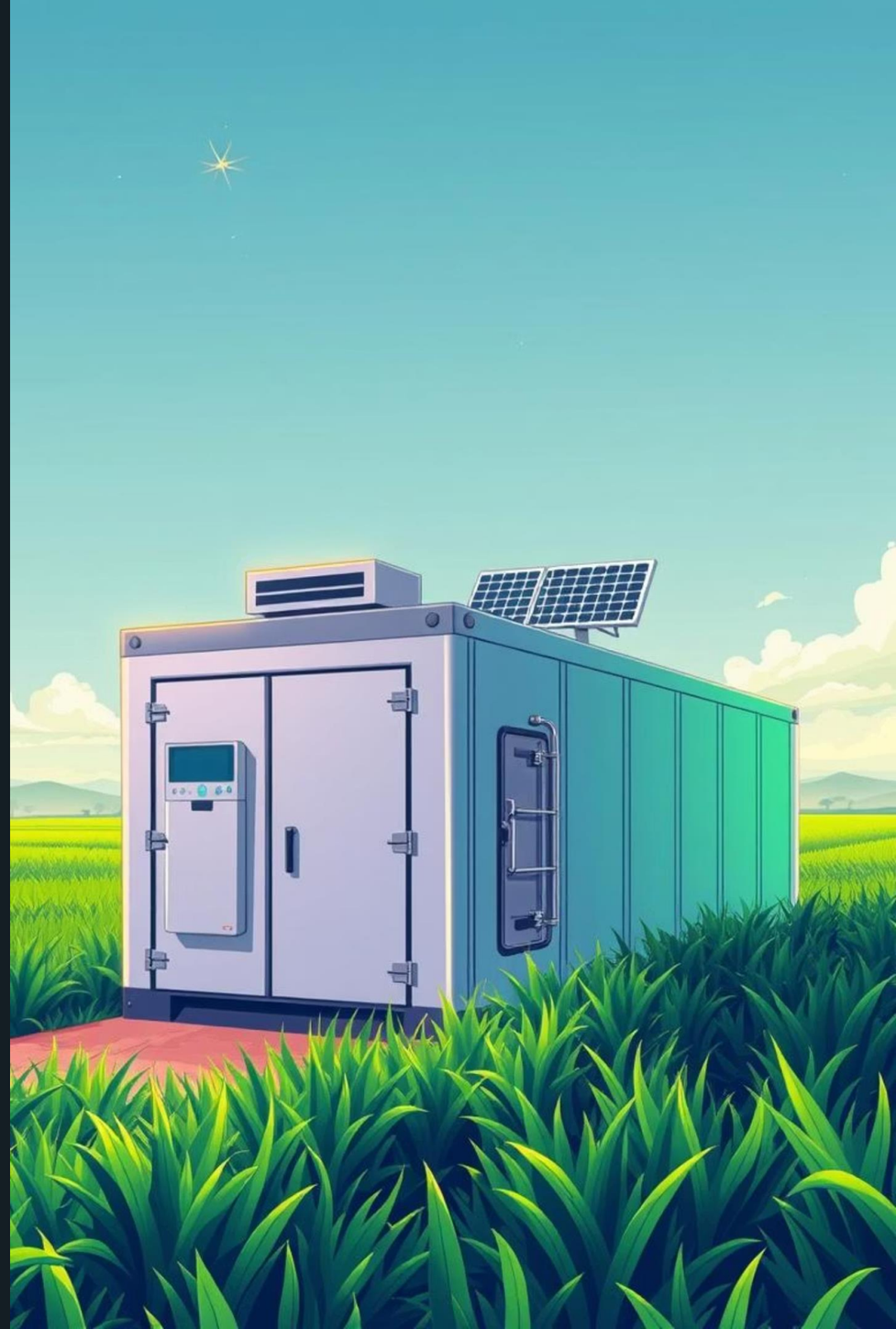
Smart Solar Cold Storage for Nigeria

A proposal for sustainable post-harvest management, addressing critical food loss and enhancing food security.



Executive Summary

Addressing Nigeria's Post-Harvest Crisis

Nigeria faces annual losses of **40-50%** of perishable harvests, impacting farmers, food security, and contributing to emissions. Our solution: modular, off-grid solar-powered cold storage units with Phase Change Materials (PCM) and Industry 4.0 IoT for remote monitoring.

Target Market

Smallholder farmers, agro-cooperatives, and rural market traders.

Key Advantages

Sustainability, affordability, 70%+ local content, smart technology.

Introduction

The Challenge: Post-Harvest Losses in Nigeria

Globally, 30% of food is lost post-harvest, with Nigeria losing 40-50% of perishable crops due to inadequate cold storage and unreliable power. This results in significant income loss for 93 million small farmers and contributes to 4% of global GHG emissions.

Current Impact

40-50% perishable crop loss annually.

Farmer Income

25% income loss for smallholder farmers.

Environmental Cost

Food loss accounts for 4% of global GHG emissions.

Project Aim & Objectives

Sustainable Post-Harvest Management

Our primary aim is to design, fabricate, and commercialize smart solar-powered cold storage units for Nigeria.

1. **Modular Design**

   Fabricate low-cost, scalable units for community, cooperative, and market use.

2. **Industry 4.0 Integration**

   Integrate IoT sensors and analytics for energy efficiency and inventory management.

3. **Reduce Losses**

   Aim to reduce post-harvest losses by at least 40% in pilot regions.

4. **Local Capacity**

   Source over 70% of materials locally to stimulate the economy.

5. **Commercialization**

   Enable scalability through cooperative and microfinance models.

6. **Sustainability**

   Contribute to national goals by eliminating diesel reliance and reducing emissions.

Justification

Economic, Social, and Environmental Impact

This project aligns with national priorities, NASENI's mandate, and UN SDGs (2, 7, 9, 12, 13).

Economic Benefits

- 25-50% annual increase in farmer incomes.
- Job creation in manufacturing and technology.
- Stimulates local industries.

Social Benefits

- Empowers women in agriculture.
- Improves rural quality of life and nutrition.
- Bridges urban-rural infrastructure gap.

Environmental Benefits: Reduces GHG emissions by replacing diesel generators and curbing methane from food waste.

Methodology

Key Components & Production Phases

Our modular, walk-in cold storage units are designed for various agricultural applications.

Key Components

- Structural Materials: Mild steel/aluminum, polyurethane foam (70%+ local content).
- Solar Energy System: Locally assembled PV panels, lithium-ion batteries (10-day autonomy).
- Cooling System: High-efficiency refrigeration with eco-friendly R600a.
- Thermal Storage: PCM blocks for backup cooling (up to 30 hours).
- Smart System: IoT sensors, remote monitoring, predictive maintenance.

Production Phases

1. Concept Validation & Planning (Months 1-6)
2. Design & Prototyping (Months 1-6)
3. Testing & Validation (Months 1-6)
4. Pilot Deployment & Data Collection (Months 7-12)
5. Refinement & Commercialization (Months 13-24)
6. Full-Scale Implementation (Months 13-24 onwards)

Collaborations & Timeline

Partnerships for Success

Collaboration is crucial for successful development and commercialization. The project spans 24 months.

Key Collaborators

- Internal Teams (PEDI R&D, Engineering)
- External Research Partners
- Local Fabricators & SMEs
- Solar Technology Providers (e.g., NASENI Solar Energy)
- Aggregators & Farmer Groups
- Government & NGOs

Timeline

Months 1-6

Design, Prototyping, Lab Validation

Months 7-12

Pilot Deployment, Data Collection, SME Training

Months 13-24

Refinement, Commercialization, Scaled Deployment (50+ units)

Cost Analysis & Marketability

Financials & Market Opportunity

The pilot phase budget is ₦36,355,000 for 3 units, serving 2,000–5,000 farmers. A single 12m³ unit costs ₦5,800,000.

Funding Needs

- Total for 180 units (4 years): ₦1.044 billion
- Year 1 (20 units): ₦116 million
- Unit Cost: ₦5.8 million

Market Potential

- Nigerian cold chain market: NGN 160B+ annually.
- Global solar cold storage market: $254B by 2027.
- Target: Smallholder farmers, agro-cooperatives, rural traders.

Strategy: Partnerships, flexible financing (pay-per-use), promotional campaigns, after-sales support.

Conclusion

A Transformative Solution for Nigeria

Our Smart Solar-Powered Cold Storage Units offer a sustainable, scalable, and locally fabricated solution to Nigeria's post-harvest loss crisis.

Sustainable Design

Solar energy, PCM thermal storage, IoT technology.

Local Content

Over 70% local fabrication stimulates the economy.

Farmer Impact

Boosts incomes, enhances food security, reduces emissions.

With funding and partnerships, this project will build a resilient cold chain for Nigeria's future.

Thank you