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Analysis of Electrical Interconnection Strategies in Vertical Solar Brick Walls under Partial Shading Conditions for BIPV Applications

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Abstract:

The integration of solar bricks into vertical walls offers a promising pathway for architecturally embedded photovoltaic systems within BIPV applications. However, shading, whether from nearby structures, self-shading, or moving elements, can significantly reduce energy output and system stability. This study presents a simulation-based analysis of different interconnection schemes for a vertical solar brick wall, aiming to identify the electrical effects of partial shading on such products. A detailed model of a modular photovoltaic unit at brick scale was developed and arranged into a system of eight interconnected bricks. In a simulation environment, various interconnection topologies were implemented, and representative shading patterns were applied for morning, noon, and afternoon conditions. Key performance metrics, such as current uniformity across connections, power output, and mismatch losses, were extracted under different shading scenarios. The results show that different interconnection configurations respond properly to partial shading, with those allowing more balanced current distribution standing out for their greater stability and lower sensitivity to electrical losses between solar bricks. Furthermore, control strategies based on real-time monitoring of voltages and currents at the brick level were shown to enhance recovery following partial shadow exposure. These findings guide interconnection layouts for vertical solar brick façades, allowing the development of high-performance and reliable building-integrated photovoltaic systems.

Keywords:

BIPV, Solar bricks, Partial shading, Interconnection strategies, Missmatch losses.