Journal of Harbin Engineering University
ISSN: 1006-7043

Vol 44 No. 9
September 2023

Significance Of Policy Development to Control Carbon Footprint Using Renewable Energy Sources

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Abstract
Renewable energy generation is the top rated solution for reduction in carbon foot printing. As the fossil fuels are causing carbon dioxide emission, hence it is necessary to focus on renewable energy sources. This paper presents the significance on hybrid energy generation and energy mix with focus on policy implications for renewable energy policies to reduce carbon foot printing. India is a second largest emission country so, it is important to contribute the significant policies for our country. Paper also reveals the need of MPPT to use clean energy generation with optimum reliability. The Conventional P&O algorithm for MPPT can be modified for optimum energy mix with reference to renewable energy generation.

Keywords: Carbon foot printing, Energy mix, hybrid energy, clean energy, MPPT, P&O

1. Introduction

In the global attempt to meet the international commitments for the reduction of GHG emissions, organizations integrate the environmental management system in their entire production chains. The carbon foot printing is considered as an essential first step in trying to reduce GHG emissions. The data collected from carbon foot printing can help in identifying, formulating, and implementing activities that can significantly reduce GHG emissions [1]. Most of current human energy requirements are satisfied using fossil fuels, which are harmful to the environment. The most imminent dangers stemming from the energy sector are the emission of greenhouse gases (GHGs), air pollution, and water stress [4]. The emission of GHGs is a global issue and perhaps the most concerning. The energy sector contributes about two thirds of all anthropogenic GHG emissions. According to the Intergovernmental Panel on Climate Change (IPCC), these anthropogenic GHG emissions may have contributed between 0.5 and 1.3 °C increase to the global mean surface warming from 1951 to 2010 [2]. For per capita emission of India, refer Fig. 1.

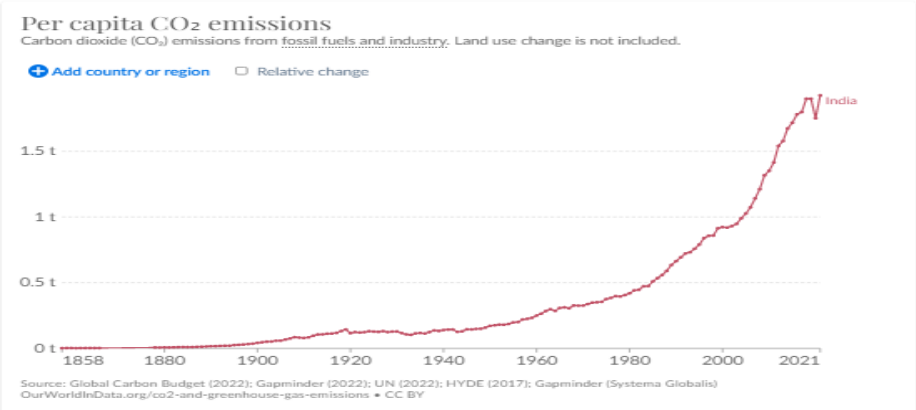

Fig.1: India: Per capita Emission of CO_2

Designing an energy efficient and environmentally sustainable desalination plant requires the identification of optimum renewable energy sources that could ultimately improve the efficiency of a standard desalination system, with regards to savings in energy consumption and other associated operating costs. Therefore, various methods that aim towards reducing the overall power consumption and energy costs associated with desalination technologies are continuously being investigated. In this regard, the design and optimization of autonomous solar–wind-reverse osmosis desalination systems has been presented through coupling battery and hydrogen energy storage by an improved bee algorithm resulting in cost-effective energy systems [3].

Advocates for energy conservation and for policies that reduce carbon emissions must expect ad hominem arguments based on their own energy use. Such arguments are probably best countered personally, by leading the way and demonstrating how to act in concordance with one's own beliefs and recommendations, and by being an exemplar others can follow rather than relying primarily on communicating scientific facts about global warming and its risks [4]. Previous studies have recognized on-road operation, among other factors such as the curb weight, lifetime mileage and battery cycle, as the most important component in the carbon footprints of vehicles. The GHG emissions during the operation stage can be regarded as the product of two factors, i.e., GHG emissions during power generation and electricity consumption during vehicle operation [5].

Hydropower is considered by some to be the most important type of renewable energy. It satisfies renewable energy demands under climate change policies and can bring substantial economic benefits. Hydropower has been developed and used in many countries worldwide. Hydropower is among the most widely-adopted renewable energy sources worldwide. Its development has, however, led to environmental impacts such as carbon emissions and water loss. To date, the water footprint (WF) and carbon footprint (CF) of hydropower stations have been assessed, but not simultaneously or at a large scale such as national scale [6]. Renewable energy is energy generated through natural processes. It is generated by exploitation of renewable energy resources, i.e., solar radiation, water, wind, energy from solid and liquid biomass, geothermal energy, and tidal and ocean currents. An increase in the general consumption and acceleration in the shift from conventional to renewable energy are stimulated by environmental motives. Non-conventional sources, unlike non-renewable ones, do not produce energy residues, i.e., sulfur monoxide and dust emitted into the atmosphere. Despite the constant progress in the energy generation technology, no emission-free devices have yet been invented. [7].

2. Literature review

According to the author, at present, the research target of 100% RE focuses on the electricity demand, which relies mainly on wind power and photovoltaic's (PV). However, for islands with dual demand for electricity and freshwater, the above configuration mode still needs to be improved: Electricity-driven desalination equipment will greatly increase the power demand. Also, the peak-valley difference of load is enlarged because of the positive correlation between freshwater and power demand. Therefore, higher requirements are put forward for the capacity of wind and solar power systems. However, the seasonal characteristics of island peak load are typical, leading to the redundancy of island power generation [8]. As per the existing research, Hydrogen and methanol produced from renewable energy and stored in special tanks provide another way to produce electrical power and heat. Some developed technologies to enhance the efficiency of solar concentrators are mainly based on physical studies of the flow of heat can be considered [9]. As per the author, due to relatively low output power generated by standalone energy harvester, the focus of research area has now shifted from standalone to Hybrid Energy Harvester (HEH). HEH is basically a technique to integrate multiple energy sources into a single system, which is capable to generate higher output power as compared to standalone harvester. The input energy can come from different sources,

such as vibration, thermal, light, acoustic, solar, wind, radio frequency etc. Author has listed down clearly conventional energy sources and its corresponding power density and harvesting method. However, one of the key challenges for any HEH system is to design a Power Management Circuit, which can provide efficient and seamless output power to any load applications [10].

To minimize the dependence on fossil-fuels, researchers focused on integrating renewable energy with different power electronic inverters. In that process multilevel inverters (MLIs) have gained more attention due to its impeccable advantages. In this work, a novel topology with boost ability, and reduced number of components is proposed. Capacitors used in the proposed structure possess self-balancing ability and the works competently under any loading condition. It is worthy to mention that the blocking voltage of proposed circuit is within the limits of source voltage even with the dual boost. Sinusoidal pulse width modulation switching strategy technique is employed to get gating signals [11].

The future source of energy generation technologies is the Distribution Generation (DG), which allows the bidirectional flow of power within an electrical system. Many challenges have to be faced by the researchers to implement accurate and protected schemes for DG connected Distribution Network. This new technology uses Distributed generators varying from kW to MW at the load side, whereas the traditional centralized generator units sized from 100 MW to GW, which are located far away from the loads, where the natural resources are available. This paper gives the survey of various Distributed Generation systems which are practically coming into existence and getting added to the electric power generation. DGs along with their benefits, impacts, advantages and applications in the current energy world in the electrical power system are presented [12].

Floating Photovoltaic (FPV) is an emerging technology that has experienced significant growth in the renewable energy market since 2016. It is estimated that technical improvements along with governmental initiatives will promote the growth rate of this technology over 31% in 2024. This study comprehensively reviews the floating photovoltaic (FPV) solar energy conversion technology by deep investigating the technical advancements and presenting a deliberate discussion on the comparison between floating and ground-mounted photovoltaic (PV) systems [13]. The energy issues and environmental concern have led to intense research activities in renewable energy conversion, such as photovoltaic (PV) to convert solar energy into electricity. Perovskite solar cells (PSCs) based on metal halides are rapidly emerging as the most promising and competing PV technology due to its high record power conversion efficiencies and potentially low production costs. Conductive carbon materials, which are abundantly available and low-cost, are introduced into the PSCs. Author provided a mini review of applications of carbon materials for perovskite solar cells. Firstly, a brief introduction of the development of perovskite solar cell is provided. Secondly, applications of carbon nanomaterials in perovskite solar cells are presented and discussed [14].

According to the author, in the past 10 years, there has been an unprecedented effort to explore various chemical elements and organic functional groups in perovskite and perovskite-related compounds, as well as to determine the crystal structure-optoelectronics properties relations. Despite all the exploratory synthesis, formamidinium/methylammonium, lead and iodine remain the dominant organic groups and chemical elements in 3D-ABX_3 perovskite structures that produce the most efficient solar cells. In general, photo catalysis is the acceleration of a photochemical reaction in the presence of a catalyst. The most common case of heterogeneous catalysis is when light is absorbed by a semiconducting substrate, such as ZnO or TiO_2. The photo catalyst creates electron-hole pairs, which in turn generate free radicals [15]

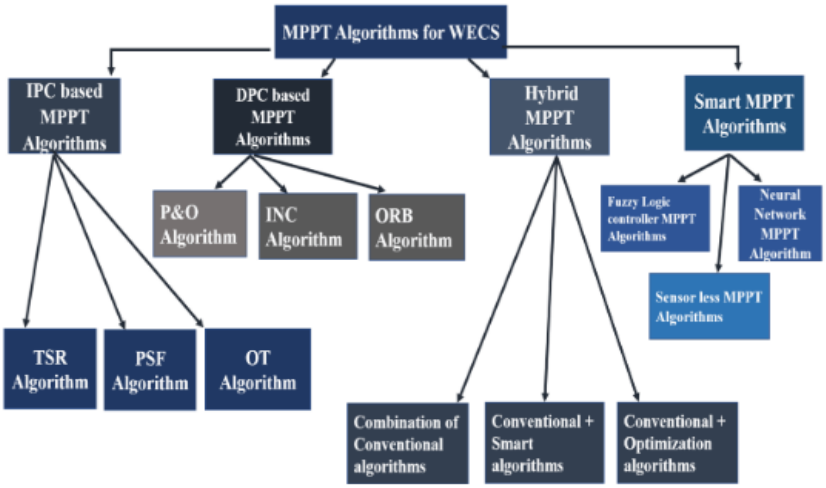

Fig. 2: Classification of MPPT Algorithms for WECS (Pande, J. et al, 2021)

In the past few decades, among the available green energy resources, wind energy has been the most attractive option among the resources available. It is imperative to use the maximum power available in the wind to achieve the wind turbine (WT) operation at maximum power. The maximum power point tracking (MPPT) algorithms are a pioneer in this context (refer Fig. 2 above). Many research papers are contributed in this domain which necessitates a thorough review while choosing an appropriate technique. As shown in Fig. 3, author comprehensively focuses on reviewing algorithms in the past and present for tracking maximum power point, and capturing maximized output power from the wind energy conversion system (WECS).

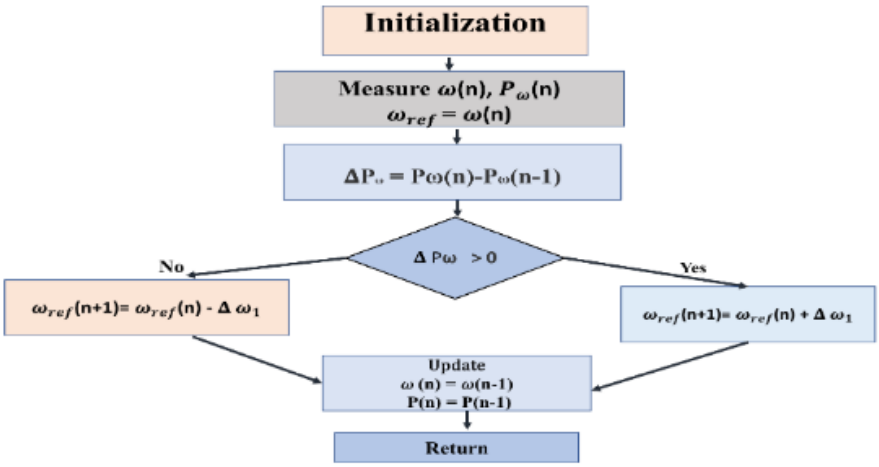

Fig. 3: Conventional Perturb and Observe MPPT Algorithms (Pande, J. et al, 2021)

The author classified the algorithms based on the direct and indirect power measurement, hybrid and smart algorithms for tracking maximum power point, and they are compared, considering the parameters like complexity, convergence speed, use of sensors, memory requirement, need for knowledge of system parameters, etc. The immense popularity of the different versions of

perturb and observe (P&O) based algorithms due to their various features is evident from the literature [16]. Conversion technology is a solution that was born to solve energy problems and human needs. Without energy, all human activities ranging from households and jobs to the industry cannot work as they should, but energy conversion that uses conventional fuels will cause new issues such as climate changes. Therefore, energy conservation is very important for sustainability and energy saving. So, by reducing energy use, the pollution produced will decrease.

3. Need of Policy Development

Research focuses on the introduction of energy conversion and conservation technology based on a qualitative literature review to deal with net-zero emission conditions. The conversion technology is environmentally friendly and efficient, and is committed to following the international Net Zero Emissions agreement [17]. India being a vast country is rich in natural resources such as coal and is ranked 3rd in primary coal production. India is ranked as the 3rd largest net electricity generating country with a generation of 330,861 MWs. 66.2% of India's total electricity comes from coal-based (thermal) power plants. India's CO2 emissions (the 3rd largest after China and the USA) are nearly 6% of the world's total; 53% of India's CO2 emissions from fuel combustion comes from the power sector.

Part IV, Sec. 23 of The National Renewable Energy Act proposes the establishment of a National Renewable Energy Fund. This fund shall be operated by the Central Government, the funds shall be provided by the National Clean Fund. Further, the added amount to the fund may be collected through international finances and other climate agreements. State governments may develop a State Green Fund for the promotion of renewable. The ministry also proposes to offer an initializing corpus to SGF (State Green Fund) from NREF (National Renewable Energy Fund) [18]. Accordingly, this study tries to reveal the relationships between Carbon Dioxide (CO_2) emissions, renewable energy consumption, international trade, and economic growth in India in order to recommend policies that can help the nation attain carbon neutrality. Both the conventional Autoregressive Distributed Lag (ARDL) and the newly developed Quantile ARDL (QARDL) models are used in this study. The ARDL results unveil that 1% increase in renewable energy consumption contributes to 0.8% reduction in CO_2 emissions, while economic growth boosts CO_2 emissions in the long run. Besides, international trade deteriorates the environment by amplifying emissions only in the short run. The QARDL results reveal that economic growth positively and renewable energy consumption negatively affects CO_2 emissions across all quantiles of CO_2 emissions [19, 20].

4. Conclusion

The effects of renewable energy, ICT, technological innovation, and democracy are found to be increasing agricultural productivity. Environmental policy stringency coefficient confirms the hypothesis. The result from the causality test suggests that bidirectional causality exists between CO_2, $PM_{2.5}$, renewable energy, technological innovation, ICT, and agricultural productivity. Finally, the study suggests that there is a need for policy development for the governments of the BRICS economies in order to increase renewable energy generation productivity while tackling the environmental vulnerability.

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