Optimization of combined cooling, heating and power generation by a solar system

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Abstract

In this paper Energy, Exergy and Economic optimization of a combined cooling, heating and power (CCHP) solar generation system equipped with conventional photovoltaic (PV), concentrated photovoltaic/ thermal (CPVT), and evacuated tube (ET) collectors is presented. Optimization was performed to achieve the highest values of relative net annual benefit (RNAB) and exergy efficiency as two objectives. Decision or design parameters were the number of CPVT collectors, the number of ET collectors, the number of PV collectors as well as the capacity of batteries and the size of hot water storage tank. Optimum values of design parameters with maximizing objective functions were performed by NSGA-II multi-objective optimization technique. LINMAP method was used to select one optimum point among many others which had constructed the Pareto front curve. The chosen point used only 3 CPVT collectors and specific water storage tank volume without any battery. Sensitivity analysis of effects of changes in fuel and electricity prices as well as equipment investment costs on optimum values of design parameters were also investigated. Finally the equipment selection results for a full CPVT solar energy system connected to the grid and disconnected to the grid (remote area) were also compared and reported.

Keywords: Combined cooling heating and power generation; concentrated photovoltaics; solar energy system; Relative net annual benefit; NSGA-II

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