













Applying energy-exergy, environmental, sustainability, and exergoeconomic metrics and bi-objective optimization for assessment of an innovative tri-generation system

Tao Hai^{a, b, c}  , Masood Ashraf Ali^d  , As'ad Alizadeh^e  ,
Bhupendra Singh Chauhan^f, Sattam Fahad Almojil^g  , Abdulaziz Ibrahim Almohana^g,
Abdulrhman Fahmi Alali^g

Show more 

 Add to Mendeley  Share  Cite

<https://doi.org/10.1016/j.ijhydene.2023.01.317>

[Get rights and content](#) 

Abstract

One of the reasons why renewable energies are so attractive compared to **fossil fuels** is their low environmental impact. In addition, **geothermal power** plants contribute tremendously to sustainable energy generation for cities despite their lower energy efficiency than fossil fuel plants. The multi-heat recovery will eliminate the applicability defect mentioned. Therefore, this paper studies a novel tri-generation schema with the maximum use of heat loss through a multi-heat recovery technique in two principal processes, namely waste heat-to-power and power-to-H₂ and -purified water. A double-flash binary cycle, **Rankine cycle**, electrolyzer unit, and **reverse osmosis** desalination system all play a part in the creation of this system. The technical feasibility of the system is scrutinized based on energy-exergy, environmental, **sustainability**, and exergoeconomic metrics and bi-objective optimization. Generally, 1st separator pressure made the strongest effect on the measured variables among decision variables. The increase in this parameter led to an upward-and-downward behavior of the net electricity and exergetic efficiency; while the cost of products experienced a converse trend. Also, the produced H₂ and purified water together with the tri-generation gain output ratio augmented. Changes were not observed in net electricity and purified water with the change in 2nd separator pressure, but the H₂ production rate changed significantly. Through bi-objective optimization, net electricity, purified water production rate, and total investment cost rate also significantly increase. Based on the optimum design mode, the CO₂ emission rate and the **sustainability** index are higher than under the base case design.