, T.M. Under land, and W.P. Robbins, Power Electronics: Converters, Applications, and Design, 3rd ed., Wiley, 2003.

[16] S. Choi, et al., “Analysis, design and experimental results of a floating-output interleaved input boost-derived DC-DC high-gain transformer-less converter,” IET Power Electron., vol. 4, issue. 1, pp. 168-180, Jan. 2011.