



International Conference on Emerging Trends in Engineering,  
Science, Humanities and Management (ICETESHM – 2024)  
31<sup>st</sup> March, 2024, New Delhi, India.

**CERTIFICATE NO: ICETESHM /2024/ C0324307**

**ADVANCED MATERIALS AND TECHNOLOGIES FOR EFFICIENT SOLAR  
AND WIND POWER GENERATION**

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**ABSTRACT**

Solar and wind power generation, which are essential in the shift to renewable energy, can only be made more efficient with the help of newly developed materials and technology. This research looks at new developments in wind turbines and photovoltaic (PV) cells that try to make them better and cheaper. Novel materials like perovskites are the center of solar energy research because they outperform conventional silicon-based cells in terms of efficiency while having lower production costs. It is also possible to increase energy conversion rates by investigating new organic PV materials and multi-junction cells, both of which have the ability to absorb a wider range of solar radiation. If wind power is to reach its full potential while keeping maintenance expenses to a minimum, modern turbine designs must incorporate aerodynamic improvements and make use of innovative composite materials. The creation of lighter, more durable composites and the use of smart materials that change in response to their surroundings are emphasized. To further enhance efficiency and dependability, we also look at how predictive maintenance and operational optimization may be enhanced with the use of artificial intelligence and machine learning.