

**IMPACT OF AIR POLLUTION ON SOLAR ENERGY GENERATION IN RAIGAD DISTRICT**

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**Abstract:**

*Due to the continuous increase of environmental pollution in recent years, the high concentration of particulate matters in air has greatly reduced the amount of solar radiation that can reach the earth, and this reduction has a direct effect on the use of solar energy in buildings. To quantify this attenuation effect, historical meteorological data collected from Panvel region from January 2021 to December 2021 and it is used to investigate the correlation between clearness index (reflecting available radiation) and air quality index (reflecting pollution level). The analysis results have revealed that higher air quality index would result in lower clearness index, and the sunny days gave higher decreasing rate than cloudy days. This study presents an impact of air pollution and PV soiling on solar resources and techno-economic performances of PV systems.*

**Keywords:** *Solar PV cells, AQI, Technologies.*

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**Introduction:**

With the continuous growth of global population, traditional fossil energy has become insufficient to meet people's living requirements. To achieve sustainable development, it is urgent to promote the use of renewable energy [1-3]. Solar energy has become a popular renewable energy for building applications, due to their advantages like wide distribution, large reservation, free of pollution [4]. It has captured great attentions of researchers in the world, studying the transmission, conversion and utilization of solar energy [1, 5]. In 2018, the global capacity of solar power has reached 402 GW, according to the "Renewables Energy 2018 - Global Status Report" [6]. In the past two decades, the utilization of solar energy has been developed rapidly, and more attention has been paid to solar energy conversion efficiency, including electrical efficiency, thermal efficiency and exergy efficiency [7, 8]. For conversion efficiency of solar energy systems, many factors have been identified as influential, such as photovoltaic module temperature [9], dust accumulation [10], ambient temperature and wind speed [11]. The intensity of solar radiation reaching the PV surface plays a significant role in determining the power generation from the solar PV modules [12]. However, air pollution and dust prevail worldwide, especially in regions with the rapid growth of solar PV markets such as China and India, where solar PV power generation is significantly reduced [13]. Atmospheric pollutants have the potential to attenuate solar radiation reaching the PV surface through reflection, scattering and absorption, which is a threat to solar power production. In addition, soiling of PV modules caused by deposition of contaminants (e.g., dust, industry emissions and engine exhausts) on the PV surface is another severe challenge, particularly in arid and semi-arid regions with a high concentration of airborne dust such as the Arabian Peninsula and northern Africa [14-17]. As a barrier between PV modules and solar radiation, soiling can reduce solar transmittance through the covers

of PV, resulting in significant degradation of PV generation efficiency. Overall, both air pollution and soiling have a significant impact on solar PV power generation. Previous studies have reviewed the related works on the soiling of solar PV modules, for example, Ilse et al. [18] provided an overview of soiling processes on PV modules from microscopic and macroscopic levels.

#### **Air pollution and solar photovoltaic power generation:**

Air pollution has a significant influence on solar PV energy potential as air pollutants reduce the amount of solar radiation reaching PV surfaces. This section discusses the long-term solar resources variability, the impact of air pollution on solar PV power generation at various scales.

Currently, the global growth of solar PV markets is exceeding projections. It is projected that the PV installations in China, Middle East, Africa and India will supply 10% of the global electricity generation and exceed 60% of the total PV power generation around the world by 2050 [19].

However, the growing atmospheric aerosols loads caused by anthropogenic air pollution significantly attenuate surface solar radiation, which casts a shadow on solar PV power generation. In recent years, the quantitative impact of air pollution on PV systems has been evaluated. Simulation models are adopted to estimate the effect of surface solar radiation changes caused by air pollution on the PV performance, with a perspective of solar engineering from global to urban scales. Moreover, field experiments on PV systems in different capacities are also conducted to study the impact of air pollution on PV power generation, mainly focusing on high-polluted countries and regions with continuously expanding PV markets.

The rapid growth of the population in urban areas, with an expectation of 2.5 billion in 2050, increases energy consumption [20]. In recent years, a growing number of cities have integrated renewable energy technologies into the energy sector, especially solar PV technologies, to achieve a sustainable energy supply and low-carbon environment. However, urban air pollution has been an urgent environmental issue faced by many cities due to urbanization and industrialization along with the combustion of fossil fuels, which inversely affects the solar PV potential.

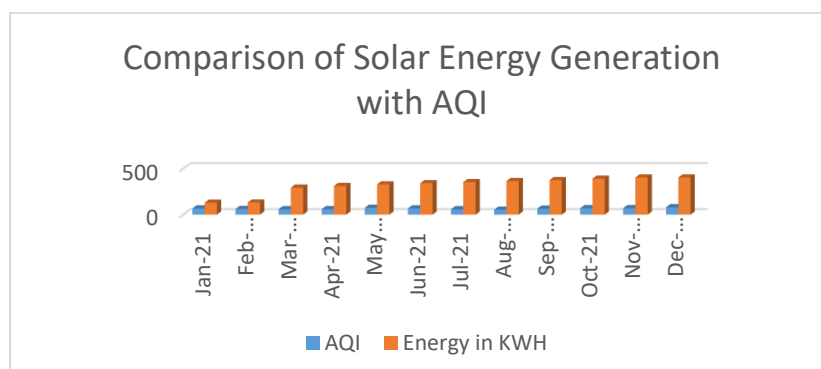
#### **Methodology:**

For the present study, area like Panvel which is located near the industrial area is selected for collecting Air Quality Index data. Solar power generation data is collected from the Solar Panels installed at Changu Kana Thakur Arts, Commerce and Science College, New Panvel.

#### **Data interpretation:**

Here we interpret some important short points which further help in analyzing the data. The data of Air Quality Index of Panvel from January 2021 to December 2021 was collected from Maharashtra Pollution Control Board. Data of Electricity generated from the Solar Panels was collected from Trackso, an IoT based energy management platform to track performance.

**Data Analysis:** The data were analysed as follow:



From the graph, it is observed that the amount of solar energy generated using PV cells depends on the intensity of solar radiations reaching the surface of the Solar Panels. Higher value of AQI (Air pollution) reduces the intensity of radiation reaching the solar PV cells and hence affects the electricity generation from the panels.

**Conclusion:**

Increased air pollution would weaken the transmission of solar radiation, and reduce the performance of solar energy systems. The type of air pollutants, mass concentration and size of particulate matter are crucial factors for attenuation coefficient. Elimination of air pollution by governmental policies and measures is beneficial to increase surface solar radiation and, consequently, increasing the power generation of PV modules. In addition, reducing air pollution, especially the concentrations of particulate matter, would also decrease the soiling of PV modules.

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