NASENI Research Commercialization Grants Programme (NRCGP) Proposal
Proposal Title: Community-Scale Biogas Cylinder Commercialization and Briquette Stove Systems for Clean Cooking in Nigeria
Focal Area: Renewable Energy and Sustainability & Agriculture and Food Manufacturing
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Executive Summary

Over 70% of average Nigerian households still depend on firewood and charcoal for cooking, leading to deforestation, greenhouse gas emissions, and health risks from indoor air pollution. LPG is increasingly becoming unaffordable to many and inaccessible to some others, while traditional biogas models are inefficient. This proposal seeks NASENI's support to commercialize two validated clean cooking solutions:

(1) a large-scale biodigester with compressor and cylinder filling plant, and

(2) digestate briquettes with compatible stoves.

Both technologies were piloted successfully through a TechWomen grant in 2019 and a Ph.D. research at the University of Ilorin, showing strong adoption and willingness-to-pay. Phase 1 will establish a ₦100M biogas cylinder plant; Phase 2 will expand to ₦40–50M briquette and stove commercialization with return on investment in 3 years or less. Combined, they will deliver affordable energy, improve health outcomes, reduce deforestation, and create jobs, aligned with NASENI's Renewed Hope Agenda.

Problem Statement & Background

The average Nigerian households rely heavily on biomass fuels, with over 70% using firewood or charcoal. This dependency accelerates deforestation, contributes to climate change, and exposes families; especially women and children to respiratory illnesses. LPG is increasingly becoming inaccessible due to price volatility and poor distribution infrastructure. Conventional biogas systems tested in rural settings have been limited by inconsistent yields, low methane quality, and poor adoption.

There is a clear and urgent need for affordable, scalable, and community-friendly alternatives. Our pilot project which won a TechWomen, USA grant in 2019 and a Ph.D research work, demonstrated technical feasibility and market readiness for a biogas + briquette hybrid system. Farmers also embraced the slurry by-product as fertilizer, boosting productivity.

Innovation & Approach

Our solution integrates three synergistic clean energy innovations:

- **Biogas Cylinder Plant (Phase 1):** Large-scale biodigester with compressor and filling station to deliver compressed biogas in safe, refillable cylinders for households.
- **Digestate Briquettes & Stove Assembly (Phase 2):** By-products and agro-residues converted into smokeless briquettes, paired with locally fabricated stoves.
- **Slurry Fertilizer Utilization:** Organic slurry distributed to farmers, enhancing soil fertility and crop yields.

What differentiates this solution is its commercialization-readiness, proven pilot results, and triple impact across energy, environment, and agriculture.

Objectives

To scale two validated clean cooking technologies into commercially viable enterprises.

Phase 1 will deploy a biogas cylinder plant to deliver affordable gas, reduce deforestation, and create jobs.

Phase 2 will establish briquette production and stove assembly for regions with limited feedstock and high logistics costs.

Phase 1 will maximize slurry use as organic fertilizer while phase 2 will repurpose digestate and rice husk into briquettes.

The project targets adoption in both urban and rural households, validates market readiness through cooperatives, and builds a nationwide commercialization pathway.

Expected Outcomes

Affordable, sustainable clean cooking fuels for average Nigerian homes via biogas cylinders and briquettes. Farmers gain from slurry fertilizer, boosting productivity. Families benefit from reduced air pollution and lower cooking costs. Jobs are created through digester fabrication, briquette production, and stove assembly. Phase 1 ensures revenues from cylinder refills, while Phase 2 adds additional earnings from briquette sales. This creates a self-sustaining pathway that scales nationally. The combined outcomes align with NASENI's Renewed Hope Agenda, reducing deforestation, improving public health, creating jobs, and strengthening Nigeria's renewable energy and agricultural sectors.

Implementation Plan & Deliverables

Phase 1: Construct and deploy biogas plant with compressor, cylinders, and distribution networks. Train operators and communities, and validate adoption through cooperatives. Phase 2: Install briquette and stove assembly lines, train artisans and cooperatives, and pilot briquette adoption in feedstock-limited areas. Deliverables include: biodigester units, refillable cylinders, briquettes, stoves, signed off-take agreements, adoption study, and expansion plan.

Budget Summary

Phase 1 – Biogas Cylinder Plant (₦100,000,000)

S/N	Item	Estimated Cost (₦)	Description
1	Infrastructure & Equipment	65,000,000	Fabrication and installation of large-capacity biodigester; compressor and cylinder filling system; initial refillable cylinders.
2	Operations & Logistics	15,000,000	Cylinder transport and distribution setup; safety certification; regulatory permits; storage racks and accessories.
3	Human Capital & Training	10,000,000	Training of plant operators, welders, and cylinder handlers; community training for safe cylinder use and maintenance.
4	Market Development & Monitoring	10,000,000	Branding, awareness campaigns, cooperative engagement, distributor agreements; monitoring and evaluation of adoption.
5	**Subtotal Phase 1:**	**₦100,000,000**	

Phase 2 – Briquette & Stove Commercialization

Rationale: For areas with limited feedstock and/or high logistics costs, where biogas cylinders may be expensive to distribute, briquette production and stove assembly provide a localized, low-cost clean energy option.

S/N	**Item**	**Estimated Cost (₦)**	**Description**
1	Briquette Production Unit	18,000,000	Carbonizer, briquette press, dryers, and packaging line to convert digestate and agro-residues into smokeless briquettes.
2	Stove Assembly Unit	12,000,000	Fabrication tools, raw materials, and assembly of efficient briquette-compatible stoves.
3	Operations & Training	8,000,000	Training of local artisans in stove parts fabrication; assembling training of women's cooperatives in briquette packaging and distribution.
4	Market Pilot & Expansion	7,000,000	Sales and Distribution of briquettes and stoves in select communities; off-take agreements with cooperatives and distributors.
5	**Subtotal**	**₦45,000,000**	

Scalability & Sustainability

This project is designed for replication across Nigeria. Biogas cylinders suit regions with concentrated feedstock, while briquettes and stoves fit areas with scattered biomass. Local fabrication ensures low costs and job creation. Farmers' use of slurry fertilizer integrates energy with food security. Partnerships with cooperatives and distributors ensure market access. Early pilot validation and signed letters of intent prove strong demand and willingness-to-pay.

Risk Analysis & Mitigation

Key risks and corresponding mitigation approach include:

- **Feedstock Supply:** Mitigated through farmer cooperative partnerships.
- **Logistics:** Managed by decentralized distributors and cooperatives.
- **Adoption:** Addressed via community training and awareness.
- **Cost Volatility:** Reduced through local sourcing and modular expansion.
- **Regulatory and safety compliance**: These would be secured before scaling operations.

Conclusion

This proposal transitions proven pilots into commercially sustainable enterprises that deliver clean cooking fuel, improve health, reduce deforestation, and create jobs. With NASENI's support, we can scale an innovation that aligns with the Renewed Hope Agenda and builds Nigeria's renewable energy and agricultural resilience.

APPENDIX: PICTURES OF PRODUCTS

PROTPTYPE ETHANOL STOVE – TESTED AND IN USE

TEST PHASE DECENTRALIZED DIGESTER INSTALLED AT THE UNIVERSITY OF ILORIN

REFILLABLE COMPRESSED BIOGAS INSATLLED AT IITA SERVING THE CAMPUS KITCHEN AND OTHER RESIDENTS AND STAFF

NUTRIENT RICH BIO-FERTILIZER FROM DIGESTER SLURRY

DIGESTATE + RICE HUSK BRIQUTTEE AND COOK STOVE (PILOT PHASE SPONSORED TECHWOMEN, USA GRANT 2019)