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REVIEWER'S REPORT

Manuscript No.: **IJAR-52405** Date: 22.06.2025

Title: **Tubular Gas Heaters for Free Volume Water Heating as an alternative to Hot Water Boilers**

Recommendation:
Accept after minor revision.....

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

Reviewer Name: Dr.K.Arumuganainar **Date:** 22.06.2025

Reviewer's Comment for Publication.

1. **Revise Abstract and Language** – Improve sentence structure and clarity.
2. **Update References** – Include recent papers and replace dated or non-peer-reviewed sources where possible.
3. **Polish Equations and Figures** – Format equations more professionally; label all diagrams clearly.
4. **Elaborate Broader Impact** – Expand on how this approach could impact small-scale or rural heating.
5. **Add Comparative Analysis** – Benchmark against hot water boilers in terms of cost, efficiency, and emissions.

Detailed Reviewer's Report

“Tubular Gas Heaters for Free Volume Water Heating as an Alternative to Hot Water Boilers”

1. Title and Abstract Evaluation

Title:

- Clear and technically accurate.
- Reflects the main application and comparison point (alternative to boilers).

Abstract:

- The abstract presents the core concepts: mathematical modeling, optimization via evolutionary algorithms, and real-world application.
- However, it lacks clarity in grammar and structure. A few run-on sentences reduce readability.
- Suggestion: Use short, well-separated sentences and explicitly state objective, methods, results, and conclusions.

Rating: 7.5/10

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2. Introduction and Motivation

- The introduction outlines the background of tubular gas heaters and their historical development from infrared gas heaters.
- It gives a practical grounding in applications like greenhouses and industrial processes.
- The transition to biomass fuel (wood pellets) adds to the paper's relevance in sustainable heating.
- Suggestion: Better motivation by contrasting conventional boiler limitations with the advantages of the proposed heater could strengthen the argument.

Rating: 8/10

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3. Literature Review

- The literature cited covers industrial systems, infrared heating, and applications in greenhouses and pellet combustion.
- Cites both technical reports and peer-reviewed works.
- However, many references are slightly dated (mostly before 2021), and the review is somewhat superficial.
- Suggestion: Include more comparative analysis and recent studies on biomass-based heating or optimization in HVAC systems.

Rating: 7.5/10

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4. Mathematical Modeling and Methodology

- One of the strongest parts of the paper.
- Provides detailed modeling of the tubular heater as a hydraulic circuit using nonlinear differential equations.
- Covers pressure drop, heat transfer, fan effects, and introduces Kirchhoff's law analogy.
- The use of two optimization criteria: thermal efficiency and material intensity is appropriate.
- The inclusion of evolutionary algorithm logic (including fuzzy generation relations and convergence proof) is mathematically rich.
- Suggestion: The explanation could benefit from a more structured layout and graphical support for equations.

Rating: 9/10

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5. Optimization and Simulation Results

- The optimization problem is well-defined with six key variables and bounded constraints.
- The table of evolutionary iterations and convergence is detailed and shows practical efficiency (up to 90.6%).

- The heater design parameters and performance are logically presented.
- Graphical results (like heater length vs. efficiency) add clarity.
- Suggestion: Clearly separate baseline vs. optimized scenarios to highlight efficiency gain.

Rating: 8.5/10

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6. Experimental Validation / Practical Use Case

- The paper includes an industrial use case (Dnipro Pipe Plant) where four 100kW tubular gas heaters are used.
- Heating a 30.6 m^3 water bath to 85°C is a strong proof of concept.
- Real-world performance validates model predictions, which adds credibility.

Rating: 9/10

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7. Novelty and Contribution

- High novelty in combining:
    - Evolutionary optimization,
    - Biomass fuel use in tubular heaters,
    - Practical deployment evidence.
- Contribution is technically valuable for heat engineering and sustainable industrial process heating.
- Suggestion: Emphasize real-world implications more explicitly in the abstract and conclusion.

Rating: 9/10

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8. Conclusion

- Summarizes the work appropriately.

- Reiterates the convergence of the optimization process and effectiveness of pellet-based heaters.
- Suggestion: Include a forward-looking statement about possible applications (residential heating, agricultural drying, etc.)

Rating: 8.5/10

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9. References and Citations

- Relevant and from credible sources.
- Citations include technical reports, military heating systems, and Ukrainian energy research.
- A few references (e.g., [1], [2]) are from institutional documents, not journal articles.
- Suggestion: Increase the number of peer-reviewed recent journal references (post-2021) to strengthen scholarly grounding.

Rating: 7.5/10

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10. Language and Presentation

- The paper is technical but suffers from grammatical issues, inconsistent symbols, and formatting.
- Equations are sometimes embedded awkwardly within the text.
- Some figures and charts lack labeling or clarity (e.g., Figure 2).
- Suggestion: Thorough proofreading is needed to improve professionalism.

Rating: 7/10

Overall Evaluation

Criterion	Score (out of 10)
Title & Abstract	7.5
Introduction & Motivation	8.0
Literature Review	7.5
Mathematical Modeling	9.0
Optimization & Results	8.5
Practical Validation	9.0
Novelty & Contribution	9.0
Conclusion	8.5
References	7.5
Language & Presentation	7.0
Overall Score	**8.3 / 10**

Recommendation:

Minor Revision

Suggestions for Improvement

1. **Revise Abstract and Language** – Improve sentence structure and clarity.
2. **Update References** – Include recent papers and replace dated or non-peer-reviewed sources where possible.
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