A study on a polygeneration plant based on solar power and solid oxide cells

While energy demand in this fast developing world is increasing, its future is being compromised by the CO2 emissions produced through the burning of fossil fuels. Clean energy technologies are available, but there are still barriers hindering their full integration into the society, the majority of which are economic and social. For these reasons, the development of new technologies and configurations to make renewable energies systems more cost-effective is urgently needed. The plant design proposed in this paper consists of basic Dish-Stirling collectors supported by a reversible solid oxide fuel 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, which is very convenient for arid areas with high solar radiation and shortage of freshwater. The present work is an analytical study in which thermodynamic investigation of the performance evaluation of a self-sustainable polygeneration system with integrated hydrogen production, power generation, and freshwater production is conducted. An evaluation in a real context (South Africa) showed the potential of this system to supply 500 kW, 24 h a day, while producing a considerable amount of freshwater. Although the distillation system presented is able to produce 8464 L per day, there is potential for it to increase its output by nine times or more.