Energy innovations. Powerful collaborations.

4th TERTIARY INSTITUTIONS STUDENT ENERGY CHALLENGE (TIEC4.0)

TIEC Principal Sponsor: ALL ON

11th NIGERIA ENERGY FORUM 2026

TIEC4.0 Poster Title

Name: AGROCOOL+

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Proposed Solution

Nigeria suffers major post-harvest losses due to poor storage systems, unreliable electricity, and limited access to affordable refrigeration in rural areas. **AGROCOOL**+ is an AI-optimized, solar-powered multi-compartment cold storage system designed to address this challenge.it uses IoT sensors to monitor temperature, humidity, and energy usage in real time, while embedded AI optimizes cooling cycles to reduce energy waste and maintain ideal storage conditions for different produce types . By combining renewable energy with intelligent control, AGROCOOL+ provides a scalable and cost-effective solution that improves food preservation, increases farmers' income, and strengthens food security.

Technical Design

AGROCOOL+ is a solar-powered cold storage system that integrates sensors, edge AI, and automated cooling control.

An ESP32-S3 processes temperature, humidity, and gas sensor data locally using a TinyML model to estimate spoilage risk and regulate cooling.

A relay-controlled compressor adjusts operation based on AI decisions using optimized duty cycles to reduce energy consumption.

The system runs as a closed loop: sensing, processing, and actuation.

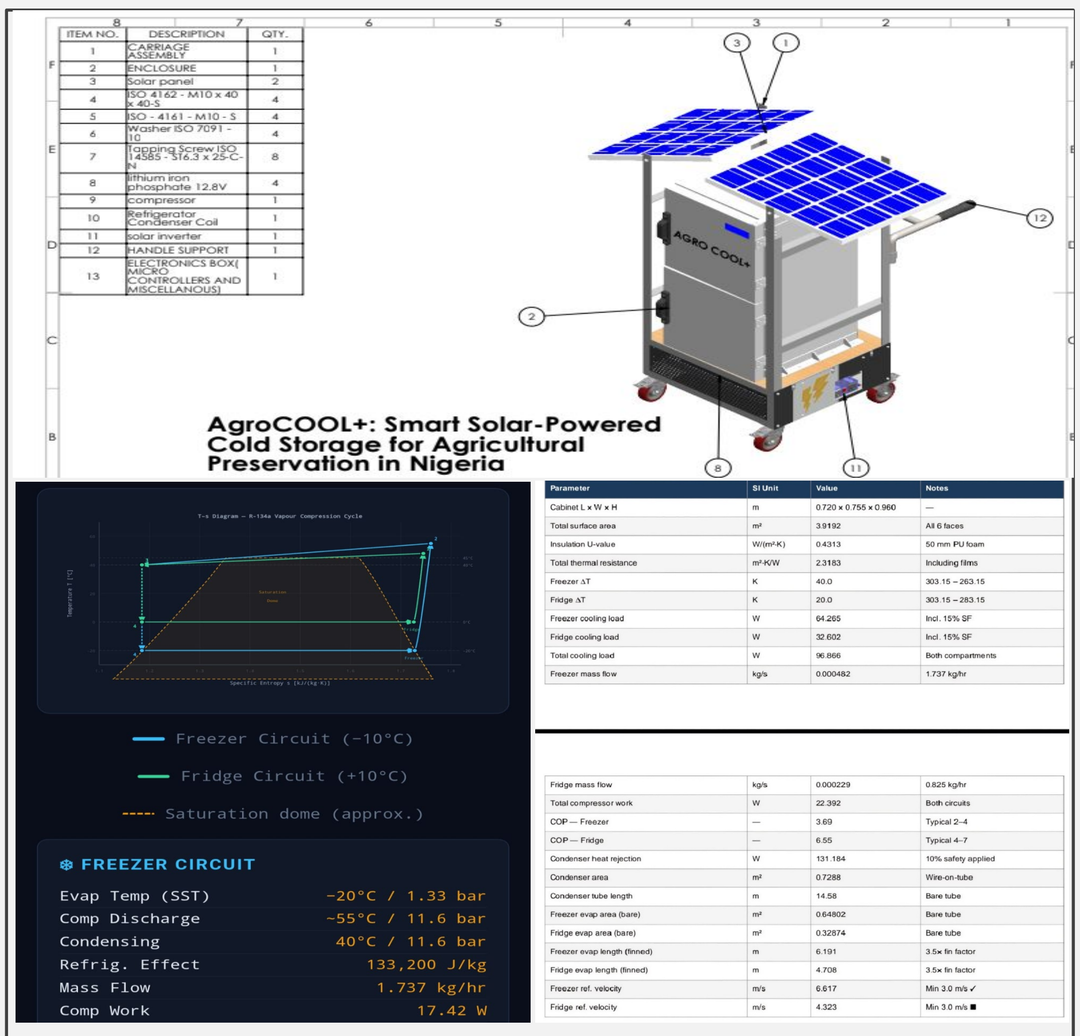
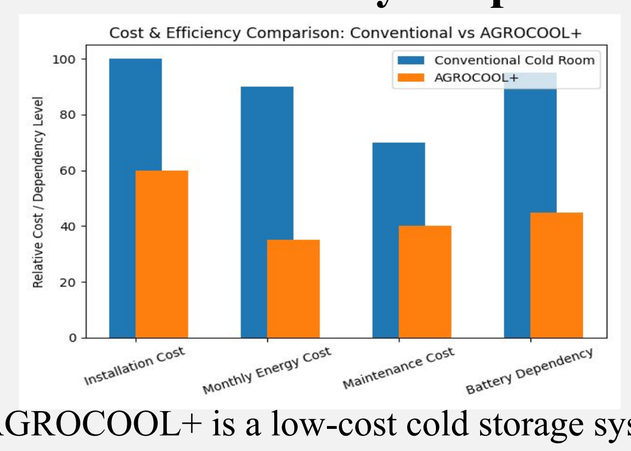


Fig. 1: Technical design

Economic feasibility/Proposed Business Model



AGROCOOL+ is a low-cost cold storage system for farmers and distributors.

It uses pay-per-use, subscriptions, and leasing, with added income from maintenance and monitoring.

Smart cooling reduces energy demand, lowering battery size, installation cost, and overall operating expenses.

Timeline for developing prototype/trial

The prototype will be tested with perishable produce under different conditions to assess cooling efficiency, energy use, and spoilage reduction.

Week 1-2	**Requirement analysis, system design, and feasibility study**
Week 3-4	System design (cooling compartments, and power setup)
Week 5-6	Component sourcing and procurement
Week 7-8	Prototype construction and system integration
Week 9	Software setup (monitoring + smart cooling control system)
Week 10	Testing and performance optimization
Week 11	Pilot deployment in selected rural/farm location
Week 12	Evaluation, feedback collection, and final refinement

Budget & Target User/Market/Scale

Solar Panel & High-Capacity Battery System	₦350,000
Cooling Unit (Efficient Compressor System)	₦250,000
ESP32-S3, Sensors & Control Electronics	₦90,000
Thermal Insulation & Multi-Compartment Fabrication	₦180,000
Wiring, Power Management & Safety Systems	₦70,000
AI/IoT Integration, Testing & Calibration	₦60,000
Miscellaneous & Contingency	₦50,000 Total estimate= ₦1,000,000

AGROCOOL+ is designed for farmers, cooperatives, food distributors, and rural cold-chain operators needing affordable and reliable cold storage.

References

[1]FAO (2019). *The State of Food and Agriculture: Moving forward on food loss and waste reduction.* Food and Agriculture Organization of the United Nations.

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[3]Opara, L. U. (2011). *Postharvest losses in horticultural supply chains in Africa. Postharvest Biology and Technology.*

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