Analysis of a polygeneration plant based on solar energy, dual mode solid oxide cells and desalination

Fossil fuels are stored energy during millions of years and we are using it in a rate that new fuels cannot be formed. Renewable energies are not available all the time and there is a need to find ways to store them. One way of storing renewable energies is in fuel form, similar to the fossil fuels and then use this stored fuel whenever needed. The plant design proposed in this paper consists of Dish-Stirling collectors supported by a reversible solid oxide cell acting as a power generator and storage unit, and therefore offering dispatchable power on demand. Further, the system reuses the waste heat for seawater desalination. The present work is an analytical study in which the performance evaluation of a self-sustainable polygeneration system with integrated hydrogen production, power generation, and freshwater production is conducted. An evaluation for selected days, representative for summer, fall, winter and spring in an area with low solar irradiation is studies to investigate the potential of this system to supply 500 kW continuously and simultaneously producing a considerable amount of freshwater. The study shows that the plant can produced hydrogen even in low irradiation winter days together with at least 6500 L of freshwater daily.