Sustainability Assessment of Perovskite Solar Cells

Application for Emergency Shelters

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Abstract

Concise summary of objectives, methods, key findings, and conclusions. Will do last.

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1 Introduction

This study conducts a comprehensive sustainability assessment of emergency shelter tents[1], examining their environmental impact, economic feasibility, social consequences, and socio-environmental trade-offs. Rather than addressing shelters in a broad sense, the focus is specifically on common types of emergency shelter technologies and the energy systems that support them.

The frequency and magnitude of natural disasters around the world highlight the significance of sustainable emergency shelters. Each year, over 100 countries are affected, with more than 200 million people impacted and an estimated 20 to 40 million individuals requiring temporary shelters (Alves, B., 2014). As a *[engineering/design/sustainability]* student, I am motivated by the challenge of balancing humanitarian[2] needs with environmental responsibility. The ability to provide timely, efficient, and sustainable shelter in disaster situations is life-threatening, making the assessment of emergency shelter technologies highly relevant.

Three distinct power solutions come to mind:

- **Perovskite-integrated shelters**: The primary focus, representing an emerging technology with potential advantages in efficiency and manufacturing cost compared to conventional options.
- **Silicon solar-equipped shelters**: Serving as the baseline renewable alternative, with established performance data and widespread deployment in field operations.
- **Diesel generator systems**: Representing conventional power solutions for shelters in grid-independent scenarios, despite their known environmental drawbacks.

This selection encompasses both mature and emerging technologies to provide a balanced perspective on sustainability trade-offs in disaster response applications.

The primary objective is to compare these power options to understand their implications for both sustainability goals and disaster relief efforts.

[1] An emergency shelter tent is a portable structure, often lightweight and easy to set up, designed to provide temporary protection from the elements in emergency situations. It offers a safe and sheltered space, especially in scenarios where traditional housing is unavailable or inadequate, as noted by Gala Tent (2024) and ICBrindle (2022) [2] Concerned with or seeking to promote human welfare. *"groups sending humanitarian aid"*

2 Environmental Assessment

Briefly introduce the concept of what an Environmental Assessment is.

> “ Environmental Impact Assessment (EIA) evaluates the environmental consequences of plans, policies, or projects before decisions are made. EIA applies to projects, while Strategic Environmental Assessment (SEA) applies to policies and plans. It is a tool for decision-making, often involving public participation and legal review. The goal is to ensure environmental impacts are considered before proceeding. The International Association for Impact Assessment (IAIA) defines EIA as identifying, predicting, evaluating, and mitigating the effects of development proposals before major decisions are made, requiring justification based on environmental studies and public input. ”
>
> *Wikipedia, 2025*

Relevance/Relation: Mention the importance of assessing environmental impacts for your chosen shelter technologies.

2.1 Selection of Environmental Indicator(s)

Define which environmental indicators you will be assessing (e.g., carbon emissions, energy use, water consumption). Justify why these indicators are relevant to your product comparison.

2.2 Goal and Scope Definition (LCA)

Goal: Explain the purpose of the environmental assessment. For example, “To compare the environmental impacts of perovskite-integrated shelters, silicon solar-equipped shelters, and diesel generators.”

Scope: Define the boundaries of the assessment (e.g., cradle-to-grave or gate-to-gate, life cycle stages considered, cut-off points for data).

2.3 Inventory Data Collection

Discuss the data collected for each product’s life cycle stages (production, use, disposal).

Include information on environmental inputs/outputs, energy requirements, and waste.

Mention data sources, assumptions, and limitations where applicable.

2.4 Impact Assessment

Explain how emissions and other environmental impacts are assessed and quantified.

Use tools like CO2 equivalents to estimate climate change impacts.

Present data showing emissions for each shelter technology and compare them.

2.5 Interpretation

Hotspot Analysis: Identify the largest emissions and key sources in each technology’s life cycle.

Compare these emissions with the comparator product.

Discuss potential ways to reduce environmental impacts (e.g., material changes, process optimizations, alternative energy sources).

3 Economic Assessment

4 Social Assessment

5 Interpretation / Discussion / Incorporation into Design

6 Conclusions

7 References

1. GalaTent (2024). *Emergency Medical Tents and Shelters*. [online] Available at: https://www.galatent.co.uk/uses/emergency-medical-tents-and-shelters.

2. ICBrindle (2022). *Rapid Deployment Inflatable Emergency Shelters*. [online] Available at: https://icbrindle.com/rapid-response-inflatable-shelters/inflatable-emergency-shelters-tents.html.

3. Alves, B., (2014). *Topic: Natural disasters*. [online] www.statista.com. Available at: https://www.statista.com/topics/2155/natural-disasters/

4. Wikipedia (2025). *Environmental impact assessment*. [online] Wikipedia. Available at: https://en.wikipedia.org/wiki/Environmental_impact_assessment.