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Development and transient performance analysis of a decentralized grid-connected smart energy system based on hybrid solar-geothermal resources; Techno-economic evaluation

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Highlights

- A novel smart energy system based on hybrid solar-geothermal energies is proposed.
- The system is supposed to meet the energy demands for a small community as the case study.
- Dynamic simulation and annually transient performance assessment is presented.
- The highest and the lowest exergy efficiency is attained in July and December as 55.9% and 22.8%.
- The highest and the lowest unit product cost is obtained for January and July as 8.38 and 32.77 $/GJ.

Abstract

The world energy sector is going to change over from its present state of centralized energy generation to a future state with a larger share of distributed generation. In this respect, an innovative smart energy system based on hybrid solar-geothermal energies is proposed in this work, and transient performance assessment and techno-economic analysis are presented to evaluate its dynamic performance applying TRNSYS software. The proposed system is developed to provide power, heating, and cooling demands for a small urban community as the case study. The system consists of PVT panels, thermal energy storage tanks, a turbine, an absorption chiller, and a heat pump as the main components. Also, other subsidiary components like controllers and diverters are incorporated to guarantee the proposed system performance in a smart manner in various ambient conditions of the year. The results show that the system not only provides the annual electrical demand for the considered case study but also a considerable amount of excess power is produced, which can be sold to the power grid to compensate for some expenses of the system. The highest and the lowest exergy efficiency for the proposed system is attained in July and December with the values of 55.9% and 22.8%, respectively. Also, the highest and the lowest values of system unit product cost are obtained for January and July, respectively, as 8.38 and 32.77 $/GJ.

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Keywords

Distributed generation; Smart energy system; hybrid solar-geothermal energies; thermal energy storage tanks; Thechno-economic

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