World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:17, No:06, 2023

Potential Opportunity and Challenge of Developing Organic Rankine Cycle Geothermal Power Plant in China Based on an Energy-Economic Model

Authors : Jiachen Wang, Dongxu Ji

Abstract : Geothermal power generation is a mature technology with zero carbon emission and stable power output, which could play a vital role as an optimum substitution of base load technology in China's future decarbonization society. However, the development of geothermal power plants in China is stagnated for a decade due to the underestimation of geothermal energy and insufficient favoring policy. Lack of understanding of the potential value of base-load technology and environmental benefits is the critical reason for disappointed policy support. This paper proposed a different energy-economic model to uncover the potential benefit of developing a geothermal power plant in Puer, including the value of base-load power generation, and environmental and economic benefits. Optimization of the Organic Rankine Cycle (ORC) for maximum power output and minimum Levelized cost of electricity was first conducted. This process aimed at finding the optimum working fluid, turbine inlet pressure, pinch point temperature difference and superheat degrees. Then the optimal ORC model was sent to the energy-economic model to simulate the potential economic and environmental benefits. Impact of geothermal power plants based on the scenarios of implementing carbon trade market, the direct subsidy per electricity generation and nothing was tested. In addition, a requirement of geothermal reservoirs, including geothermal temperature and mass flow rate for a competitive power generation technology with other renewables, was listed. The result indicated that the ORC power plant has a significant economic and environmental benefit over other renewable power generation technologies when implementing carbon trading market and subsidy support. At the same time, developers must locate the geothermal reservoirs with minimum temperature and mass flow rate of 130 degrees and 50 m/s to guarantee a profitable project under nothing scenarios.

Keywords : geothermal power generation, optimization, energy model, thermodynamics
Conference Title : ICSEEESEI 2023 : International Conference on Sustainable Energy Engineering, Environmental and Socio-Economic Issues
Conference Location : Vienna, Austria
Conference Dates : June 19-20, 2023