Thermoelectric Generator Optimisation for Electrical Oven Waste Heat Recovery at Low Temperatures

International Conference on Computer and Communication Engineering, ICCCE • Conference Paper • 2025 • DOI: 10.1109/ICCCE66530.2025.11474148

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Abstract

This research employs energy harvesting technology to recuperate waste heat from an electric oven system using a thermoelectric generator (TEG). This research aims to investigate electrical energy generation via the optimized simulation of thermoelectric generators (TEGs) utilizing ANSYS-Fluent. The findings show that TEG's voltage and power increase with temperature differential and positively correlate with external load. Moreover, the numbers and arrangement of TEGs significantly affect their power output. The study indicates advantages for power generation influenced by the oven's size and the number of TEGs. The most excellent power output is significantly associated with greater temperature variations. Using the 150 TEG modules, the highest power output of 70.23 W was observed. These results are significant for designing and optimizing TEGs for energy harvesting. Future research on cutting-edge TEG module designs and innovative

thermoelectric (TE) materials should significantly enhance electrical power and efficiency. In addition to the number of TEGs and temperature variations, the study also found that the material composition of the TEG modules played a role in power output. Researchers can further improve power generation capabilities by exploring TE materials and designing more efficient TEG modules. These findings will be essential for advancing the field of energy harvesting and creating more sustainable and efficient technologies for the future.

Author keywords

ANSYS-Fluent; oven system; Thermoelectric generators; thermoelectric materials; waste heat recovery

Indexed keywords

Engineering controlled terms

Electric ovens; Energy efficiency; Energy harvesting; Temperature; Thermoelectric equipment; Thermoelectric power

Engineering uncontrolled terms

ANSYS-fluent; Energy; Fluents; Oven system; Power output; Power- generations; Thermo-Electric materials; Thermoelectric generators; Thermoelectric material; Waste-heat recovery

Engineering main heading

Waste heat

Funding details

Details about financial support for research, including funding sources and grant numbers as provided in academic publications.

Funding sponsor	Funding number	Acronym
Ministry of Higher Education, Malaysia See opportunities by MOHE ↗	FRGS/1/2024/TK08/UIAM/02/7	MOHE

Funding text

This project is funded by the Ministry of Higher Education, Malaysia, through the Fundamental Research Grant Scheme (FRGS), Project ID: FRGS/1/2024/TK08/UIAM/02/7.