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Urban green-space loss in rapidly developing cities intensifies urban heat stress and increases building cooling demand, making vertical greenery systems (VGS) an important nature-based mitigation strategy. This study evaluates VGS performance in temperate Shanghai and tropical Kuala Lumpur using an integrated framework that couples a building–plant thermal model, street-canyon computational fluid dynamics (CFD), and life-cycle cost–benefit analysis. The results show that the Shanghai scenario reduced annual cooling load by 23% (1,240 kWh/year), while the Kuala Lumpur scenario achieved a 15% reduction (980 kWh/year). CFD simulations further indicated pedestrian-level cooling of 2.6 °C in Shanghai and 1.5 °C in Kuala Lumpur under peak summer conditions. Carbon sequestration was higher in the dense evergreen modular system modelled for Shanghai than in the seasonal edible façade system modelled for Kuala Lumpur. Economically, the Shanghai case remained favourable under subsidized conditions, whereas the Kuala Lumpur case required policy intervention. Deterministic scenario testing identified a 12% subsidy threshold that reduced the Malaysian payback period from 15 to 10 years and shifted the net present value from negative to positive. Overall, the findings support climate-responsive and financially informed VGS implementation across contrasting climatic contexts.

Key words: building energy efficiency, life cycle cost-benefit analysis, techno-economic assessment, urban microclimate, vertical greenery systems

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