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REVIEWER'S REPORT

Manuscript No.: **IJAR-52405** Date: 25-06-2025

Title: TUBULAR GAS HEATERS FOR FREE VOLUME WATER HEATING AS AN ALTERNATIVE TO HOT WATER BOILERS

Recommendation:
Accept as it is .....Yes.....
Accept after minor revision.....
Accept after major revision .....
Do not accept (*Reasons below*) .....

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality			✓	
Clarity		✓		
Significance		✓		

Reviewer Name: Mr Mir Bilal

Reviewer's Comment for Publication.

Reviewer's Comment for Publication

General Overview:
The manuscript addresses a practical and technically significant topic: the use of tubular gas heaters (TGH) for water heating in free volumes as an alternative to conventional hot water boilers. The paper combines theoretical modeling, optimization methodology, and practical application, offering a comprehensive approach to evaluating the performance and feasibility of TGHs. The focus on alternative fuels such as wood pellets adds environmental relevance and aligns with sustainable energy trends.

Abstract:
The abstract is detailed and informative. It effectively outlines the mathematical modeling approach, the optimization strategy via evolutionary algorithms, and the key findings related to thermal efficiency and material intensity. The mention of practical implementation with a 400 kW system provides a concrete context. Technical terminology is used accurately, and the balance between theoretical and applied aspects is maintained throughout the abstract.

Introduction:
The introduction provides a clear background on the evolution and usage of tubular gas heaters, particularly the distinction between ITGOs and TGHs. The references to prior studies and technological advancements offer context and demonstrate the authors' awareness of existing literature. The inclusion

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of wood pellets as an alternative energy source highlights the study's ecological and practical dimensions. The section outlines the need for methodological frameworks in the design and application of TGHs, establishing a solid rationale for the study.

Technical Content and Modeling:
The core technical contribution of the manuscript lies in the development of a mathematical model described as a hydraulic circuit governed by nonlinear differential equations. The dual criteria—thermal efficiency and material intensity—reflect a well-rounded engineering perspective. The implementation of an evolutionary algorithm with multiple solution branches to find optimal design parameters is a notable methodological strength. The claim of convergence with probability 1 adds theoretical rigor to the optimization approach. The use of numerical solutions further supports the validity of the design method.

Results and Practical Relevance:
The numerical analysis confirms the feasibility of achieving high thermal efficiency with moderate material requirements, a central engineering trade-off. The discussion on wood pellet combustion for heat generation underlines the ecological potential and adaptability of the system. The practical example involving a 400 kW application strengthens the real-world applicability of the research. This blend of theory, modeling, and application enhances the manuscript's value for both academic and industrial audiences.

Keywords:
The keywords are well chosen and effectively represent the key concepts and methodologies discussed in the paper, aiding in indexing and discoverability.

Overall Assessment:
The manuscript presents a well-structured and technically sound exploration of tubular gas heaters as a viable alternative for free volume water heating. The integration of advanced modeling, optimization techniques, and practical considerations reflects a high level of scholarly and engineering competence. The paper is relevant for researchers and practitioners involved in thermal systems design, energy optimization, and sustainable heating technologies.