Project Development Document (PDD)

Enugu Clean Cookstove Carbon Project

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1. Project Summary

- **Project Owner**: Powerstove Energy
- **Location**: Enugu State, Nigeria
- **Technology**: Powerstove T100 (Tier 4+ wood pellet stove, 58.9% thermal efficiency)
- **Fuel Source:** Wood pellets from sawdust and post-harvest crop waste (sustainable biomass).
- **Crediting Period**: 5 years (2024–2028)
- **Funding**: Fully funded by NASENI (Nigeria's National Agency for Science and Engineering Infrastructure).
- **Carbon Standard**: Tyndall Carbon Standard (Aligned with AMS-II.G under UNFCCC)
- **Methodology**: Tyndall Methodology for High-Efficiency Cookstoves.
- **Beneficiary Incentive**: $40/year/household from carbon revenue.
- **Carbon Credit Price:** $30/$tCO_2e$.
- **Profit Sharing:**
  - **Powerstove Energy**: 80% of net profit post-recovery.
  - **NASENI**: 18% of net profit.
  - **Zeco**: 2% of net profit.

2. Project Objectives

1. **Mitigate Climate Change:** Reduce 241,725 tCO_2e (net after 10% buffer pool) tCO2e over 5 years by displacing wood/charcoal use.
2. **Improve Health**: Eliminate household air pollution (HAP) for 75,000 beneficiaries.
3. **Economic Empowerment:** Distribute **$3M** in direct payments to households from carbon revenues.
4. **Deforestation Reduction:** Save 1,200 hectares of forest via reduced biomass demand.

3. Baseline Scenario

Baseline Fuel Consumption

- **Current Practice:** Traditional three-stone stoves (15% thermal efficiency).
- **Daily Fuel Use:** 12.4 kg wood/household (validated via surveys).
- **Annual Fuel Use:**
  - 12.4 kg/day × 365 days = 4,526 kg/year = **4.526 tonnes/year/household**

Fraction of Non-Renewable Biomass (fNRB)

- **Source:** World Bank Climate Portal (2023) for Nigeria
- **fNRB Value:**

fNRB = 0.35 (35%) (validated by satellite deforestation data)

Baseline Emissions Calculation

- **Emissions Factor (EF):** 1.85 tCO_2e/tonne (IPCC default).
- **Annual Emissions per Stove:**

Emissions = Fuel × EF × fNRB = 4.526 t × 1.85 tCO_2e/t × 0.35 =

2.93 tCO2e/year/stove

4. Project Scenario

Powerstove T100 Efficiency

- **Thermal Efficiency**: 58.9% (certified by Nigeria Stove Testing Labs, UNN).
- **Daily Fuel Use:** 2kg wood pellets/household (produced from **sawdust and crop waste**).
- **Annual Fuel Use**:

2 kg/day × 365 = 730 kg/year = 0.73 t/year

Project Emissions

- **Renewable Biomass:** Pellets from waste residues are **sustainable**; thus, $fNRB_{project} = 0$).
- **Annual Emissions per Stove**:

0.73 t × 1.85 tCO_2e/t × 0 = 0 tCO2e/year/stove

Emission Reductions:

- **Annual Reductions per Stove**

2.93 tCO_2e − 0 tCO_2e = **2.93 tCO2e/year /stove**

- **Total Annual Reductions (15,000 stoves)**

15,000 × 2.93 = **43,950 tCO2e /year.**

- **Buffer Pool (10%)**: 43,950 × 10% = **4,395 tCO_2e withheld**.
- **Net Issued Credits**: 43,950 – 4,395 = **39,555 tCO_2e/year**.

4. Co-Benefits Certificates (Tyndall Carbon Standard)

Co-Benefit	Quantification	Price Premium	Rationale
Health	60% reduction in HAP-linked diseases (0.02 DALYs saved/stove/year)	+\$2.5/tCO_2e	WHO valuation of \$5,000/DALY
Gender Inclusion	40% female participation in stove assembly	+\$1/tCO_2e	UN Women equity benchmarks
Economic	\$40/household/year from carbon revenues	+\$1.5/tCO_2e	Local income multiplier effect
Total Premium	**\$5/tCO_2e**		

Total Co-Benefit Revenue:
39,555 tCO_2e/year x $5 = **$197,775/year.**

5. Financial Analysis

A. Cost

Category	Cost
Powerstove (Stoves): 15,000 × $30	$450,000
NASENI (IoT Devices): 15,000 × $38	$570,000
Project Registration Fee	$500
Total Initial Cost	**$1,020,500**

- **Distribution**: Partner with 20 local cooperatives for household targeting (prioritizing female-headed homes).

B. Carbon Credit Workflow

1. **Data Collection**: IoT devices transmit fuel use, temperature, and usage hours.
2. **dMRV Validation**: Tyndall's AI verifies data; blockchain ledger ensures tamper-proof records.
3. **Credit Issuance**: Credits issued quarterly (3-month cycle vs. 18-month industry standard).

C. Community Engagement

- **Training**: 50 workshops on stove maintenance and pellet production.
- **Beneficiary Payments**: **$40/household/year** via mobile money (Bank API integration).

D. Revenue Streams

- **Carbon Credits (5-year total):** 39,555 tCO_2e/year × 5 × $30 **= $5,933,250.**
- **Co-Benefits (5-year total):** $19 7,775/year × 5 **= $988,875.**
- **Total 5-Year Revenue: $6,922,125**

E. Revenue Payment Schedule

- **Year 1:** 45% of $6,922,125 = **$3,114,956.**
- **Year 2:** 55% of $6,922,125 = **$3,807,169.**

F. Operational Costs

- **Tyndall Commission (7.5%):** $5,933,250 × 7.5% **= $444,994.**
- **Issuance Fee:** 39,555 tCO_2e/year × 5 × $0.05 **= $9,889.**
- **O&M (5%):** $5,933,250 × 5% **= $296,663.**
- **Insurance (4%):** $5,933,250 × 4% **= $237,330.**
- **Beneficiary Payments:** 15,000 × $40 × 5 **= $3,000,000.**
- **Total OpEx: $3,988,876.**

G. Net Profit
Annual Net Profit = $6,922,125 – ($1,020,500 - $3,988,876) = **$ 1,912,749/year**

H. Profit Sharing

- **Powerstove Energy**: 80% × $1,912,749 **= $1,530,199.**
- **NASENI:** 18% × $1,912,749 **= $344,295.**
- **Zeco:** 2% × $1,912,749 **= $38,255.**

Cash Flow Table

Metric	Value
Buffer Pool	10% of credits (4,395 tCO_2e/year) withheld to mitigate reversal risks
Powerstove ROI	340%, Full investment recovery by Year 2
Revenue Front-Loading	100% of 5-year revenue received in Years 1–2 to expedite cost recovery.
Insurance	4% premium ensures coverage for credit underperformance.

5-Year Cash Flow Table

Year	0	1	2	3–5
Initial Cost	($1,020,500)	-	-	-
Revenue	-	$3,114,956	$3,807,169	-
Operational Costs	-	($797,500)	($797,500)	($797,500/year)
Net Cash Flow	($1,020,500)	$2,317,456	$3,009,669	($797,500/year)
Cumulative Cash	($1,020,500)	$1,296,956	$4,306,625	$1,912,749
Year	0	1	2	3–5
Initial Cost	($1,020,500)	-	-	-

6. Validation & Verification

- **UNFCCC Compliance**: fNRB of 35% validated by Enugu Forestry Department.
- **dMRV System**: Tyndall's IoT sensors + blockchain ensure real-time, tamper-proof data.
- **Third-Party Audit**: Annual verification by Carboncoy Global Ltd.

7. Risk Management

Risk	Likelihood	Impact	Mitigation
Carbon price drop <$20	Likely	High	Forward contracts (70% pre-sold credits)
IoT device malfunction	Unlikely	Medium	2-year warranty + remote diagnostics
Low community adoption	Low	Medium	$40/year incentive + NGO partnerships
Pellet Supply Disruption	Likely	Medium	Partnerships with local agro-waste suppliers.
fNRB Reassessment	Very Likely	High	Annual biomass sustainability audits.

8. Monitoring Plan

Parameter	Methodology	Frequency
Fuel Savings	IoT-reported pellet use vs. baseline	Real-time
Household Adoption	GPS-verified stove usage (Tyndall dMRV)	Monthly
Health Outcomes	WHO HAP surveys (pre/post-implementation)	Bi-annual
Carbon Integrity	Blockchain-audited emission calculations	Quarterly (Tyndall)
Deforestation	Deforestation: Satellite imagery to track forest conservation (1,200 ha/year preserved)	Quarterly

9. Stakeholder Engagement

Stakeholder	Role	Benefit
Powerstove	Project Owner	Technology + Co-investment in Product
NASENI	Co-financier	Investment recover + profit share
Tyndall	MRV & blockchain provider	7.5% revenue share + tech royalties
Enugu State Govt	Policy support	Tax waivers + SDG alignment
Local Communities	End-users	$40/year/household for 5 years + health benefits

10. Environmental & Social Safeguards

- **Environmental**: Reduces deforestation by **81%** (vs. baseline).
- **Social**:
  - **Beneficiary Support**: $40/year/household for 5 years.
  - **Gender Equity**: 40% female employment in pellet production.
- **Grievance Mechanism**: Community liaison officers address complaints.
- **Biodiversity:** Zero impact on protected areas (stoves reduce deforestation pressure).

Key Notes

1. **Co-Benefits**: Adds $5/t$CO_2$e premium, enhancing alignment with SDGs 3, 5, 7 and 13.
2. **Social Impact**: $40/year/household directly supports beneficiaries.
3. **Updated fNRB**: 35% aligns with World Bank Climate Portal data for Nigeria, increasing emission reductions by **17%** vs. 30% default.
4. **Replicability** possible across Nigeria's biomass-dependent states positions it as a model for scalable climate action.

Appendices:

- A1: Technical Specifications of Anya Powerstove
- A2: Tyndall dMRV System Architecture
- A3: Stakeholder Consent Forms
- A4: Monitoring Data Templates
- A5: Co-Benefit Valuation Framework