Technical and Economic Feasibility of Utility-Scale Solar Energy Conversion Systems in Saudi Arabia

A move toward renewable energy sources has become a global trend due to the economic and the environmental inconveniences of fossil fuels. Solar energy receives a great share of research focus owing to its availability and eco-friendly characteristics. Different approaches are advised and implemented for converting solar energy into electricity. Photovoltaic (PV) and concentrated solar power (CSP) systems are the most promising technologies in this field. PV is simply direct conversion of solar energy into electricity. It gains the advantages of size/power versatility. Meanwhile, CSP converts solar energy to electricity indirectly via thermal energy. This article introduces a comprehensive comparison between PV and CSP types regarding technical and economic feasibility of utility-scale solar power plants. Kingdom of Saudi Arabia is taken as a case study. The different types of either CSP or PV have been tested under hourly climatic data of 10 locations throughout the Kingdom of Saudi Arabia by using system advisor model software from National Renewable Energy Laboratory in order to identify the appropriate type of these systems to Saudi Arabia. The article produces fairly accurate forecasting for utility-scale solar energy market in Saudi Arabia. Several significant conclusions are presented that could act as reference for solar energy projects. For example, solar PV and parabolic trough are preferred candidates in Saudi energy market due to the lowest levelized cost of electricity. The minimum cost of electricity was found to be 0.06$US/kWh that was generated by solar trough technology in the Solar Village site.