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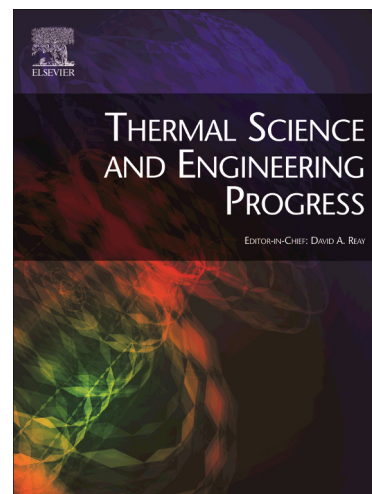
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# Energetic and exergetic evaluation of a novel trigeneration system driven by parabolic trough solar collectors

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## Abstract

The energy consumption in the building sector is responsible for the one-third of the global energy consumption. Thus, the utilization of renewable energy sources in the building sector is vital in order to achieve the sustainability. The objective of this work is to present a novel solar-driven trigeneration system ideal for building applications which produces heating, cooling and electricity. This system includes parabolic trough collectors, an absorption heat pump operating with LiBr-H<sub>2</sub>O and a turbine. More specifically, the produced superheated steam from the generator is separated into two quantities: the first one goes to the condenser (heating production) and to the evaporator (cooling production), while the other to the turbine for electricity production. An important advantage of this system is the possibility to produce different proportions of the useful products. Parabolic trough collectors of 100 m<sup>2</sup> collecting area are coupled to a storage tank of 5 m<sup>3</sup> and this sub-system feeds the generator with heat input. For the typical case of 80% steam fraction to the turbine, the electricity production is 7.16 kW, the heating production is 9.35 kW, the cooling production is 8.55 kW and the system exergetic efficiency is 9.80%. The daily evaluation proved that the electricity, the heating and the cooling productions are 48 kWh, 63 kWh and 58 kWh respectively, for a sunny day and 80% steam fraction. The analysis is carried out with a developed model in Engineering Equation Solver under steady-state and dynamic conditions.

## Keywords

Exergy analysis, Trigeneration, Absorption heat pump, Parabolic trough collector

## 1. Introduction

Solar energy utilization is vital for facing various problems as the fossil fuel depletion [1], the population growth [2] and the climate change. The energy consumption in the building sector is responsible for a great percentage of the global energy consumption which is ranged from 30% to 40% [3]. This fact makes important the reduction of this huge energy consumption or the utilization of renewable and sustainable energy sources in the building sector. Especially, the use of renewable energy systems in the zero energy buildings is something vital in order to achieve the proper energy consumption goals [4]. Solar energy is the most easily exploited energy source in the building sector and it can be utilized in many ways. Flat plate technologies produce heat for space heating or domestic hot water production, photovoltaic panels produce

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