

Diverse renewable energy systems accessible to technologically less developed countries are urgently needed to ensure energy security, enrich the generation portfolio, and tackle clean development issues. Solar chimney power plants (SCPP) offer this opportunity and have been accepted as one of the promising technologies for solar energy utilization. The present study consists of an investigation of various techniques for the improvement of this system. The sloped collector is an interesting technique to improve SCPP performance. Taking benefit from the sloped collector advantages while limiting its disadvantages, a novel concept, which consists of a horizontal collector with an adapted collector entrance, has been proposed. Optimization of this concept has allowed a considerable gain in the system performance. The passive flow control method, widely used as a key element in engineering, has also been used within the collector. Three different profiles of control devices have been selected to highlight the impact of this control technique on energy transfer. The divergent tower solar chimney is an attractive upgrading of the solar chimney system. However, the boundary layer separation phenomenon can appear when the divergence angle exceeds a specific value, inducing system performance degradation. A novel solar chimney tower concept, named annular tower solar chimney power plant, has been proposed to deal with the boundary layer separation phenomenon and improve the divergent tower system. Accordingly, the influence of tower dimensions has been evaluated. An improved concept that allows a compromise between induced cost and performance gain has also been suggested. The demand for solar energy technologies is increasing due to the growing interest in renewable energies. However, these technologies are affected by atmospheric conditions and low overall efficiency. A combined solar chimney-photovoltaic system has been proposed to deal with chimney system deficiencies. The performance of this sustainable system has been evaluated. The energy produced under the climatic conditions of Algeria has also been estimated