

# State-of-Art Techniques for Photovoltaic (PV) Power Systems and their Impacts

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**Abstract:** *Solar energy, a ubiquitous and free resource, has vast potential for addressing global energy needs through direct conversion into heat or electricity using photovoltaic (PV) and solar thermal technologies. The evolution of photovoltaic (PV) technology has transformed solar energy from a niche application to a major component of the global energy landscape. This article summarises the latest developments in photovoltaic power systems, with an emphasis on crystalline silicon and thin-film technology. It highlights key developments in efficiency, cost reduction, and emerging technologies such as organic photovoltaics and nanostructure oxide films. Despite significant progress, challenges remain, including cost, efficiency, and integration with energy systems. The paper concludes with recommendations for future research, emphasising the need for improved efficiency, durability, and integration of AI and energy storage solutions to improve a viability and sustainability of solar power*

**Keywords:** photovoltaic, solar cell, efficiency, lifetime, thin film, Organic photovoltaics, crystalline silicon.