

PV-Integrated Shading Devices in Urban Spaces: Enhancing Power Generation, Energy Efficiency Thermal Comfort, and Societal Well-Being

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Abstract : Providing thermal comfort in urban spaces for vulnerable groups, particularly children, remains a critical yet often overlooked priority in private and governmental initiatives. Shading devices play a vital role in urban environments, regulating thermal comfort and, when integrated with photovoltaic (PV) systems, generating clean energy while enhancing user satisfaction. Cyprus, with over 300 sunny days annually, offers a unique opportunity for solar energy integration. This research investigates the design of PV-integrated shading devices for a primary school in Famagusta, Cyprus, aiming to enhance students' outdoor thermal comfort and reduce dependency on fossil fuels through efficient use of open spaces. The study employs site observations, surveys, and statistical analysis to evaluate the impact of these devices. Findings reveal significant discomfort among students and staff due to inadequate thermally comfortable outdoor spaces and high energy costs for indoor climate control. The proposed solution requires an initial investment of \$1,500,000 and offers annual power generation approximately 10 times the current consumption, resulting in \$500,000 in annual energy savings and surplus energy sales, with a payback period of three years. Recommendations include installing PV-integrated shading for sports spaces, parking lots, and gathering areas, as well as rooftop PV panels to maximize renewable energy generation. Beyond improving thermal comfort and reducing energy costs, this initiative fosters community engagement in outdoor spaces, enhancing societal well-being. The study concludes with recommendations for integrating sustainable urban planning practices in Cyprus.

Keywords : photovoltaic shading devices, thermal comfort, societal well-being, sustainable urban design

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