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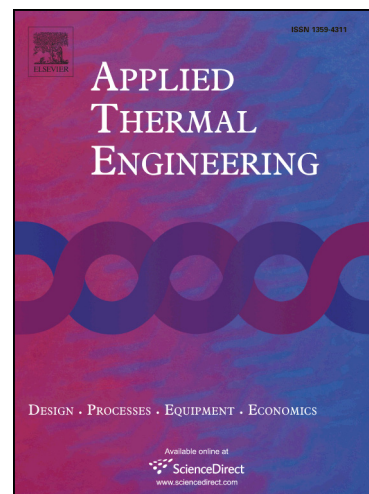
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Analytical Investigation of Different Operational Scenarios of a Novel Greenhouse Combined with Solar Stills

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ABSTRACT

This study is an analytical investigation for the performance of a new stand-alone agriculture Green House (GH) integrated with on-roof Transparent Solar Stills (TSS) to be a self-sufficient of irrigation requirements. This system utilizes the surplus solar energy via direct solar desalination in TSS and Humidification-Dehumidification (HDH) process as two sources for water production. The effect of using the on-roof TSS on the GH performance, the power required for heating and fans operation at different climate conditions is discussed. The paper investigates the effect of the fresh air ratio and the bypass ratio for the condenser of the cooling system on the internal micro-climatic conditions of the GH. For different climatic conditions of Borg-Elarab, Egypt, controlling both the condenser bypass and fresh air ratios can be used to satisfy the required micro-climate conditions and water requirements for plant growth and minimize the power consumption for cooling system. The results show that the daily average temperature inside the GH can be increased during winter. Furthermore, the system can produce a sufficient amount of fresh water during summer. The system can only produce a maximum amount of water of 2.44 L/m².day during the coldest day which indicates the need for additional solar stills to be installed if a higher amount of water is required. In general, recovering the extra solar radiation to either produce fresh water via on-roof TSS or reduce the power consumption by cooling, heating and ventilation systems is the main advantage of the new proposed GH system. This work is a good applied example for food, water, energy and climate change Nexus which covers the main elements of Sustainable Development Goals (SDGs).

Keywords: Greenhouse, Renewable Energy, Solar Desalination, Transparent Solar Stills, Food-water-energy-climate change Nexus, SDGs

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