Unlocking Climate Finance Pathways

for the Clean Cooking Sector in Africa

2025

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List of Abbreviations

Acronym	Full Form
ABPL	Africa Bioenergy Programs Limited
ACMI	Africa Carbon Markets Initiative
AECF	Africa Enterprise Challenge Fund
CCM	Compliance Carbon Market
CCA	Clean Cooking Alliance
CDM	Clean Development Mechanism
CIB	Clean Impact Bond
CO_2	Carbon Dioxide
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSR	Corporate Social Responsibility
DFI	Development Finance Institution
DMRV	Data Monitoring, Reporting, and Verification
DRC	Democratic Republic of Congo
EIB	European Investment Bank
ER	Emissions Reductions
ERPA	Emission Reduction Purchase Agreement
ESG	Environmental, Social, and Governance

Acronym	Full Form
EU ETS	European Union Emissions Trading System
GCF	Green Climate Fund
GHG	Greenhouse Gas
GS	Gold Standard
ICVCM	Integrity Council for the Voluntary Carbon Market
ICS	Improved Cookstoves
IEA	International Energy Agency
IoT	Internet of Things
ITMO	Internationally Transferable Mitigation Outcomes
JSE	Johannesburg Stock Exchange
KPT	Kitchen Performance Test
LMICs	Low- and Middle-Income Countries
LoA	Letter of Authorization
LPG	Liquefied Petroleum Gas
MCFA	Modern Cooking Facility for Africa
MFI	Microfinance Institution
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NORDA	Nordic Environment Finance Corporation

Acronym	Full Form
OECD	Organisation for Economic Co-operation and Development
PAYGO	Pay-As-You-Go
RBF	Results-Based Financing
SDG	Sustainable Development Goal
SE for ALL	Sustainable Energy for All
SSA	Sub-Saharan Africa
TCCP	Tanzania Clean Cooking Project
TPDDTEC	Technologies and Practices to Displace Decentralized Thermal Energy Consumption
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VCM	Voluntary Carbon Market
VCS	Verified Carbon Standard
VAT	Value Added Tax

GLOSSARY

01
Article 6 of the Paris Agreement

Article 6 of the Paris Agreement allows countries to voluntarily cooperate to achieve emission reduction targets set out in their nationally determined contributions. This means that, under Article 6, a country (or countries) is able to transfer carbon credits earned from the reduction of greenhouse gas (GHG) emissions to help one or more countries meet their climate targets. Article 6, essentially, has three components: Article 6.2, 6.4, and 6.8. Under Article 6.2, Parties receive accounting and reporting guidance to use their internationally transferred mitigation outcomes towards their NDCs. Whereas Article 6.4 establishes a new UNFCCC mechanism which is expected to help Parties trade high-quality carbon credits. On the other hand, Article 6.8 recognizes nonmarket approaches to promote mitigation and adaptation. It introduces means other than trading, such as cooperation through finance, technology transfer, and capacity building.

02
Carbon Neutrality

Carbon neutrality refers to the concept of balancing the total greenhouse gas emissions produced by an entity or activity with an equivalent reduction or removal of emissions.

03
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

The Carbon Offsetting and Reduction Scheme for International Aviation defines stringent eligibility criteria for offset projects used by the aviation sector, ensuring high environmental and technical standards.

04
Clean Cooking

Clean cooking refers to the adoption of energy-efficient technologies and fuels that minimize exposure to harmful emissions and reduce environmental impact during meal preparation. It involves transitioning from traditional biomass-based or fossil fuel-based methods —such as those using firewood, charcoal, or kerosense— to cleaner alternatives such as those using electricity, liquefied petroleum gas (LPG), biogas, ethanol, and solar energy. Clean cooking solutions are designed to improve household air quality, enhance fuel efficiency, lower health and safety risks, and promote environmental sustainability, particularly in regions where reliance on traditional cooking practices remains widespread.

05
Clean Development Mechanism (CDM)

The Clean Development Mechanism, developed under the Kyoto Protocol, governs how countries can finance emission reduction projects in developing countries in exchange for certified emission reductions, in order to meet their emission targets.

06
Emission Reduction Purchase Agreement

An Emission Reduction Purchase Agreement is a contract between a seller and a buyer to deliver verified emission reductions, which specifies terms such as price, volume, timelines, among others.

07
Letter of Authorization (LoA)

A Letter of Authorization is a formal document issued by project owners that designates and empowers authorized representatives to act on their behalf in carbon market transactions.

08
Nationally Determined Contributions (NDCs)

An NDC is a national climate action plan to cut emissions. Under the Paris Agreement, each signatory country is required to establish an NDC and update it every five years. NDCs are not legally binding unless they are incorporated into national law.

09
Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 parties at the United Nations Climate Change Conference in Paris, France, on December 12, 2015. It came into force on November 4, 2016. Its overarching goal is to maintain "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels."

10
tCO_2e

Ton of CO_2 equivalent is a standardized unit for the measurement of greenhouse gases (GHG). It expresses all emissions in terms of CO_2 with equivalent global warming potential.

11
Verified Carbon Standard (VCS)

Verified Carbon Standard is a global standard managed by Verra that certifies the credibility of carbon projects and credits.

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EXECUTIVE SUMMARY

Sub-Saharan Africa (SSA) faces a clean cooking crisis, with 960 million people—primarily women and girls— relying on traditional, polluting cooking methods. This figure is projected to rise to 1 billion by 2030, making Africa the only region where the deficit in access is increasing.[1] Sub-Saharan Africa's reliance on non-renewable wood fuels contributes 2% of global emissions (1 gigaton of CO_2 annually),[2] exacerbating environmental degradation. Meanwhile, women and girls spend several hours a day collecting firewood, which limits their opportunities, increases risks like gender-based violence, and leads to significant social and economic burdens. Despite the proven climate, health, and gender benefits of clean cooking solutions (e.g., LPG, biogas), only 10% of the population has access to modern energy cooking services, highlighting a huge gap in adoption and the urgent need for scaled interventions to address these interconnected challenges.[3]

Clean cooking enterprises offer promising innovative solutions; however, their scalability is constrained by financial, operational, behavioral and social norms, and technological challenges. Achieving universal access to clean cooking in Africa by 2030 requires an annual investment of USD 8 billion.[4] However, just one-fourth of the required capital currently flows into the sector.[5] Climate finance plays a crucial role in addressing both climate and clean energy gaps. Public funding, primarily from multilateral institutions, remains the predominant form of climate finance within the clean cooking sector. Although in recent years, private investment in clean cooking has increased, it remains highly concentrated among a small number of firms. A substantial portion of this funding is directed toward a limited range of solutions and key stakeholders, particularly within East Africa. Carbon finance, particularly through Voluntary Carbon Markets (VCMs), has emerged as a transformative mechanism, enabling clean cooking project developers to generate revenue through verified emission reductions. Yet, the high cost of entry, limited buyers, and low carbon credit prices limit Africa's participation in carbon markets and its potential to bridge the clean energy and finance gap. The continent contributes just a little over 10% of global credits (2016–2021), underscoring the need for broader investment and market access strategies.[6]

This study deepens the understanding of how clean cooking enterprises can unlock climate finance and access carbon markets to scale their operations and amplify their impact, particularly on women and girls in Africa. Our research on and interactions with clean cooking enterprises, investors, buyers, think-tanks, and carbon market players have highlighted pathways through which enterprises can mobilize capital and drive impact, particularly for women and girls.

KEY FINDINGS

01 Improved cookstoves continue to dominate carbon projects, however, there has been a recent increase in the recognition and adoption of other cleaner technologies. Improved cooking appliances continue to dominate carbon markets, although there is a growing shift towards other clean cooking technologies, such as electric pressure cookers, LPG and induction stoves.

02 Intermediaries play a crucial role in the registration and management of carbon projects; however, many established clean cooking enterprises are undertaking self-owned and self-managed carbon projects. There is a notable shift in project registration trends, with enterprises increasingly seeking to register projects directly instead of relying on intermediaries. This shift has been facilitated by the development of internal capabilities and increased access to resources.

03 Voluntary carbon markets have experienced significant price fluctuations, with projects that demonstrate higher carbon integrity being able to secure better pricing. Carbon market prices have experienced significant fluctuations, contributing to volatility in the sector. However, compliance markets operating under Article 6 present new opportunities for project developers, offering more predictable demand and pricing structures, which can potentially create a more stable revenue stream for high-quality projects.

04 Carbon projects require scientific rigor and transparency to establish the integrity of carbon reductions. This ensures that emission reductions are real, measurable, additional, and verifiable, enhancing the generation of high-quality carbon credits, attracting investment, and advancing progress toward climate goals.

05 Digital monitoring, reporting, and verification mechanisms are playing a crucial role in ensuring and demonstrating carbon integrity. Businesses are adapting to buyer demands by integrating digital technologies, co-benefits, data monitoring, reporting, and verification (DMRV) mechanisms, among other strategies.

06 Most clean cooking enterprises are using carbon revenues to subsidize the cost of clean cooking products and increase market access for cleaner technologies. Carbon revenues are proving to be instrumental in lowering the upfront cost for end-users. Emerging solutions are focused on subsidizing upfront costs (both product and after-sales service costs) for the end-user. Some enterprises have adopted innovative financing models that distribute revenue directly as cashback incentives.

07 Carbon projects must strengthen market mechanisms that ensure fairness and transparency. Carbon projects must strengthen mechanisms that guarantee fair, transparent, and equitable revenue sharing, promote inclusive competition, and ensure meaningful community consultation and consent throughout the project lifecycle.

08 Forward Purchase Agreements (FPAs) are the most common financing mechanism used by clean cooking enterprises to unlock carbon revenues and support business expansion. Enterprises have adopted innovative financial instruments, such as pre-financing through FPAs and climate bonds, to unlock capital for carbon markets.

09 Women's role in the carbon market extends beyond being end-users of clean cooking products. Their involvement spans multiple roles, including as customers, financiers, advocates, and entrepreneurs. There is considerable potential for increasing female participation in green jobs, particularly in manufacturing, entrepreneurship, data collection, and impact evaluation.

RECOMMENDATIONS

For Entrepreneurs and Project Developers

1. **Prioritize product quality and after-sales service:** A reliable and efficient cooking product is the foundation of a successful carbon project. Enterprises should prioritize effective business and distribution models while continuing to enhance product quality, after-sales services, and consumer awareness campaigns.

2. **Develop a strong value proposition for carbon market programs:** Like business models, enterprises should develop and articulate a value proposition for carbon players that demonstrates their uniqueness. Enterprises should differentiate themselves through the integration of digital technologies, co-benefits, alignment with Sustainable Development Goals (SDGs), fair benefit-sharing mechanisms, and advanced product offerings.

3. **Ensure carbon integrity through rigorous monitoring and verification:** Clean cooking enterprises must implement measures to ensure carbon credit integrity and transparency. This includes adopting robust methodologies, digital technologies, and innovative business models. Enterprises should demonstrate adherence to fair carbon principles established by organizations such as the Integrity Council for the Voluntary Carbon Market (ICVCM) and the Clean Cooking Alliance.

4. **Diversify revenue streams beyond carbon markets:** Develop non-carbon revenues (e.g., product sales) to support scaling. This can be achieved by developing non-carbon business lines and leveraging pre-financed revenue streams.

5. **Ensure fair and transparent consent and revenue sharing practices:** Enterprises should enhance transparency in carbon revenue allocation across the value chain. Informed consent mechanisms should be embedded in business operations, and consumers should be educated on transaction processes. Additionally, enterprises should explore innovative models that allow end-users to benefit from carbon revenues, such as cashback incentives and community development funds.

6. **Players that are new to carbon markets should adopt low-risk market entry strategies:** To minimize risks associated with entering carbon markets, enterprises can adopt multiple strategic approaches. This includes forming partnerships with other enterprises, aggregating projects, and collaborating with project developers as co-implementers. Regardless of their chosen approach, enterprises should maintain a strong focus on scaling their core business operations.

7. **Promote gender inclusion in clean cooking projects and business models:** Enterprises should actively promote women's participation in projects and business models. This includes ensuring equitable asset ownership, prioritizing the inclusion of women end-users in subsidy allocations, and implementing targeted subsidy schemes for marginalized communities, particularly female-headed households. There is significant opportunity to drive employment generation through green jobs in manufacturing and distribution. Additionally, enterprises should integrate "do no harm" principles into their operations by enforcing strict policies to prevent workplace harassment and ensure a safe working environment.

8. **Measure and communicate co-benefits:** Enterprises should implement comprehensive impact measurement frameworks to effectively showcase project co-benefits. Although clean cooking projects yield multidimensional benefits (e.g., health, gender equity) that enhance project appeal, impact measurement remains inadequate. Collaborating with research institutions, academic entities, and global standard-setting bodies can help systematize impact measurement.

For Investors and Buyers

1. **Strengthen enterprise capacity through technical assistance:** Technical assistance and capacity-building programs should be established to help enterprises navigate the complexities of carbon markets. Investors should allocate resources to support businesses in initiating projects, trading, and complying with regulatory requirements.

2. **Support project aggregation through decentralized models:** Investors should encourage the aggregation of carbon projects through decentralized models. This will enable smaller enterprises to overcome barriers related to carbon registration costs and technical requirements.

3. **Enhance banking sector capabilities for carbon market financing:** The banking sector should strengthen its role in carbon market financing. Financial institutions should enhance their capabilities to support carbon markets by adopting innovative financial instruments and risk-mitigation strategies.

4. **Provide patient capital to enable market development:** Climate finance investors should deploy innovative financing mechanisms, such as carbon streamlining, quasi-debt, and blended finance instruments, to facilitate the growth of emerging enterprises.

5. **Incentivize projects and finance that prioritize women's participation and inclusion:** Investors and buyers should recognize the critical role of women in the clean cooking sector and incentivize projects that focus on women's participation. This can be achieved by developing gender-lens investment funds and integrating related impact measurement frameworks in project selection processes.

For Policymakers

1. **Develop national frameworks and carbon registries for carbon projects:** Governments should establish national frameworks and carbon registries for carbon projects. Policymakers should advocate for uniform certification procedures aligned with the Paris Agreement, ensuring that clean cooking projects are incorporated into Nationally Determined Contributions (NDCs) and broader climate strategies.

2. **Implement sound policies for SMEs:** Regulatory frameworks should be designed to support Small and medium enterprises (SMEs). Governments should introduce measures to mitigate regulatory barriers, such as complex tax structures, and establish dedicated funds to support early-stage clean cooking projects. Tax incentives and subsidies should be provided to encourage local manufacturing.

2.

Introduction

2.1 Background

Sustainable Development Goal 7 (Affordable and Clean Energy) focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all by 2030.

Globally, the gap in accessing clean cooking solutions remains significant, with approximately 2.3 billion people still reliant on traditional and polluting cooking methods in 2023.[7] Sub-Saharan Africa is disproportionately affected, with nearly 960 million individuals dependent on traditional cooking practices that predominantly use biomass fuels such as wood and charcoal.[8]

Traditional cookstoves consume a large amount of fuel, exacerbate deforestation, and lead to increased health costs for households.

The use of non-renewable wood fuels for cooking accounts for 2% of global emissions, equivalent to 1 gigaton of CO_2 equivalent (CO_2e) annually.[9] Additionally, over half of all anthropogenic black carbon emissions originate from household combustion of solid fuels used for cooking and heating.[10] In Africa, women and children account for 60% of premature deaths linked to smoke inhalation and household air pollution.[11] Firewood collection is a time-consuming and physically demanding activity that places an additional burden on women and girls in rural areas, who spend an average of more than three hours daily gathering firewood for cooking purposes. This often requires carrying heavy loads, sometimes exceeding 35 kilograms, over long distances of up to 10 km, frequently over rugged terrain.[12] Carrying such a heavy load over large distances increases the risk of spinal and leg injuries, particularly among young women.[13] Moreover, the dependence on firewood exposes women and girls to gender-based violence, as they often gather firewood in secluded spots such as bushes and forests, where they face an increased risk of attacks.[14]

Figure 1: Difference Between Clean and Improved Cooking by Clean Cooking Alliance

Clean Cooking

Cooking solutions that achieve ISO Tier 4 or 5 for PM2.5 emissions and Tier 5 for carbon monoxide emissions. These generally include solar, electric, liquefied petroleum gas (LPG), biogas, ethanol, and some processed biomass/pellet stoves.

Improved Cooking

Cooking solutions that burn fuel more efficiently than the baseline. This includes improved efficiency wood and charcoal stoves. An improved cookstove can burn wood fuel and/or charcoal more efficiently without being cleaner.

Global climate and development goals cannot be achieved without changing how people cook.[15]

Modern energy and cooking solutions (referred to as clean cooking) take this a step further by integrating advanced technologies that achieve ISO Tier 4 or higher standards for energy efficiency, safety, and emissions reduction.

Table 1: Categorization of Cooking Technologies

Cooking Solutions	Emissions	Description	Cookstove Technology/Appliance
Traditional Biomass Stove	Tier 0	High smoke emissions, long cooking time and poor safety.	**Open Fire:** e.g., Three stones
	Tier 0-1		**Legacy Stoves:** • Metallic Biomass (+wood) • Stoves with no chimney • Metallic charcoal stoves
Improved Biomass Stoves	Tier 1	Some fuel efficiency, moderate smoke.	**Basic ICS:** • Built-in/Portable biomass stoves • Basic & artisanal charcoal stoves • Ceramic stoves
	Tier 2	Fuel efficient, reduced smoke, better safety than Tier 1.	**Advanced ICS**: • Improved charcoal stoves including rocket stoves
	Tier 3	High fuel efficiency, very significantly lower emissions, improved indoor air quality.	**Advanced ICS:** • Fan-assisted biomass stoves • High-efficiency charcoal stoves

Cooking Solutions	Emissions	Description	Cookstove Technology/Appliance
Modern (Liquid, Gas & Electric) Stoves	Tier 4	Very high efficiency, very low emissions, clean fuel usage.	**LPG Stoves:** • Single burner LPG stoves • Multiple burner LPG stoves including tabletops and cookers
	Tier 4-5	High efficiency, near-zero emissions, safest cooking methods.	**Electric:** • Electric coil stoves • EPCs (Electric Pressure Cookers) • Electric induction stoves
Renewable Fuel Stoves	Tier 4-5	High efficiency, near-zero emissions, safest cooking methods.	**Biofuel Stoves:** • Liquid biofuel stoves (e.g., Ethanol) • Solid biofuel stoves (pellets) • Biogas stoves
	Tier 5	No smoke, optimal efficiency, clean energy.	**Renewable:** • Solar cookers • Retained heat cookers

Ensuring universal access to clean cooking for Africa by 2030 requires USD 8 billion annually.[16]

However, only one-fourth of this required amount is currently directed towards the clean cooking sector. Projections indicate that, if capital flows continue at the current rate, up to 1 billion people in SSA could still lack access to clean cooking solutions by 2030.[17] Climate finance, including carbon finance, has played a pivotal role in promoting clean cooking initiatives globally, particularly in Africa.[18] By bridging the annual investment gap, climate finance offers a pathway to ensuring universal access to clean cooking solutions.

2.2 Study Objectives

This study aims to deepen the understanding of how clean cooking enterprises can unlock climate finance and access carbon markets to scale their operations and maximize impact, particularly for women and girls in Africa.

Clean cooking enterprises in Africa and globally address key societal and environmental challenges by providing affordable and accessible clean cooking technologies. To achieve widespread adoption and impact, clean cooking enterprises have implemented various measures, including raising awareness, influencing behavioural change, enhancing product affordability through end-user financing or rebates, and ensuring effective last-mile distribution. This study highlights models, measures, pathways, and strategies adopted by clean cooking enterprises and investors to channel and utilize capital for achieving high-impact outcomes. Women play a crucial role in the clean cooking sector since they undertake most of the unpaid care work related to collecting fuel and cooking. There is a strong correlation between women's involvement in climate change mitigation and adaptation and the reduction in greenhouse gas emissions.[19]

This study aims to highlight gender-responsive models adopted by enterprises to integrate women as consumers, financiers, leaders, and advocates of climate action within their respective regions.

Study Objective: To enhance the understanding of how clean cooking enterprises can unlock climate finance and carbon markets to drive scale and deliver impact, particularly for women and girls in Africa.

Figure 2: Research Questions for the Study

Research Questions

I. What models, measures, pathways, and strategies have enterprises and investors adopted to channel and utilize climate finance in the clean cooking sector?

II. What mechanisms and changes can clean cooking enterprises implement to unlock climate finance and optimize pricing for carbon credits, while also demonstrating a dual impact on climate and gender?

III. How can clean cooking businesses enhance incentives and maximize benefits for communities, including women and girls, through climate finance?

IV. What challenges do clean cooking enterprises face in accessing climate finance, and what strategies can be employed to address these challenges? What specific financial needs must be met to facilitate access to climate finance?

V. What changes and initiatives can investors undertake to enhance the viability and long-term sustainability of their projects and investments in the clean cooking and modern energy-cooking sector?

2.3 Approach and Methodology

The study employed a mixed- methodology approach, incorporating both primary and secondary research.

Figure 3: Research Approach and Methodology of the Landscape Study

Desktop Review (Secondary Research)

A comprehensive desk-based review of the literature on climate finance and carbon markets was conducted.

This included:

- An in-depth analysis of knowledge resources (details in Annex 1&2) from organizations such as Clean Cooking Alliance (CCA), the Africa Carbon Markets Initiative (ACMI), etc.
- Examination of all carbon projects implemented by enterprises and development organizations.

Secondary review offered valuable insights into technologies, business models, use cases, and financing mechanisms employed by these enterprises.

Primary Interviews

Key informant interviews (KII) were conducted with a diverse group of 25 stakeholders including: clean cooking enterprises, investors, development organizations, networks, and carbon market actors such as buyers and rating agencies (details of stakeholders in Annex 1).

Primary research offered fresh insights and trends, behaviors and perspectives that had not been covered by secondary research.

Analysis and Documentation

Data collected from primary and secondary sources were consolidated and analyzed to generate key findings. These findings offer a comprehensive perspective on the opportunities and challenges faced by enterprises and investors in unlocking climate financing in the sector.

Case studies were developed on enterprises offering clean cooking solutions and utilizing climate finance based on 3 categories.

i. Leader enterprises in carbon markets
ii. Established enterprises in carbon markets
iii. Emerging enterprises in carbon markets

2.4 Limitations of the Study

The study did not involve direct consultations (in this phase of the project) with end-users, i.e., women and girls. Instead, it relied on secondary knowledge products and primary consultations with stakeholders such as clean cooking enterprises, investors, and other ecosystem players, which provided insights into the experiences of women and girls in Africa. However, the research team will engage with end-users in the second phase of the project. Moreover, the study did not engage directly with standard-setting and verification bodies, such as the Gold Standard and Verra, which play a critical role in developing and certifying carbon projects related to women and girls. Instead, we used publicly available secondary materials, including those on SDGs, to inform the analysis.

3.

Climate Finance in Clean Cooking in Africa

Bridging the Gap for Clean Cooking Solutions

3.1 Climate Finance and Clean Cooking: A Critical Strategy for Climate Mitigation

Clean cooking is an essential pillar of sustainable development and climate mitigation in Sub-Saharan Africa; however, the sector faces a massive financing gap.

Achieving universal access to clean cooking by 2030 will require billions of dollars in investment and an ecosystem of supportive policies, enterprises, and community action. Ecosystem enablers such as policy frameworks, innovative financing instruments, and capacity-building initiatives, alongside diverse investment pathways, are crucial for scaling clean cooking solutions. Ultimately, unlocking climate finance for scaling clean cooking solutions and creating an environment where clean cooking businesses can thrive and increase their impact demands a coordinated effort from public and private financiers, on-ground implementers, policymakers, and community advocates.

Climate finance is a critical enabler for expanding access to clean cooking in Africa, yet current investments fall significantly short of what is needed.

The International Energy Agency (IEA) estimates that an annual investment of USD 8 billion is required to achieve universal access to clean cooking by 2030; yet just 30% of the required funding, around USD 2.5 billion, is invested annually.[20] This shortfall highlights a major gap in climate financing for the clean cooking sector. Bridging this gap is not only a humanitarian and public health imperative but also a crucial climate change mitigation strategy. Thus, transitioning households to clean cooking reduces emissions and deforestation, directly supporting countries' NDCs under the Paris Agreement and reinforcing the case for climate-focused funding.

Figure 4: Annual Clean Cooking Investment Gap by IEA (2023)

$ 2.5 Billion
Current Funding

$ 5 Billion
Funding Gap

$ 8 Billion
Total Funding

Current Investment Landscape and Trends in Clean Cooking

Public funding, primarily from multilateral Development Financial Institutions (DFIs), is the largest source of climate finance for clean cooking initiatives but is insufficient to close the gap.

For example, even though the World Bank, the largest financier in low- and middle-income countries (LMICs), provided USD 562 million to support clean cooking projects across 30 countries from 2015 to 2022,[21] this significant contribution barely made a dent in the multi-billion annual need. While public and concessional funding play a critical role in de-risking and facilitating market entry, they alone cannot meet the scale of investment required, underscoring the need for private capital to drive scale, innovation, efficiency, and long-term growth through balanced approaches like blended finance.

Although private investment in the clean cooking sector has steadily risen over recent years, its rate of growth is not enough to meet the 2030 target.

In 2022, clean cooking companies globally secured a record investment of USD 215 million, of which 54% came from private sources (e.g., banks, corporations, fund managers). This reflects a shift from relying solely on grants to accessing commercial financing. However, the Clean Cooking Alliance reports a 20% CAGR in investments from 2014 to 2020, estimating that at this growth rate, annual investments won't exceed USD 1 billion until 2036[22]—this is far below the yearly USD 4 billion private sector contribution needed by the sector.[23]

Notably, available investments are concentrated among a few dominant companies and regions.

Since 2020, a small group of large enterprises has captured a significant portion of capital inflows—seven of the largest clean cooking companies, including Kenya's BURN Manufacturing, received approximately 90% of the total investments in the sector in 2022. Geographically, East Africa continues to lead, with countries like Kenya, Tanzania, and Rwanda attracting most of the available funding due to the presence of established enterprises, supportive policy environments, and higher consumer demand driven by greater climate awareness. In contrast, while West African markets such as Ghana and Nigeria are beginning to attract investment, particularly in LPG and ethanol ventures, they still lag behind their East African counterparts. This imbalance highlights a critical gap: many smaller, emerging enterprises across SSA remain underserved and lack the capital required to scale.

The sector has witnessed a shift towards debt financing, with clean cooking enterprises increasingly favouring debt over equity as the industry matures.

Between 2016 and 2020, equity investments (particularly venture capital) were the primary source of funding for many clean cooking startups, especially improved cookstove manufacturers. However, by 2022, the balance had shifted dramatically, with debt financing making up roughly 79% of total investments in 2022, followed by equity at 18% and grants at around 3%.[24] This shift suggests that more clean cooking businesses have achieved a level of revenue generation and stability where they can take on loans or other debt. It also reflects the entry of more debt-oriented capital providers, such as impact debt funds. While the growing availability of debt finance is a positive development (as debt can often provide larger sums than small equity investments), an over-reliance on risk-averse lenders could limit innovation. Thus, a healthy balance between patient equity and grant funding is still needed to incubate new ideas.

There has been a steady rise in carbon finance—Carbon markets are increasingly being recognized as a transformative investment pathway for scaling clean cooking solutions.

Since 2020, revenue from the sale of carbon credits has risen significantly among leading clean cooking enterprises. Notably, during 2021-2022, approximately two-thirds of the investment in the sector was directed toward companies engaged in carbon credit generation.[25] An well-documented example is BURN Manufacturing in Kenya, which has financed over half of its business expansion since 2018 through the forward sales of carbon credits.[26] Although it requires broader market participation and supportive policies, carbon finance incentivizes low-emission technologies, providing a new revenue stream for scaling clean cooking while also enhancing co-benefits like health and gender equity.

Blended finance and innovative instruments: To bridge the gap between public and private capital, blended finance models are being increasingly explored.

Blended finance involves using concessional funds (from governments or philanthropic organizations) to de-risk or lower the cost of capital, thereby "crowding in" commercial investors who would otherwise stay out. In the clean cooking sector, finance providers are utilizing blended structures such as junior tranches in impact investment funds, results-based grant components attached to loans, or public-funded guarantee facilities. These tools balance financial sustainability with social impact by aligning the risk-return expectations of different investors. Listed below are some examples of blended structures in the clean cooking sector:

Spark+ Africa Fund (2022)

Provides debt financing (typically starting at USD 500,000) to companies across SSA that focus on improved cookstoves, biofuels, and other clean cooking solutions. The fund's structure allows it to offer relatively affordable debt while assuring its DFI backers that their contributions leverage private co-investment.

Results-based financing (RBF) programs

For instance, the World Bank's Clean Cooking Fund and the Modern Cooking Facility for Africa (MCFA) are paying companies for achieving specific outcomes (e.g., each verified stove in use or household adopting clean fuel). This effectively acts as an output subsidy, improving the project's viability and attracting investors who see a stronger revenue model when such incentives are in place.

3.2 Key Ecosystem Actors and Enablers in the Clean Cooking Sector

Unlocking climate finance for the clean cooking sector requires increased funding and a robust, well-coordinated ecosystem capable of effectively channelling and utilising these resources to maximize impact. A diverse set of actors, including investors, entrepreneurs, regulators, and community members, play critical roles in enabling the growth of the clean cooking ecosystem. Each actor contributes distinct capabilities, and when strategically aligned, their collective efforts can significantly accelerate progress. The following section outlines these key stakeholder groups, their respective roles in scaling clean cooking solutions, and opportunities to amplify their impact.

Table 2: Stakeholders, Roles, and Opportunities in Scaling Clean Cooking Solutions

Profile	Example	Strategic Role	Transformation Potential	Enhancement Opportunity
1. Financiers: Capital Providers Driving Market Scale				
Growth-Stage Impact Investors	Acumen's USD 6 million investment across five clean cooking firms since 2019.	Bridge early commercial funding gaps, validate business models, scale women-led and high-impact SMEs.	**High –** absorb risk and crowd in commercial capital.	Co-create gender/carbon impact metrics; link to SDG incentives.
Development Finance Institutions (DFIs)	World Bank's USD 562 million investment in the clean cooking sector between 2015 and 2022.	Set policy benchmarks, anchor blended finance structures, fund enabling infrastructure.	**High –** catalyze wider private investment.	Expand credit enhancements, improve SME access to registries.
Commercial Banks and Early-Stage VCs	Commercial banks provided 79% of total investments in clean cooking in 2022.	Provide working capital, inventory financing, and seed innovation.	**Moderate –** need risk-sharing tools to scale.	Develop aggregation platforms and implement credit guarantees.

Profile	Example	Strategic Role	Transformation Potential	Enhancement Opportunity
2. Implementers: Enterprises Delivering Clean Cooking Solutions				
Large Clean Cooking Enterprises	BURN Manufacturing accounts for 90% of 2022 investment flows in the clean cooking sector.	Drive volume adoption, scale carbon finance, build data systems.	**High** for emissions reduction; **Moderate** for inclusivity.	Partner with SMEs, track gender impact, localize distribution.
SMEs and Women-Led Enterprises	Solar Sister and Bidhaa Sasa have women-centric distribution models.	Reach underserved communities, unlock adoption and enhance gender co-benefits.	**High** for gender equity and community impact.	Scale DMRV tools, aggregate for carbon access, offer working capital.
3. Enablers: Policy and Market Access Facilitators				
National Policymakers and Regulators	Kenya's VAT exemption for LPG led to a 40% increase in adoption.	Shape enabling policies, unlock carbon finance, and incentivize private sector.	**High –** a single policy shift can unlock large investments.	Embed gender/CO_2 targets in strategies, establish registries.
Carbon Market Enablers and Standards	Gold Standard certifies 70% of clean cooking projects globally.	Gatekeepers to carbon finance through certification and verification.	**Moderate –** critical for access but co-benefits integration limited.	Simplify SME certification and include health/gender in credit value.
Women's Cooperatives and Community Networks	Solar Sister's women agents sell 3x more stoves than their male counterparts.	Promote behavioral adoption, trust-building, and sustained use.	**High –** especially for inclusive market design.	Formalize women as agents/stakeholders, invest in upskilling.
NGOs and Research Institutions	Clean Cooking Alliance's SDG-tagged credits earn a 31% price premium.	Guide funders, build evidence, support policy development.	**Moderate –** enables evidence-based scaling and accountability.	Create impact dashboards, gender data, and co-investment models.

Financiers: Capital Providers Driving Market Scale

Mobilizing sufficient finance requires engaging a diverse range of capital providers, each bringing distinct strengths. Key financier categories include impact-driven investors, DFIs, commercial banks, philanthropic funders, and corporates.

Development Financial Institutions

Between 2020 and 2024, DFIs invested over USD 600 million in the clean cooking sector.

While DFIs remain the largest source of funding among all financiers, the overall volume of investment —currently estimated at USD 2.5 billion till date— falls far short of the USD 8 billion required annually until 2030 to achieve universal access.[27]

Figure 5: EIB's Investment in BURN to Scale Clean Cooking

European Investment Bank (EIB) and BURN Manufacturing

In 2024, the EIB provided a USD 15 million financing to Kenya-based BURN Manufacturing. This investment aims to produce and distribute the ECOA Induction Cooker to over 1 million households across East Africa, positively impacting approximately 6.5 million people and avoiding 12 million tons of carbon emissions over five years.

DFIs invest in the clean cooking sector either through investment funds or directly in the enterprise. Investments made via funds are ideal for reaching early-stage enterprises, developing the market and building the ecosystem.

A notable example is the **Spark+ Africa Fund,** the first impact fund that focuses exclusively on clean cooking. Launched in 2022, it has raised over **USD 64 million** with contributions from DFIs such as Denmark's IFU, the U.S. International Development Finance Corporation (DFC), and FMO (the Dutch development bank). Spark+ provides debt financing starting at USD 500,000 to companies producing and distributing improved cookstoves, biofuels, ethanol systems, and other clean cooking technologies across Sub-Saharan Africa.

When investing directly in enterprises, DFIs typically deploy large ticket sizes —starting from USD 5 million, to scale proven business models that have already demonstrated scalability and their ability to generate commercial returns.

Notably, a significant portion of direct DFI investments has been concentrated in East Africa, where a majority of large enterprises capable of absorbing higher investments are based.

In addition to funding, DFIs have supported initiatives around awareness raising and consumer education, especially among disenfranchised consumers. Moreover, DFIs have been known to fund technical assistance facilities aimed at addressing key investor concerns such as the lack of viable business models, a limited pipeline and the lack of profitability and operational history among potential investees— factors that are often barriers to achieving scale.

Impact Investors

In the clean cooking sector, impact investors[28] primarily leverage private equity and private debt instruments to support innovative solutions.

Over the past five years (2019–2024), more than 10 impact investors have actively invested in clean cooking enterprises across Africa, helping to bridge the financing gap for this underfunded but crucial sector. These investors have supported a range of solutions, including LPG distribution (e.g., XpressGas in Ghana), ethanol systems (e.g., KOKO Networks in Kenya), improved biomass cookstoves (e.g., BURN Manufacturing), and biogas digesters (e.g., Sistema.bio). Prominent impact investors include Acumen, KawiSafi Ventures, Novastar Ventures, BIX Capital, KCV, and AECF.

Impact investors in this sector are critical for its growth, as they invest in early-stage clean cooking enterprises through equity financing and growth-stage enterprises through debt financing.

Ticket sizes have typically ranged from **USD 500,000** to **USD 5 million,** depending on the enterprise's maturity and capital requirement. For example, in 2022 **Acumen** deployed over **USD 6 million** into five clean cooking companies in the early stages of their business cycle including KopaGas and BioLite, while **KawiSafi Ventures** (owned by Acumen) led a **USD 15.6 million Series B round for Sistema.bio.**[29] According to fund disclosures and CCA snapshots, over 50% of these investments were structured as debt, particularly working capital loans and carbon revenue-backed facilities. The remaining investments were in the form of equity, convertible debt, and in some cases, results-based financing or blended concessional structures.[30]

Geographically, most impact investment has flowed into East Africa, particularly Kenya, Tanzania, Uganda, and Rwanda, which host well-established clean cooking enterprises.

West African countries like Ghana and Nigeria have also seen increasing investor interest, especially in LPG distribution and biofuel businesses. For instance, XpressGas in Ghana secured impact equity investment from Investisseurs & Partenaires (I&P) and debt funding from Belgium's BIO.[31]

Box 1: Clean Cooking Impact Investors

Kenya Climate Ventures

Kenya Climate Ventures Limited is a climate impact, gender lens investment company, de-risking early and growth stage gender inclusive climate smart enterprises. KCV provides tailored, patient ,and affordable capital in the form of debt, convertible debt and equity, combined with business growth support to early-stage and growth-stage climate smart enterprises in Kenya, supporting them to gain market traction and attract follow-on capital to bridge and sustain business growth. KCV ticket sizes range from USD 50,000 to USD 2,500,000.

To date, KCV has invested in 5 clean cooking businesses in the region namely: Sunken Limited, Rafode Limited, Kings Bio Fuels, Sistema Bio and Acacia Innovations.[32]

Box 1: Clean Cooking Impact Investors

Tanzania Clean Cooking Project (TCCP) Investment Thesis

The TCCP project, an initiative of AECF, is a USD 3.75 million, three-year grant fund aimed at accelerating the adoption of clean cooking solutions in Tanzania, catalyzing private sector participation and innovation, and strengthening sector coordination while advocating for a conducive policy environment.[33] In Tanzania, the project provides funding in two categories:

- Catalytic Fund (USD 50,000–USD 75,000) for early "seed" stage companies with an annual turnover of USD 30,000–USD 200,000.
- Growth Fund (USD 100,000–USD 400,000) for early growth stage companies with an annual turnover above USD 200,000.

3.3 Overview of Carbon Markets and their Relevance to the Clean Cooking Sector

Carbon markets are trading platforms that enable organizations, governments, and individuals to buy and sell carbon credits to offset their greenhouse gas (GHG) emissions.

These markets are crucial for facilitating the transition to a low-carbon economy by incentivizing emission reductions and funding low-carbon technologies. Carbon finance—a subset of climate finance that refers to funding mechanisms which assign a monetary value to carbon emissions—lies at the heart of carbon markets. It utilizes carbon markets to generate revenue by selling **carbon credits,** representing verified reductions in GHG emissions.

Figure 6: Definition of NDCs by UNFCC

Nationally Determined Contributions (NDCs)

These are national climate action plans that each country submits to the **United Nations Framework Convention on Climate Change (UNFCC)** under the **Paris Agreement**, outlining their plans to reduce greenhouse gas emissions and adapt to climate change impacts, contributing to the global goal of limiting temperature rise to **1.5°C.**

The Kyoto Protocol (1997), established the first international framework for trading carbon credits under the Clean Development Mechanism (CDM), spurring the evolution of carbon markets.

The Mechanism allowed developed countries to offset their emissions by investing in carbon reduction projects in developing nations. By introducing NDCs and encouraging countries to use carbon markets to meet climate commitments, the Paris Agreement (2015) further catalysed the development of carbon markets. In 2021, the detailed rules for implementing **Article 6** were finalized and it became operational.

Box 2: Overview of Article 6 Mechanisms for Selling Clean Cooking through Carbon Markets

Article 6 Mechanisms

The Paris Agreement under Article 6, specifically Articles 6.2: Bilateral or Multilateral Cooperation and 6.4: Paris Agreement Crediting Mechanism, introduces international market mechanisms to unlock climate finance for achieving NDCs. These mechanisms aim to increase private sector contributions towards achieving global mitigation goals, which seek to limit the rise in global temperature to well below 1.5 degrees Celsius.

A) Article 6.2: Bilateral or Multilateral Cooperation

This provision permits parties to the UN Framework Convention on Climate Change to collaborate by transferring carbon credits —called Internationally Transferable Mitigation Outcomes (ITMOs)— for three uses:

- NDC compliance by the acquiring country receiving the ITMO transfer. This ensures that the credits are only counted in one country and avoids the challenge of double counting.
- Compliance by international airlines with the carbon offsetting reduction scheme for International Aviation (CORSIA).
- Achievement of country level net-zero or carbon neutral goals by individual buyers in voluntary carbon markets.

Clean cooking projects can generate ITMOs by quantifying reductions that result from adopting efficient cookstoves or shifting to cleaner fuels. These emission reductions can be sold to other countries or entities seeking to fulfil their NDC targets. For example, a country investing in clean cooking projects in Africa could claim these reductions as part of its NDC while simultaneously benefiting host communities by improving health outcomes, enhancing women's economic well-being, and reducing deforestation.

B) Article 6.4: Paris Agreement Crediting Mechanism

Article 6.4 establishes a centralized, UN-supervised mechanism for the global trading of emission reductions. Clean cooking projects can participate in this mechanism by earning ERs for verified emissions reductions. To qualify, projects must demonstrate additionality, environmental integrity, and alignment with SDGs. In particular, clean cooking projects must show co-benefits such as health improvements, increased gender equality, and poverty reduction. These credits can then be sold to governments, corporations, or investors, thereby providing financial support to scale clean cooking solutions.[34]

Types of Carbon Markets

Carbon markets mainly operate through two main mechanisms: **compliance carbon markets (CCM),** which are regulated by governments and international bodies, and **voluntary carbon markets (VCMs),** where businesses and individuals purchase credits to meet their sustainability goals.

Compliance Carbon Markets

Compliance markets are established under national, regional, or international policy or regulatory frameworks to regulate GHG emissions from industries and businesses. **In 2024, the global compliance carbon market was valued at USD 113 billion, with projections indicating a growth to over USD 450 billion by 2034.**[35]

This rapid expansion is fuelled by a confluence of factors, such as the rise of corporate sustainability initiatives, the tightening of green regulations by governments globally, and the growing emphasis on ESG commitments. As regulatory frameworks evolve and carbon pricing mechanisms become more sophisticated, compliance markets are set to become a cornerstone of global decarbonization efforts.

Notably, the European Union Emissions Trading System (EU ETS) continues to dominate compliance markets globally with an estimated Value of USD 80 billion as of 2024. This represents a significant portion of the global carbon dioxide permits market.

However, the China National ETS, launched in 2021, is the world's largest carbon trading system, as it regulates approximately 5 billion tCO_2e (EU ETS: 2 billion tCO_2e) and is expected to surpass the EU ETS's valuation in the future.[36]

Table 3: Top Compliance Markets Globally

Rank	Name of Market	Estimated Value (USD, 2024)	Dominant Project Types	Regions Covered	Share of Clean Cooking Projects
1	EU Emissions Trading System (EU ETS)	80 billion	Power sector, aviation	European Union	Minimal
2	China National ETS	15 billion	Power sector	China	Non-existent
3	California Cap-and - Trade Program	10 billion	Power plants, transportation fuels	USA	Low
4	South Korea ETS	5 billion	Industry emissions, energy generation	South Korea	Minimal with select projects from Africa i.e. Koko Networks

Source: CarbonCredits.com

Box 3: Clean Cooking Projects in Compliance Markets

The participation of clean cooking projects in compliance markets globally is limited, however, compliance markets have the potential to offer clean cooking projects premium pricing for their carbon credits, leading to long-term revenue stability and hence scalability. Unlike voluntary carbon markets (discussed below) where prices for credits from clean cooking projects typically range from USD 5 to 25 per tCO_2e, compliance markets such as the EU ETS and emerging Article 6.2 mechanisms offer far more attractive pricing, with credits trading between USD 30 to 100 per tCO_2e. However, to access these markets clean cooking projects must meet stricter eligibility criteria and methodological requirements. This include, possessing robust MRV systems, obtaining host country authorization, and complying with international accounting rules under Article 6. As a result, access to compliance markets is currently limited to countries that have developed the necessary carbon governance infrastructure and signed bilateral agreements to enable the transfer of ITMOs. Encouragingly, countries like Ghana and Kenya in Africa, have made significant strides towards operationalizing Article 6 and building their carbon governance infrastructures through various regulations and policies. Such countries have the potential to drive the development of numerous clean cooking projects that can trade in these markets.

Voluntary Carbon Markets

Voluntary Carbon Markets (VCMs) allow companies, organizations, and individuals to buy carbon credits to offset their greenhouse gas emissions outside of regulatory obligations.

Unlike compliance markets, which are mandated by governments, VCMs operate on a discretionary basis, enabling private sector actors to support climate initiatives and meet sustainability commitments. There are three key players in VCMs, namely, buyers, standards and registries, and project developers.

Figure 7: Key Players in Voluntary Markets

Buyers	Project Developers	Standards & Registries
Purchase carbon credits to offset emissions voluntarily • A majority of buyers are large corporations such as energy companies, airlines, and pharmaceuticals	**Design and implement carbon projects** • Large clean cooking enterprises i.e., BURN Manufacturing • Intermediaries i.e., Impact Carbon	**Set rules/methodologies for credit issuance and conducts third-party verification** • Gold Standard • Verra

Voluntary markets have grown significantly over the last decade, driven by corporate net-zero commitments, investor pressure, and carbon neutrality goals.

Valued at USD 2 billion in 2023, voluntary carbon markets are expected to expand as the demand for high-quality, credible carbon credits grows.[37] Key trends shaping the market include the push for high-integrity credits to combat greenwashing, the operationalization of international credit trading under Article 6 of the Paris Agreement, and the rise of nature-based and social-impact projects like clean cooking.

Box 4: Key Developments in VCMs in 2024

In 2024, **VCMs** witnessed transformative developments aimed at strengthening market integrity and expanding their role in global climate action.

- **Article 6 Advancements at COP29:** Negotiators at COP29 in Baku finalized Article 6.2 rules, enabling bilateral and multilateral carbon credit trading through ITMOs. The development of the Paris Agreement Crediting Mechanism (PACM) under Article 6.4 created an UN-regulated global carbon market, enhancing cross-border cooperation for emissions reduction.
- **CORSIA Program Approvals:** The International Civil Aviation Organization (ICAO) approved four carbon offset programs under CORSIA, allowing airlines to meet emissions targets by purchasing accredited carbon credits.
- **Integrity Council for the Voluntary Carbon Market (ICVCM) Core Carbon Principles (CCPs):** ICVCM introduced Core Carbon Principles (CCPs), establishing a quality benchmark to improve the credibility and reliability of carbon credits. Gold Standard and Verra are recognized as CCP-Eligible by the ICVCM.

Source: ICVCM – Approved Programs under Core Carbon Principles.

Box 5: Clean Cooking Projects in Voluntary Carbon Markets

Clean cooking projects dominate VCMs due to their social co-benefits, lower verification barriers, and alignment with ESG goals. Unlike compliance markets, which focus on large industrial emissions and have stricter requirements, VCMs prioritize high-impact sustainability projects that focus on improving health outcomes, reducing deforestation, and empowering communities. Clean cooking solutions deliver measurable carbon savings by replacing biomass fuels, making them attractive to corporate buyers seeking credible offsets. Lower entry barriers in comparison to other carbon projects, flexible methodologies, and the rising demand for social-impact credits continue to drive their growing presence in voluntary carbon markets.

Carbon Market Mechanisms

Table 4: Carbon Market Mechanisms

Carbon Market Mechanism	Type of GHG Units	Relevance to Clean Cooking
Cap & Trade: A system where the government sets a limit (cap) on total emissions and issues tradable emission allowances. Entities must surrender enough allowances to cover their emissions. **How it Works:** A cap is set on total emissions; companies must hold allowances equal to their emissions. Allowances can be traded. **Market Type:** i. Compliance only e.g. EU ETS, ii. California Cap-and-Trade, RGGI	**Allowances:** Allowances are permits issued by governments under cap-and-trade systems that allow the holder to emit 1 tonne of CO_2e. These are typically distributed via auctions or free allocation. **Examples:** i. EUAs: European Union Allowances under the EU Emissions Trading System. ii. CCAs: California Carbon Allowances under the California Cap-and-Trade Program.	Clean cooking projects don't receive allowances but may sell offsets to regulated entities participating in allowance markets. **Example:** Koko Networks
Baseline & Credit: A system where emissions reductions are measured against a predetermined baseline. **How it Works:** Projects that reduce emissions below this baseline receive credits that can be traded or used for offsetting. **Market Type:** i. VCMs ii. Compliance Markets	**VERs (Verified Emission Reductions):** VERs are carbon credits generated by voluntary projects that reduce or remove GHG emissions. ***(One VER equals one tonne of CO_2e avoided or removed.)*** **CERs (Certified Emission Reductions):** CERs are carbon credits issued under the CDM of the Kyoto Protocol. ***(One CER equals one tonne of CO_2e reduced.)***	VERs is the primary mechanism used for cookstove carbon credit generation; widely adopted in VCMs. **Example:** Most clean cooking projects such as BURN Manufacturing (Gold Standard), UpEnergy (Verra), Inyenyeri (CDM) use this mechanism to generate carbon finance.

Carbon Project Journey

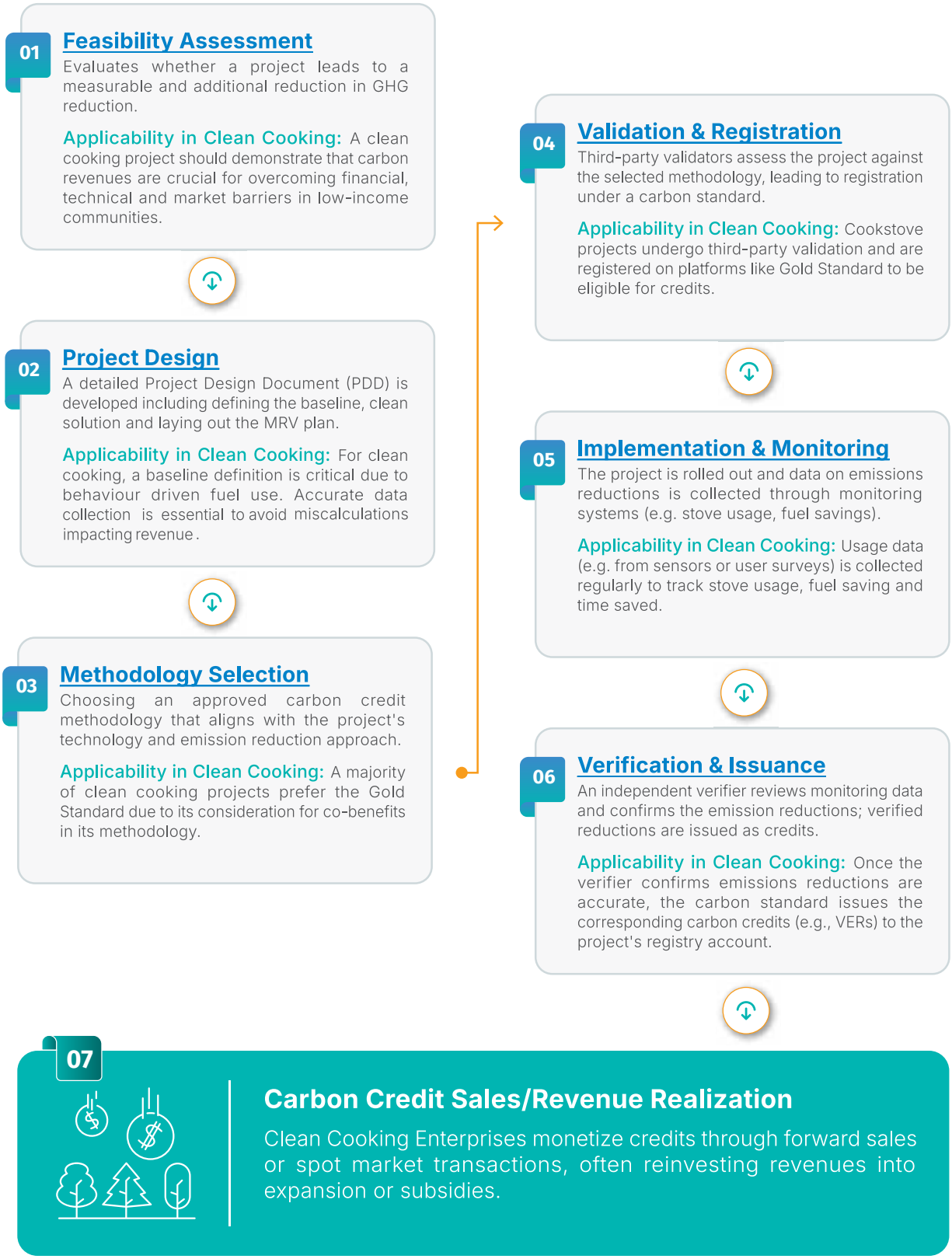
The carbon journey of a clean cooking project begins with a feasibility assessment followed by project design, which includes defining eligible technologies and aligning with approved methodologies.

A baseline study documents existing cooking practices and associated emissions. Next, the project selects a suitable carbon standard, such as the Gold Standard, and undergoes a third-party validation before being formally registered. During implementation, clean cooking solutions are deployed, and usage data is collected through monitoring systems. Independent verification confirms emissions reductions, leading to the issuance of carbon credits. These credits are subsequently sold in the carbon market, generating revenue that can be reinvested to scale access and improve long-term sustainability.

The entire process typically takes **14 to 16 months,** with account creation and registration taking around **9 months**, and each issuance cycle taking **5 to 7 months.**

The figure below illustrates the carbon project journey:

Figure 8: Illustration of the End-to-End Carbon Journey for Clean Cooking Projects



Carbon Markets in Africa

Until 2022, Africa's participation in carbon markets remained relatively limited, accounting for only a small fraction of total carbon credits issued globally.[38]

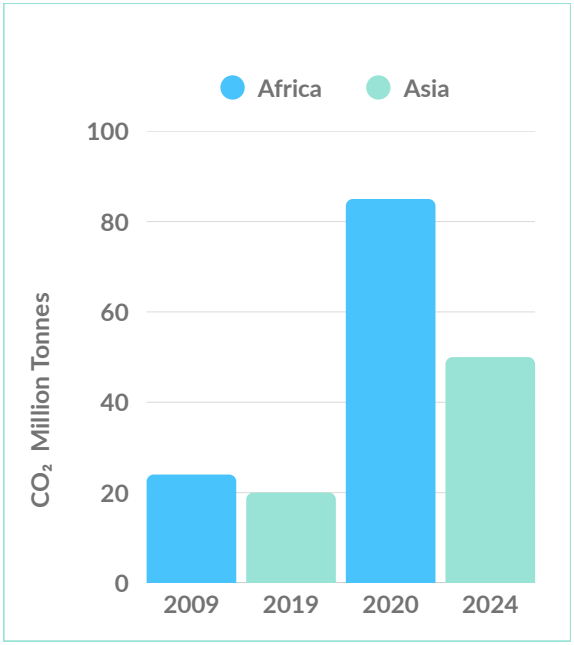
For instance, between 2016 and 2021, Africa accounted for only 11% of global carbon credits.[39] However, notable progress has been made since 2022, driven by the increasing demand for African-origin carbon credits with strong co-benefits, increased corporate commitments towards net-zero targets, and proactive efforts by African governments to engage with carbon markets through supportive policy environments.

Additionally, the development of the Africa Carbon Markets Initiative (ACMI), launched during COP27, has further accelerated the growth of carbon credit production in Africa. ACMI aims to scale carbon credit production in Africa to 300 million carbon credits annually by 2030 and 1.5 billion by 2050, unlocking substantial revenue and supporting the creation of millions of jobs across the continent.[40]

Clean cooking carbon projects in Africa are gaining prominence in carbon markets, especially in voluntary markets.

In a survey conducted by the Berkeley Carbon Trading Database, total credits issued by the clean cooking sector in Africa increased by 2.5x from 26 million credits (issued between 2009 and 2019) to 90 million credits (issued between 2020 and 2024). In comparison, Asia saw an increase of 1.3x from 22 million credits (issued between 2009 and 2019) to 52 million credits (issued between 2020 and 2024).[41] Our analysis reveals that this sharp increase in carbon credit issuance in Africa is a result of increased advocacy and commitments from African governments to develop carbon markets, the launch of initiatives such as the ACMI and greater access to carbon finance through DFIs and private investors.

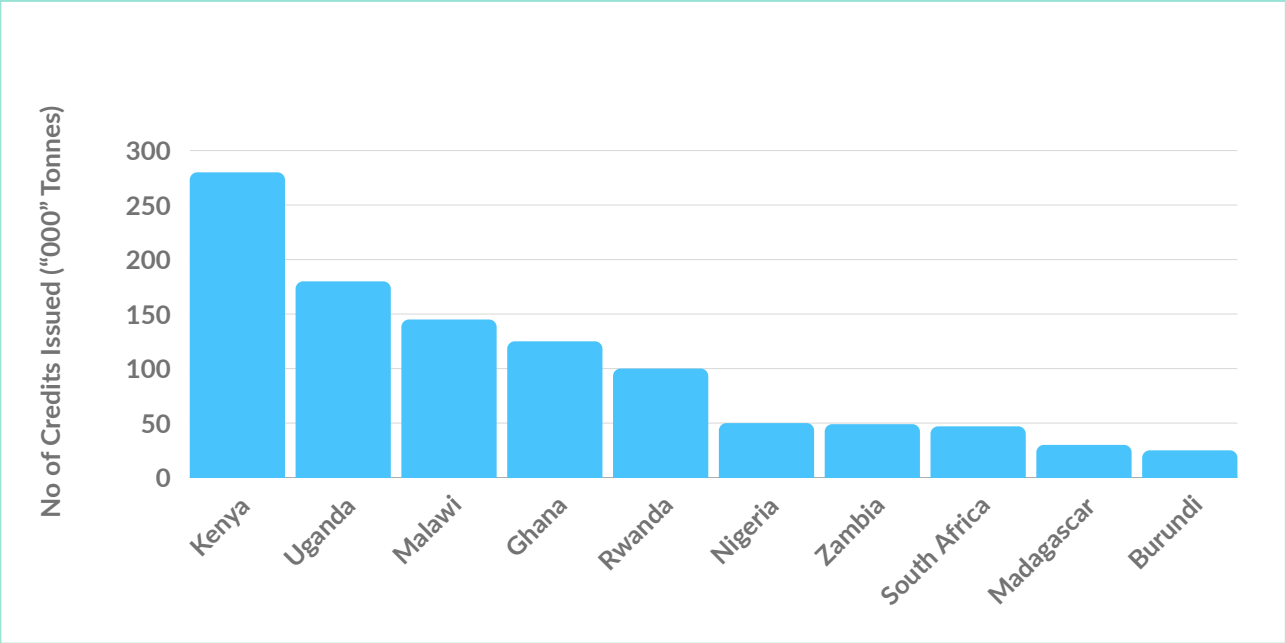
Figure 9: Carbon Credits Generated in Clean Cooking from Berkley Data (2024)



Clean cooking projects within Africa's carbon markets are predominantly concentrated in East Africa, largely due to supportive policy environments and enabling regulatory frameworks.

The regional distribution of carbon credit issuance highlights this imbalance: East Africa leads with an estimated 68 million credits issued, followed by Southern Africa with approximately 30 million, and West Africa with around 20 million. Central Africa remains the least represented in this space. Countries leading in carbon credit issuance from clean cooking initiatives—such as Kenya and Rwanda—have introduced targeted policies and incentives to accelerate adoption. South Africa has made significant progress by establishing formal regulatory frameworks for its carbon market. Meanwhile, countries like Zambia and Tanzania are actively working to develop comprehensive carbon market mechanisms alongside clean cooking policies to unlock the sector's full potential.

Figure 10: Top 10 Carbon Credits Issues in Clean Cooking from Berkeley Data(2024)



A key factor responsible for the relatively low adoption rates in West and Central Africa is the absence of robust policy frameworks and the limited integration of clean cooking targets into NDCs. NDCs are crucial in shaping the development of carbon markets. Countries that have successfully embedded clean cooking within their NDCs, such as Kenya and Rwanda, have seen a significant expansion in carbon credit generation.

Tier 2&3 improved cookstoves largely dominate clean cooking projects across Africa.

According to 2024 data from Berkeley Carbon Projects, Sub-Saharan and North Africa account for 984 clean cooking projects, of which 433 are classified as Tier 2 technologies. Insights from selected clean cooking enterprises suggest that many low-income households in the region continue to rely on traditional cooking methods. The lower cost of Tier 2 cookstoves contributes to their widespread use compared to more advanced Tier 3 – 5 technologies. Moreover, Tier 2 stoves cause less cultural disruption and support simpler business models that typically continue using baseline fuels like charcoal or firewood. Although access to electricity is rising across Africa, studies indicate that this does not necessarily translate into widespread adoption of electric cookstoves.[42] Traditional cooking practices and policy limitations appear to play a more decisive role in influencing household cooking behaviour.[43]

Although the number of compliance markets in Africa are limited, there is growing momentum in the participation of clean cooking projects from Africa in compliance markets across the world.

For instance, countries with established compliance markets like South Korea and Singapore have, in the past, accepted carbon credits from select African projects, including clean cooking initiatives. Specifically, Koko Networks, a cooking fuel and equipment company in Kenya that provides bioethanol as a cooking fuel to replace charcoal, sold carbon credits worth over USD 100 million in South Korea in 2023 and plans to do so in Singapore and Japan in the future. These markets have strict eligibility criteria, but their acceptance of African projects marks a significant step toward integrating the continent's clean cooking efforts into the global compliance framework. **Additionally, South Africa operates within the compliance market.** It has established a compliance market through its Carbon Tax Act (2019), which requires companies exceeding specific emission thresholds to pay a carbon tax or offset their emissions through carbon credits. This system is part of a broader cap-and-trade mechanism, where large emitters must either reduce emissions or purchase carbon offsets from approved projects.

3.4 Regulatory Landscape Governing Carbon Finance for Africa's Clean Cooking Sector

Ongoing efforts to combat climate change have resulted in many countries aligning their Nationally Determined Contributions with clean cooking initiatives.

As of December 2023, 96 low- and middle-income countries incorporated clean cooking or broader household energy measures into their NDCs. In SSA, more than two-thirds of countries have incorporated clean cooking into their NDCs.[44] Of these, some countries, such as Rwanda, have included one or more measures that explicitly target clean cooking, with commitments to increase their use of clean cooking energy from 15% to 65% by 2030. Others have included indirect measures, such as increasing the efficiency of charcoal production, or broader household energy initiatives that encompass cooking, lighting, and heating.[45] For example, Kenya committed to planting 2 billion trees by 2022, restoring 5.1 million hectares of forests, and shifting from biomass energy to 100% clean cooking fuel.[46]

The development of Article 6 of the Paris Agreement presents tangible opportunities for clean cooking projects in Africa. While its successful implementation depends on the host country's readiness and the existence of bilateral agreements, early progress in Africa is evident (See Box 6).

Box 6: Article 6.2 Illustration

Del Agua Live Well Clean Cookstove Programme

A notable example of a clean cooking project in Africa leveraging Article 6.2 to sell carbon credits is Rwanda's Del Agua Live Well Clean Cookstove Programme. This project is the first to have its Verified Carbon Units (VCUs) recognized under Article 6.2 through Verra's registry. The initiative collaborates closely with the Government of Rwanda, and has received Letters of Authorization (LoA) from the Rwanda Environment Management Authority (REMA). This ensures compliance with Article 6.2 by enabling corresponding adjustments in Rwanda's climate reporting under the Paris Agreement. The program has distributed clean cookstoves to households across the country, reducing emissions and improving public health.[47]

Transformative Cookstove Activity in Rural Ghana

Ghana and Switzerland have authorized the "Transformative Cookstove Activity in Rural Ghana," a project under Article 6.2 of the Paris Agreement, co-developed by ACT Group and Envirofit, with financial support from the KliK Foundation. The initiative will distribute 180,000 improved cookstoves to rural Ghanaian households, reducing smoke emissions by 80% and fuel costs by 60%, benefiting 750,000 people and creating 300 local jobs. Supported by carbon finance, improved cookstoves are sold below cost and paired with consumer credit through Village Loan and Savings Associations. Rigorous monitoring, including through thermal sensors and performance tests, ensures emission reductions are accurately measured and align with Ghana's Nationally Determined Contributions to the Paris Agreement.[48]

Box 7: Article 6.4 Illustration

Improved and Efficient Cooking Energy Solution for Nigeria

This project is spearheaded by Green Plinth Africa in collaboration with the Nigerian National Council on Climate Change. This ambitious initiative aims to distribute 80 million clean cookstoves across Nigeria. It is recognized as a programmatic Article 6.4 project under the United Nations Framework Convention on Climate Change. This project focuses on combating deforestation, reducing greenhouse gas emissions, and improving health outcomes by reducing indoor air pollution. It also includes a significant afforestation campaign, with plans to plant 4 billion economic trees to enhance biodiversity and create economic opportunities. The initiative is fully financed through carbon credits and aligns with Nigeria's NDC under the Paris Agreement.[49]

Favourable fiscal and energy policies are crucial for increasing the adoption of efficient clean cooking in Africa.

For example, Kenya has demonstrated a higher adoption rate of improved cookstoves compared to Nigeria, largely due to supportive fiscal policies, tax incentives, and proactive government interventions. Between 2016 and 2020, the Kenyan government eliminated the value-added tax (VAT) on liquefied petroleum gas significantly reducing its cost and leading to a 40% increase in urban adoption rates, while the use of kerosene and charcoal declined. Conversely, despite being one of Africa's largest natural gas producers, Nigeria has faced challenges in expanding LPG adoption due to delays in implementing the National Gas Policy and limited enforcement of LPG promotion initiatives.[50]

Overview of Regulations and Fiscal Policies in Select Countries in Africa

This section provides an overview of the regulatory landscape in Kenya, Tanzania, Ghana, Nigeria, Zambia, and South Africa. Kenya, Tanzania, and Ghana have been prioritized because each of these countries has rapidly developed both carbon-market rules and clean cooking policies. Nigeria, Zambia, and South Africa were selected due to their large markets and maturing carbon policies. No country in North Africa and Central Africa was selected due to their limited participation in carbon markets.

Table 12: Overview of Regulations and Fiscal Policies in Select Countries in Africa

Country	Name	Description of Regulation	Impact/Relevance on clean cooking
Kenya	Climate Change (Carbon Markets) Regulations, 2024	Establishes a legal framework to operationalize carbon markets in Kenya, including establishing a carbon registry which records all carbon projects.	Facilitates access to carbon markets by clean cooking projects by providing clear guidelines that govern how carbon credits are traded. It also provides various tax incentives, such as a lower corporate income tax of 15% (the current rate is 30%) for the first 10 years to a company operating a carbon market exchange or emission-trading system.
	Kenya Household Cooking Sector Study (2019)	Comprehensive analysis addressing the demand and supply of energy used for cooking in Kenya, highlighting challenges such as the continued reliance on biomass fuels.	It contributes to the development of policies aimed at increasing the adoption of clean cooking solutions and reducing the environmental and health impacts of traditional cooking methods.
	Finance Act, 2023 (Including Amendment of the VAT Act, 2013 (2024)	In 2023, the government of Kenya removed the VAT on cooking gas. In 2024, the government also exempted suppliers of cooking gas meters from paying the 16% VAT.	The removal of VAT on cooking gas was expected to help lower cooking gas prices and therefore increase uptake by households, businesses and public institutions such as schools. As a result of the Act, meter sellers will not charge their customers VAT and buyers will not reclaim VAT to enhance access to clean energy for low-income households.

Country	Name	Description of Regulation	Impact/Relevance on clean cooking
Tanzania	Environmental Management (Control and Management of Carbon Trading) Regulations, 2022	Enacted in 2022 this regulation establishes the legal framework for carbon trading in Tanzania, outlining procedures for project registration and compliance. In 2023, the regulation was updated to improve clarity and address emerging issues in carbon trading practices.	It facilitates the development of carbon credit projects, including those related to clean cooking initiatives, by providing clear guidelines and promoting environmental conservation. Moreover, the amendments provide clear guidelines that enable carbon projects (including clean cooking initiatives) to align with international standards thereby attracting investments.
	National Clean Cooking Strategy 2024-2034	Launched in June 2024, this strategy aims to enable 80% of Tanzanians to adopt clean cooking solutions by 2034. It adopts a multi-fuel approach, promoting the use of electricity, LPG, bioethanol, biogas and improved cookstoves.	It provides a comprehensive roadmap for improving access to clean cooking, thereby also addressing the health, environmental and economic challenges associated with traditional biomass use. The strategy aims to create a dedicated fund by June 2025 to promote clean cooking solutions. The fund will promote financial support and incentives to enterprises operating in the clean cooking sector. The strategy lays out a plan on how public-private partnerships (PPPs) can be forged, which will in return unlock capital in the sector and therefore increase the adoption of clean cooking technologies. Under the strategy, taxes on all energy appliances are to be reduced by June 2026. Lowering or eliminating taxes on LPG stoves, biogas systems, electric cookers, and improved biomass stoves is expected to improve affordability and, in turn, accessibility, thereby increasing the adoption of clean cooking solutions.

Country	Name	Description of Regulation	Impact/Relevance on clean cooking
Ghana	Ghana's Nationally Determined Contribution (NDC)	Ghana's NDC outlines a mitigation policy to expand the adoption of market-based clean cooking solutions. Its specific goals are: i. To increase LPG use from 5.5% to 50% in peri-urban and rural households by 2030. ii. To distribute 2 million efficient cookstoves annually.	The NDC aims to promote access to clean cooking solutions, thereby reducing reliance on traditional biomass fuels and improving health outcomes.
	Ghana's Framework on International Carbon Markets and Non-Market Approaches (2022)	This framework: i. Translates the principles and procedures of Article 6.2 into operational guidelines for carbon markets in Ghana. ii. Includes bilateral agreements with countries like Sweden, Switzerland and Singapore.	Establishes a comprehensive regulatory framework for carbon markets, facilitating carbon credit projects, including those related to clean cooking initiatives.
Nigeria	Climate Change Act, 2021	The Act establishes a framework for Nigeria to achieve its climate goals, including: i. Laying out a National Climate Change Action plan. ii. Creating a 5-year carbon budget to achieve net-zero emissions between 2050 and 2070.	The carbon budget will enable clean cooking enterprises to tap into the carbon markets, improving the affordability and accessibility of clean cooking technologies for low-income communities.
	Value Added Tax (VAT) Modification Order 2024	This order expands the list of VAT-exempt goods and services for the clean energy sector to include, among others: i. Equipment and infrastructure for increasing LPG use, ii. Facilities and equipment for processing domestic Liquified Natural Gas (LNG), and iii. LPG conversion and installation services.	By exempting LPG and related equipment from VAT, the policy reduces costs for consumers, encouraging the adoption of cleaner cooking fuels.

Country	Name	Description of Regulation	Impact/Relevance on clean cooking
Nigeria	**Development of a Carbon Tax Framework**	Efforts by the National Climate Change Council (NCCC) to develop a carbon tax framework that will help reduce GHG emissions.	Carbon tax will incentivize the shift away from traditional biomass fuels to cleaner alternatives like LPG, supporting the achievement of emission reduction targets.
Zambia	**Climate Change Bill (2023)**	The bill aims to establish enabling conditions for GHG emission reduction efforts, such as promoting clean cooking and phasing out the use of charcoal.	This bill is expected to increase the adoption of clean cooking solutions in Zambia.
	Zambia Energy Compact	Is a comprehensive roadmap for attracting investments to achieve universal energy access with an emphasis on renewable energy and resilient infrastructure. Through collaborations with Cooperating Partners and the private sector as well as policy reforms, Zambia is well-positioned to meet its 2030 energy targets, while fostering inclusive and sustainable growth in the energy sector.	By 2030, Zambia aims to accelerate access to clean cooking solutions, such that they reach 40% of its population, up from the current level of 8.9%, significantly improving the lives of women and marginalized communities by promoting alternative fuels and clean cooking technologies. This will be achieved by scaling up clean cooking solutions in the following ways: i. By 2025, Zambia aims to adopt a comprehensive clean cooking strategy, focusing on making alternative fuels and technologies available to women and marginalized groups. ii. By 2026, Zambia plans to introduce a clear policy on zero import duties, duty exemptions and tax relief measures for renewable energy technologies and clean cooking solutions, along with simplified tax-exemption procedures.

Country	Name	Description of Regulation	Impact/Relevance on clean cooking
Zambia	Carbon Market Framework 2023	The framework outlines guidelines for carbon trading, monitoring and reporting to support Zambia's mitigation strategies and NDC.	Provides a roadmap for supporting the development of clean cooking projects through carbon credit mechanisms.
South Africa	Carbon Tax Act (Act No. 15 of 2019)	The Carbon Tax Act, enacted in June 2019, enforces the polluter-pays principle by requiring large emitters to account for their environmental impact in production, consumption, and investment decisions. The first phase (2019-2022) applied to scope 1 emitters, with tax-free allowances ranging from 60% to 95%. The second phase (2023-2030) introduces higher taxes and reduced allowances.	By taxing carbon emissions, the Act incentivizes industries to adopt cleaner technologies, potentially reducing their reliance on traditional biomass fuels and promoting the uptake of cleaner cooking solutions.
	Revised Carbon Tax (Effective 2026)	Scheduled for implementation in 2026, this revision reduces tax-free allowances from their current level of 60% to 30% by 2030, with an annual reduction of 2.5%. It also increases the offset allowance for combustion emissions from 10% to 25%.	The stricter tax regime encourages industries to further reduce emissions, thereby potentially leading to the increased availability and affordability of clean cooking technologies as a result of their broader emission reduction strategies.
	National Climate Change Bill (2021)	This bill shifts South Africa's carbon budget system from voluntary to mandatory, aligning it with the carbon tax. Together these measures support the country's goal of achieving net-zero carbon emissions by 2050.	Mandatory carbon budgeting may drive investments in clean energy solutions, including clean cooking technologies, as part of broader efforts to meet emission targets.

4.

Carbon Markets

Lessons from African Clean Cooking Enterprises

As a part of the study, Intellecap consulted several clean cooking enterprises that have undertaken feasibility studies for the carbon market, listed or registered projects and raised carbon finance. Interactions with these enterprises reveal significant insights about their business models, carbon projects, pricing, impact measurement, and strategies, among others. These findings are shared through the 9 case studies included in this chapter.

4.1 Case Studies: Leader Enterprises in Carbon Markets

Enterprises in this category have well-established carbon projects and operations in VCMs.

Collectively, these enterprises have listed, registered and implemented more than 15 carbon projects in VCMs and are regularly retiring carbon credits. Leader enterprises have been operational for over ten years and have an established business model as well as an internal carbon market team that registers or manages carbon market projects. Each Leader enterprise has a varied product mix, including improved and clean cooking products, and operates in at least 5 African countries.

Case Study 1: BURN Manufacturing

Enterprise Profile

Year of establishment: 2011

Headquarters: Nairobi, Kenya

Regions of operation: Democratic Republic of Congo (DRC), Ghana, Kenya, Malawi, Mozambique, Nigeria, Senegal, Somalia, Tanzania, and Uganda.

Business Model

BURN Manufacturing designs, manufactures and distributes fuel-efficient and clean cooking appliances for domestic and commercial use in Africa. They target low- and middle-income urban household consumers for their charcoal, electric, and LPG cookstoves and low-income rural households for their wood-based, fuel-efficient cookstoves. The stoves are sold to end-users through door-to-door sales and via B2B channels, such as online retailers, supermarkets, microfinance institutions (MFIs), and social distributors.[51] BURN provides delivery and after-sales services, including repair, warranty (up to 5 years) and replacement. BURN also leverages an innovative pay-as-you-cook financing model for its electric stoves, such that customers can buy their cookstoves through a small upfront payment followed by weekly instalments paid using their mobile phones.

Products

Tier 3: Woodstove and charcoal stove

Tier 4: LPG, ethanol cookstove and electric induction cooker (with cookware)

Revenue

>USD 50 million per annum. Approximately 75% of BURN's revenue is generated from the sale of cookstoves, stove accessories, and stove distribution fees, while ~25% is generated through the sale of carbon credits.

Investments

BURN has raised debt, equity, and grant funding from capital providers like Acumen Fund, AHL Ventures, Global Social Impact Fund, Oiko Credit, the Modern Cooking Facility for Africa, Nordic Environment Finance Corporation (NORDA), and the Spark+ Africa Fund.

In 2023, BURN Manufacturing issued a USD 10 million green bond, the first ever green bond issued in SSA designated for clean cooking. This issuance was supported by DRY Associates Investment Bank (placement agent), FSD (Technical Assistance party) and Agusto & Co. (Credit Rating Agency and Green Bond Verifier).[52]

Furthermore, the enterprise has recently attracted USD15 million in debt financing from the European Investment Bank to produce and distribute electric

induction cookers to over 1 million households across East Africa with the aim of impacting 6.5 million people and avoiding 12 million tons of carbon emissions over five years.

Image Courtesy : www.burnstoves.com

2X Criteria Alignment*

- Share of women in the workforce: >40%
- Representation of women in senior management: >30%
- Representation of women on the board: 25%

Social, Environment and Economic Impact[53]

Social	Environment	Economic
▪ **Time saving:** Women save an average of 54 minutes on cooking every day. ▪ **Health benefits:** The Jikokoa stove reduces indoor air pollution by 65%, resulting in a decrease in respiratory diseases, headaches, and itchy eyes.	▪ One BURN cookstove reduces 2-5 tCO_2 on average per annum. ▪ BURN cookstoves are on average 3-10x more heat efficient (delivering more heat directly to cooking) than baseline, traditional cooking methods. ▪ BURN charcoal and wood cookstoves reduce charcoal consumption by 64% and wood consumption by 71% respectively, slowing deforestation. ▪ Since its inception, BURN has contributed to the reduction of over 28m tCO_2.	▪ BURN wood stoves save households an average of USD 120 annually, whereas its charcoal stoves save households USD 180 annually. ▪ The enterprise has created more than 1500 jobs for women. ▪ BURN products are estimated to provide economic benefits worth USD 119 per year.

**2X Criteria is the global industry standard for assessing and structuring investments that provide women with leadership opportunities, quality employment, finance, enterprise support, products and services that enhance economic participation and access. The study provides indicators on Entrepreneurship & Ownership, Leadership and Employment.*

Carbon Markets

Voluntary Carbon Markets Projects Overview

Since 2018, BURN Manufacturing has participated in over 43 clean cooking carbon projects either registered or in the process of being registered with Gold Standard. These projects span 10 countries directly registered through its wholly owned carbon subsidiary ECOA Climate Capital, and an additional 4 countries registered through intermediaries.

BURN is one of the few carbon project developers in Africa that covers the full carbon value chain from project design and in-house monitoring to credit issuance. This integrated approach ensures compliance with global carbon market standards, maximizes the value of emissions reductions, and enhances the credibility of, and demand for, its carbon credits. BURN sells carbon credits to corporate buyers through one-time purchases, monthly subscriptions, and forward sales agreements. These credits are available directly via BURN sales desk and website as well as through brokers, traders, and other partners.

Financing Carbon Projects

BURN Manufacturing pre-finances its carbon projects by using capital raised from investors to subsidize the deployment costs of clean cookstoves. BURN has secured carbon project financing from investors such as Key Carbon Limited, Cygnum Capital, and Talanton. To date, BURN has raised and deployed over USD 75 million in pre-financing, primarily through stove distribution and end-user discounts.

Revenue Monetization and Benefit Sharing with End-Users

Revenue from the sale of carbon credits generated by stoves enables BURN to subsidize the cost of its stoves, making them affordable for low-income households.

These subsidies allow BURN to offer stoves to end-users at discounts of up to 90% vs. retail prices with prices ranging from USD 3 to USD 20 for its biomass stoves. Additionally, these funds cover distribution and operational costs of after-sales services.

Carbon Credit Sales

BURN Manufacturing sells carbon credits at approximately USD 10 to USD 30 per tonne of CO_2. For individual retail purchasers, BURN offers subscription-based carbon offset plans that are directly linked to the quantity of carbon dioxide they wish to offset. These plans are structured as follows:

- **Small footprint:** Offsets 1 tonne of CO_2 for USD 30.
- **Medium footprint:** Offsets approximately 3 tonnes of CO_2 for USD 90.
- **Large footprint:** Offsets approximately 5 tonnes of CO_2 USD 150.

In 2023, BURN Manufacturing launched Africa's first carbon credit futures project, selling 10,000 forward contracts to represent future delivery of carbon credits, raising immediate capital to support the distribution of its ECOATM Electric Induction Cookers to low-income households in Ghana. The Carbon Credits Futures Initiative, in collaboration with CYNK, focused on emissions reductions achieved through the use of efficient cookstoves. This initiative involved the sale of 10,000 forward contracts priced at USD 25 each with a maturity of 7 years.[54]

Carbon Project Measurement

Methodologies

BURN projects have employed several prominent methodologies, including AMS-II.G (under the Clean Development Mechanism), the Gold Standard Technologies and Practices to Displace Decentralized Thermal Energy Consumption (TPDDTEC) (earlier known as Improved Cookstoves and Kitchen Regimes), and more recently, the Gold Standard Methodology for Metered and Measured Energy Cooking Devices. This latest methodology is designed for cookstoves equipped with metering technologies and accurately measures energy consumption during cooking, thereby providing data on energy savings and emissions reductions.

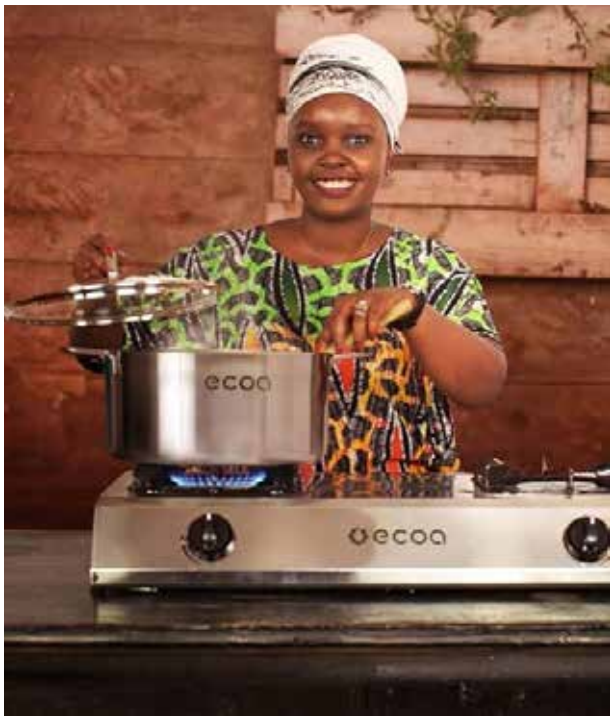


Image Courtesy : www.burnstoves.com

Monitoring methods

BURN employs a technology-driven, multi-layered approach to impact measurement, integrating real-time digital monitoring, and/or field-based surveys with sample end-users conducted through its agent network, and independent verification to track social, economic, and environmental benefits.

Digital methods: BURN has integrated digital monitoring by embedding cell phone chips into its stoves, enabling precise, second-by-second tracking of usage data. This ensures accurate reporting on fuel efficiency and reductions in air pollution. In 2023, BURN introduced tech-enabled electric cooking products equipped with Internet of Things (IoT) sensors. These sensors enable the enterprise to provide end-to end customer service and monitor real time energy consumption.

Traditional methods: Household surveys capture data on fuel savings, time efficiency, and health benefits, offering qualitative insights into the user experience. Depending on the project, BURN collects detailed information such as Unique Serial Number (USN) of the ICS model, along with end-user data such as name, state, mobile number, ID number among others, through a propriety cloud-based web platform. BURN also leverages third-party evaluations conducted by institutions such as UC Berkeley and the University of Chicago, enhancing the credibility of its impact data.

SDG tracking: BURN monitors progress towards multiple SDGs, including SDGs 1, 3, 5, 7, 8 and 13, in its projects registered under Gold Standard. It tracks the following corresponding key indicators: emission reductions, monetary savings from reduced charcoal purchases, perceived improvement in air quality, number of ICS sold, number of jobs created, and time saved during cooking.

Strategies Leveraged for the Successful Implementation of Carbon Projects

End-to-end carbon value chain management

BURN maintains complete control over its carbon credit process, minimizing reliance on third parties. This approach minimizes costs and improves efficiency, allowing BURN to extract maximum value from its carbon projects. Given the high upfront costs associated with carbon registration, an in-house team allows the company to optimize expenditures while ensuring compliance across diverse markets. In addition, BURN integrates real-time tracking technology into its induction stoves, using mobile chips to monitor usage and emissions reductions. This enables accurate reporting and verification, leading to certification by carbon regulators, thereby strengthening its credibility & integrity in global carbon markets.

Commitment to product quality and longevity

The durability of BURN's stoves is critical to the success of its carbon projects, as long-lasting stoves ensure sustained emissions reductions. If stoves break down prematurely, projected carbon savings are lost, compromising the integrity of the credits. To address this, BURN invests in robust product design and a strong after-sales service infrastructure which includes service centers across all active markets (including over 60 service centers in Kenya) that provide repairs, warranty support, and replacements. This ensures that customers continue using the stoves, maintaining emissions reductions over time.

Image Courtesy : www.burnstoves.com

Challenges in Leveraging Carbon Finance

Complexity of navigating multinational regulatory landscapes

BURN operates in over eight countries, each with its own carbon credit regulations, environmental policies, and tax structures. Compliance requirements vary widely—for example, Kenya has established the Climate Change (Carbon Market) Regulations 2024, while carbon policies in other African nations are evolving. This complexity necessitates investment in legal and compliance expertise, increases operational costs and can delay project implementation. By managing carbon projects in-house, BURN ensures greater adaptability and faster compliance, though this still requires substantial resources and technical expertise.

Image Courtesy : www.burnstoves.com

Technical expertise required for carbon registration

Registering carbon project is not just expensive but also requires technical expertise in monitoring, emissions tracking, validation, and reporting. These specialized skills are often not readily available in the regions where BURN operates. If these processes are not managed properly, it can result in delayed or rejected carbon credits being, leading to revenue loss and diminished investor confidence. While in-house management ensures better oversight, it increases costs due to the need for ongoing training and capacity building.

Volatility in carbon markets

Carbon credit prices fluctuate based on market demand, creating uncertainty in revenue planning. A drop in credit prices, can reduce the funds available to subsidize stove costs, making them less affordable. This price volatility introduces complexities in long-term financial planning. To mitigate this risk, BURN has diversified its revenue streams by combining carbon financing with long-term offtake agreements, direct stove sales, and strategic financing mechanisms.

** Insights are based on KIIs conducted with the enterprise team*

Case Study 2: UpEnergy

Enterprise profile

Year of establishment: 2011

Headquarters: Uganda

Regions of operation: Uganda, Malawi, Zambia, Nigeria, the Democratic Republic of Congo (DRC), Tanzania, Mozambique, Ghana.

Business Model

UpEnergy locally manufactures fuel-efficient biomass cookstoves and distributes them to off-grid communities dependent on charcoal. It distributes electric stoves to those with grid-access, providing an alternative to traditional biomass-based cooking. It also implements safe water solutions, offering water purification systems that reduce reliance on biomass for boiling water to households and schools. In addition to providing clean cooking and water purification solutions, UpEnergy is developing carbon removal initiatives, including biochar and agroforestry projects, to provide long-term environmental and social benefits to agricultural communities.

UpEnergy uses a multi-channel distribution model, which includes partnerships with local manufacturers, microfinance institutions, NGOs, and direct sales networks. The enterprise offers PAYGO (Pay-As-You-Go) and microloan financing options to increase the affordability and adoption of clean technologies.

Products

Tier 2: Improved charcoal and wood stoves

Tier 4-5: Electric cookstoves

Revenue

Undisclosed

Investments

UpEnergy has secured funding from Modern Cooking Facility for Africa, Finnish Fund for Industrial Cooperation Ltd (Finnfund), Climate Wedge, and Clean Cooking Alliance. The exact amount of these investments has not been publicly disclosed.

2X Criteria Alignment

- Representation of women in senior management: 40%
- Representation of women on the board: 33%

Social, Environment and Economic Impact[55]

Social	Environment	Economic
▪ **Time saving:** Women using UpEnergy's cookstoves save an average of 6 hours per week on fuel collection. ▪ **Health benefits:** UpEnergy products have reduced indoor pollution, resulting in improved respiratory health.	▪ **CO_2 emissions reductions:** Each UpEnergy cookstove reduces 3 tCO_2 annually.	▪ **Household savings:** Households can save between 50% to 70% in fuel costs, freeing up income for essential needs like education, nutrition, and healthcare. ▪ **Employment generation:** UpEnergy implements micro-entrepreneurship programs training women to sell and maintain cookstoves, thereby creating livelihood opportunities for them and fostering local economic empowerment.

Image Courtesy : www.upenergygroup.com

Carbon Markets

Voluntary Carbon Markets Projects Overview

UpEnergy has been involved in carbon finance since 2011, initially operating under the Clean Development Mechanism before transitioning to VCMs in 2018, and, more recently, engaging with compliance markets under the Article 6 framework. The company began by manufacturing and distributing improved biomass cookstoves in Uganda but has since diversified its portfolio to include projects in electric cooking, institutional and household water purification projects, and carbon removal initiatives such as biochar production and agroforestry.

UpEnergy has registered over 85 carbon projects, spanning multiple regions. It operates in several African countries, and is also developing projects in Latin America and Asia.

UpEnergy's clean cooking projects and safe water initiatives have collectively generated over 9 million tons of verified CO_2 reductions. UpEnergy operates across multiple carbon standards, including Gold Standard, Verra, and emerging Article 6 compliance mechanisms, with several key projects now tagged under CORSIA and Article 6 frameworks.

The company has a dedicated team of over 20 carbon professionals who collaborate with independent third-party verifiers to ensure robust oversight and transparency. This includes the use of verified, high-integrity data in all reporting, the adoption of conservative accounting approaches in cases of uncertainty and implementing measures to eliminate biases in surveys and tests conducted by UpEnergy and its partners.

In addition to its carbon market initiatives, UpEnergy engages in community-focused projects. For instance, the company has launched the 'Community Carbon' initiative, which consists of seven energy-saving projects that aim to deliver 3.5 million cleaner cookstoves and water purification devices across five African countries. Through revenue generated from the carbon projects registered by Community Carbon, UpEnergy has created an impact fund. A portion of the revenue from emission reductions is allocated to this impact fund, which invests in high-impact programs that empower women and girls, recognizing their critical role in driving climate action.

Article 6 Overview

In April 2024, UpEnergy received the first-ever Letter of Authorization(LoA) from the Government of Tanzania under Article 6 of the Paris Agreement, a major milestone in the development of compliance carbon markets. This approval is part of UpEnergy's Community Carbon initiative, which aims to reduce emissions from traditional cooking methods by distributing 425,000 locally manufactured fuel-efficient cookstoves in Tanzania. The project is certified under Verra and SD VISta, ensuring a high level of integrity. It has already attracted international buyers, including Ecoeye from South Korea.

Beyond Tanzania, UpEnergy is scaling its presence across compliance markets. Its Uganda project is Article 6.4-ready, and it has secured Letters of No Objection for Article 6.2 or voluntary market projects in several African countries. Additionally, UpEnergy is expanding its pipeline of Article 6-aligned projects and expects its Tanzania initiative to achieve CORSIA eligibility in 2025.

Financing Carbon Projects

UpEnergy utilizes grants, pre-financing, and carbon streaming structures to fund its initiatives:

- UpEnergy uses grant funding to subsidize products and pilot early-stage technologies like electric stoves. The company has secured a €2 million investment from MCFA to scale renewable electric cooking in Tanzania. The

funding is specifically designated to provide zero-emission cooking solutions for populations with access to electricity with the goal of replacing traditional biomass stoves with efficient electric cookers.

- UpEnergy uses pre-financing and streaming structures to secure upfront capital, which is then used to scale interventions. In return, a portion of future carbon credit revenues are shared with investors. A notable example is the company's partnership with Carbon Streaming Corporation. Under this, Carbon Streaming Corporation provides upfront financing to UpEnergy in exchange for a portion of future carbon credits generated by UpEnergy's projects. This collaboration enables UpEnergy to expand the distribution of clean cooking appliances, thereby reducing carbon emissions and combating energy poverty. The carbon credits generated are subsequently shared between UpEnergy and Carbon Streaming Corporation, aligning financial returns with environmental impact.

Revenue Monetization and Benefit Sharing with End-Users

Upfront subsidy: To make products and services affordable for low-income consumers, UpEnergy provides up to an 85% discount to its end-users. The discount is built into the cost of goods and service and varies by cookstove type. These discounts are made available to all end-users and are not based on usage.

Carbon project development cost: UpEnergy covers certain costs associated with project development and operationalization, such as data monitoring.

Community development projects: Through its Community Carbon initiative, UpEnergy has established a 'Climate Resilience Impact Fund.' The first 2 grantees of the fund are Street Child Uganda and AGE Africa, both of which have received USD 150,000 to execute projects aimed at improving the lives of women and girls.

Carbon Credit Sales

UpEnergy has employed both spot sales and offtake agreements to sell its carbon credits. UpEnergy's carbon credits have sold for prices ranging from USD 3 to USD 15 per credit in voluntary markets. During the initial phase of its carbon project, UpEnergy earned USD 3 per credit. However, in recent years, UpEnergy has been able to obtain a higher price of USD 15 per credit due to the higher integrity of its credits. This has been made possible through the use of sensor-based monitoring and rigorous verification of social and environmental benefits such as gender equality and health improvements. In the future, UpEnergy aims to target buyers who value social impact, allowing UpEnergy's carbon credits to fetch premium prices.

Carbon Project Measurement

Methodologies

UpEnergy employes multiple methodologies to quantify emission reductions in its clean cooking initiatives across multiple countries including Zambia, Malawi, and Mozambique. These include the Technologies and Practices to Displace Decentralized Thermal Energy Consumption methodology (version 3.1), VMR0006: Energy Efficiency and Fuel Switch Measures in Thermal Applications, and AMS-II.G.: Energy Efficiency Measures in Thermal Applications of Non-renewable Biomass. These methodologies are designed to track GHG emission reductions resulting from replacing traditional cooking methods with cleaner technologies like ICS and electric cooking devices, thereby reducing reliance on non-renewable biomass and charcoal.

Monitoring methods

UpEnergy's project implementation and monitoring prioritizes data integrity and uses conservative methodologies. UpEnergy uses a multi-pronged approach to monitoring and verification to ensure accurate impact assessment across its projects. While some technologies, such as electric cookers

integrate IoT-enabled sensors for real-time data collection, others rely on stratified random sampling, household surveys, and kitchen performance tests to verify use and fuel savings.

Digital methods: UpEnergy integrates digital monitoring systems into its electric cookers. Sensors in UpEnergy's electric cooking devices measure real-time energy consumption, track cooking modes, and store up to 13 months of data for analysis. Future models will support remote data transmission via GSM.

Traditional methods

Stratified Random Sampling: UpEnergy conducts independent field surveys to ensure stove usage data is representative across different stove age categories.

Household Surveys: Local teams engage with end-users annually via in-person interviews, inbound and outbound call surveys, and SMS outreach to track adoption and performance.

Kitchen Performance Tests: KPTs are conducted across all cookstove projects to assess fuel consumption, user adoption, and emission reductions based on real-world use.

Third-Party Verification: Projects are certified under Verra and SD VISta, with all emission reduction claims subject to independent audits.

SDG tracking: UpEnergy's projects use specific indicators to monitor progress toward achieving SDGs, ensuring measurable social, economic, and environmental benefits.

Some examples:

- **SDG 1 (No Poverty):** 88.76% of fuel-efficient cookstove users and 90% of electric cooking users report cost savings due to reduced fuel purchases.
- **SDG 6 (Clean Water and Sanitation):** UpEnergy's safe drinking water projects have provided thousands of beneficiaries with access to clean water, reducing the need for fuel-based water purification.
- **SDG 8 (Decent Work and Economic Growth):** UpEnergy has created 783 jobs through its fuel-efficient cookstove projects, 145 jobs through its electric cooking projects, and 109 through its safe drinking water initiatives, supporting local economies.
- **SDG 12 (Responsible Consumption and Production):** Fuel-efficient cookstove users report an average of 49.81% fuel savings.
- **SDG 13 (Climate Action):** Carbon reductions are measured across technologies in tonnes of CO_2e, contributing to verified emissions reductions through fuel-efficient cookstoves, electric cooking, and safe drinking water solutions.

UpEnergy is the first enterprise in East Africa to receive SD VISTA certification for its Tanzania Fuel-efficient cookstove project under Article 6.

Strategies Leveraged for the Successful Implementation of Carbon Projects

Projects in VCMs and compliance markets

UpEnergy is among the few project developers that have projects in both compliance and voluntary carbon markets, thereby maximizing its revenue potential. By diversifying across both types of markets, UpEnergy has been able to manage volatility and risks caused by price fluctuations.

Relationship building with relevant government ministries

UpEnergy maintains strong engagement with policy and regulatory processes by actively participating in discussions with government departments, building on existing ties from its CDM work and leveraging its diverse and widespread team of professionals to stay updated and aligned with new regulations.

Community-led projects

UpEnergy's community projects aimed at promoting clean cooking also focus on empowering local communities, often specifically benefitting women, by providing them with access to affordable and sustainable energy solutions. The projects include awareness campaigns, capacity building initiatives, and job creation through local distribution channels. As a result, UpEnergy has been able to attract buyers focusing on social impact issues.

A professional team for impactful execution

UpEnergy has a dedicated team of 20 professionals, which helps to design, execute, and monitor its initiatives effectively. The team's expertise spans areas such as carbon finance, energy distribution, and community development, ensuring that the company's strategies are impactful, scalable, and aligned with market needs.

Image Courtesy : www.upenergygroup.com

Challenges Related to Carbon Markets

High upfront costs for carbon project registration and verification

The cost of carbon project registration can often exceed USD 100,000 and poses a challenge in upfront investment. The need for feasibility studies, monitoring systems, and complying with international standards adds to this cost, limiting the ability to scale.

Volatility in voluntary carbon markets affects investor confidence

The fluctuating prices of carbon credits create financial instability. This volatility can impact investor confidence and complicate long-term planning, as carbon credits are crucial for subsidizing product costs like stoves and appliances. Price fluctuations make it harder to predict returns and secure consistent funding for scaling projects.

Transition from CDM framework

Although the CDM framework ended in 2020, many host countries are still in the process of developing their Article 6 implementation rules. UpEnergy has had to re-work its operational approach to adapt to the shift from the CDM to VCMs and emerging Article 6 frameworks. The shift has introduced new challenges, including unclear regulations and evolving methodologies in VCMs. Under the CDM, credits were sold in compliance markets with relatively predictable pricing and consistent demand (mostly from Nordic countries). In contrast, participating in VCMs exposes UpEnergy to greater market volatility, with pricing influenced by corporate buyer preferences.

**Insights are based on KIIs conducted with the enterprise team*

Case Study 3: Biolite

Enterprise Profile

Year of establishment: 2009

Headquarters: USA and Kenya

Regions of operation: Kenya, Uganda, India, Ghana, Tanzania, Nigeria

Business Model

Biolite designs and manufactures off-grid energy products for cooking, charging, and lighting, serving two distinct customer segments: outdoor recreationalists requiring portable power products and unserved communities living in off-grid regions of emerging markets. Biolite's products are distributed through channel partners and local distributors. The company collaborates with MFIs who provide end-user financing. For example, Biolite partners with One Acre Fund, which operates in Rwanda, Nigeria, Malawi, and Kenya. This partnership enables Biolite to bundle cookstoves with general agricultural inputs, providing stoves through credit-based financing models. After-sales services are provided by the last-mile distribution partners.

Products

Tier 3: Biomass cookstoves (HomeStove) that generate electricity from waste heat while cooking

Tier 5: Solar cookstoves (CampStove)

Revenue

Undisclosed

Investments

BioLite has raised ~USD 12 million across 7 funding rounds primarily in the form of conventional debt. For its carbon-related initiatives, the company utilizes quasi-debt financing some of which includes concessional terms. In 2023, Biolite secured USD 5.3 million in debt financing from Mirova SunFunder to meet its working capital needs. Biolite has also received financing from the Clean Cooking Working Capital Fund to strengthen local production, distribution, and customer support capabilities. Additionally, the company has been backed by the Shell Foundation and the Global Partnership for Results-Based Approaches (GPRBA), which prioritizes financing projects that deliver measurable social outcomes, such as improved access to energy access. KawiSafi Ventures has also invested USD 5 million in the form of equity to support Biolite's growth.

2X Criteria Alignment

- Representation of women in senior management: 30%
- Representation of women on the board: 25%

Social, Environment and Economic Impact[56]

Social	Environment	Economic
▪ **Time saving:** Women save an average of 8 hours per week on fuel collection. ▪ **Health improvements:** HomeStoves create 94% less smoke and 91% less carbon monoxide than regular cookstoves.	▪ **CO2 emission reduction:** Each Biolite cookstove reduces 3 tCO_2 annually.	▪ **Household savings:** Low-income communities can save up to USD 173 annually.[57] ▪ **Skill building:** Biolite programs provide training for over 5,000 women entrepreneurs to sell and service stoves.

Carbon Markets

Voluntary Carbon Markets Projects Overview

Biolite began its carbon market journey in 2015 and has registered its projects through intermediaries such as C02 Balance, and Stellar Works. It has over 19 projects that are currently either in the pipeline or directly registered. These projects are spread across Uganda, Kenya, and Rwanda. Biolite's projects have yielded over 1million credits to date.

Today, Biolite is a fully integrated carbon project developer and implementer. It designs projects, implements and manages them and verifies carbon offsets through partners. The company also sells carbon credits directly to corporate buyers.

Biolite has partnered with distributors for data collection and tracking carbon offsets for its carbon projects. Biolite incentivizes partners by providing cash rewards for data entry, ensuring accurate tracking of stove use, thereby fulfilling carbon credit requirements.

Financing Carbon Projects

Biolite utilizes pre-financing and debt financing to scale carbon projects before revenue generation. In certain projects, offsets are pledged as collateral in financing agreements. The debt model used is a quasi-debt, combining a fixed interest rate with an additional share of the carbon credit revenue upside. In 2024, Biolite received USD 5 million from Africa Go Green Fund (managed by Cygnum Capital) to distribute 120,000 improved cookstoves in 10 African countries.[58] The Fund provided capital upfront, enabling Biolite to subsidize its products, with repayment linked to the generation and sale of carbon credits.

Revenue Monetization and Benefit Sharing for End-Users

Upfront subsidy: Approximately 70% of the carbon revenue is used to subsidize the cost of stoves for end-users, making the technology accessible to low-income households. Biolite does not sell stoves in Africa without leveraging carbon credits.

Carbon project management cost: 30% of carbon revenue is used to cover the operational costs of the carbon credit program, including data collection and verification. This portion is primarily distributed to local partners after submission of data entries. Each distributor partner provides key stove-related data (e.g., name, location, phone number, stove serial number) in return for cash payouts for each data entry. These payouts are typically disbursed on a monthly basis.

Carbon Credit Sales

Biolite has sold carbon credits for prices ranging from USD 4 to USD 10 per tonne. Factors such as product type, project methodology, country of implementation, and the quality of credits influence pricing. Biolite's HomeStove, generates premium carbon credits due to its co-benefits—specifically, its ability to reduce smoke and provide electricity for lighting and device charging. Biolite estimates that carbon credits from projects demonstrating significant impact on women and girls have been able to command a 40%-60% price premium. Biolite has utilized both spot sales and offtake agreements for its carbon credit transactions.

Carbon Project Measurement

Methodologies

Biolite has utilized GS TPDDTEC, AMS-II.G. and VMR0006 (soon to be transitioned to VM0050).

Monitoring methods

Biolite use a combination of sampling techniques and third-party audits to verify emission reductions.

Digital methods: Biolite has embedded real-time data tracking technology in a subset of its products which it uses to collect data on use and efficiency.

Traditional methods: Biolite conducts on-the-ground audits and periodic monitoring to ensure the accuracy of its sales data and the operational effectiveness of its stoves. The company employs randomized sampling methods to balance cost-efficiency with rigorous impact tracking. These surveys are complemented by periodic data collection, such as stove installation records, and supported by a grievance mechanism to manage stakeholder feedback effectively. Stove usage is tracked over multiple years, enabling Biolite to refine its methodologies and adapt to evolving carbon market standards. The company has also collaborated with 60 Decibels, an independent agency, to conduct studies with both distributors and end-users. These studies provide additional insights into customer experience, product effectiveness and Biolite's overall impact.

SDG tracking: Biolite reports progress against several SDG, including SDG 13 (Climate Action), SDG 7 (Affordable and Clean Energy), SDG 5 (Gender Equality) and SDG 15 (Life on Land). For SDG 13, the company uses emission reductions as the primary indicator, calculated using baseline and project fuel consumption data and verified through kitchen performance tests. SDG 7 is tracked by monitoring the number of beneficiaries that rely on clean cookstoves. For SDG 5 Biolite measures the time spent by women collecting firewood, through self-reported data collected during kitchen surveys. SDG 15 is assessed by quantifying the amount of woody biomass saved.

Strategies Leveraged for the Successful Implementation of Carbon Projects

Strategic distribution partnerships

Collaborations with established partners such as Solar Sister allows Biolite to leverage their existing distribution networks for last-mile delivery. Since Biolite's products are subsidized through carbon revenues, distributors are better positioned to reach unserved markets and communities that may otherwise be unable to afford clean cooking solutions. This partnership-driven model enables Biolite to scale efficiently without needing to invest heavily in direct sales operations. High-margin incentives offered to distribution partners help ensure long-term engagement and promote sustainable growth.

Challenges Related to Carbon Markets

Depressed carbon credit market

Raising funding through the sale of carbon credits has become increasingly challenging due to a depressed market marked by declining demand and reduced carbon credit prices. This has affected Biolite's ability to secure sufficient capital from the sale of carbon credits.

Investor preferences for conservative methodologies

Investors typically prefer conservative methodologies with low crediting. Projects with aggressive assumptions, such as high fNBR (fraction of non-renewable biomass), are often considered too risky and are therefore less attractive. This poses a challenge for Biolite to attract investors for more ambitious carbon credit projects.

Lengthy and costly registration process

The registration process for carbon projects is often expensive and lengthy, sometimes taking up to two years from project design to the issuance of carbon credits. Managing timelines and milestones with external project developers adds further complexity and can lead to delays, requiring Biolite to finance projects with its own capital during the interim period.

Government approval and regulatory hurdles

Securing government approval, particularly for corresponding adjustments, has become critical for ensuring investor confidence in carbon credit projects. Projects that do not obtain approval from African governments, especially those operating in regions where regulatory processes are complex, often face delays and uncertainty. Some governments also require a share of carbon credit revenues, further complicating the registration and monetization process.

Limited availability of capital at concessional rates

Investors are often reluctant to fund projects with higher risks, which limits the availability of capital at concessional rates for carbon-related investments. This, in turn, limits Biolite's access to affordable financing for its carbon programs.

** Insights are based on KIIs conducted with the enterprise team*

4.2 Case Studies: Established Enterprises in Carbon Markets

Enterprises in this category have established carbon market projects and business models.

These enterprises have been operational for over 5 to10 years and have issued and retired carbon credits in voluntary carbon markets. **Unlike leader enterprises that have more than 15 carbon projects, these enterprises have registered approximately 5 to10 carbon projects in VCMs**.

Image Courtesy : www.burnstoves.com

Case Study 4: Sistema.bio

Enterprise Profile

Year of establishment: 2010

Headquarters: Mexico

Regions of operation: Kenya, Uganda, Malawi, Ghana, Ethiopia, Tanzania, Nigeria, Zimbabwe, Zambia and Mozambique

Business Model

Sistema.bio provides biogas technology to smallholder farmers, enabling them to convert organic waste into clean energy (biogas) for cooking and biofertilizer for agricultural use. Sistema.bio is responsible for both manufacturing and distribution of its products and has leveraged various distribution channels across African markets. In Uganda and Malawi, Sistema operates through B2B businesses partnerships with cooperatives. In Kenya, Sistema initially focused on B2C sales but is now shifting to a B2B model, with women as 75% of its primary end-users.

Sistema.bio ensures the affordability of its products for low-middle income communities by providing instalment payment plans and offering flexible financing options over 12 to 24 months. In Kenya, Sistema.bio has partnered with Musoni Kenya, a financial and distributor partner. In instances where farmers cannot afford Sistema.bio's solutions, partner organizations have purchased them on behalf of the farmers.

Sistema.bio provides end-to-end support to biodigester installers, from conducting a needs assessment to customizing biodigesters for specific farms. The company ensures professional installation and provides post-installation training on system usage and maintenance. A dedicated technical team conducts regular follow-ups, using real-time data tracking tools to monitor system performance and provide ongoing assistance.

Products

Tier 4-5: Prefabricated modular biodigester package with biogas appliances and connections. The product comes in 7 different sizes and capacities.

Revenue

USD 2.2 million (2022) in Kenya

Investments

Sistema.bio has secured funding through a combination of equity, debt, and grants.

- **Results-based financing (2019–2020):** Sistema.bio received funding from AECF under the REACT Sub-Saharan Africa program, enabling the installation of 882 biodigesters in Kenya and expanding its footprint in the region.

- **Debt financing (ongoing):** Over the years, Sistema.bio has secured debt facilities from impact-focused lenders such as FMO, Triodos, and BIX Capital to support working capital and scale deployments, although specific amounts remain undisclosed.
- **Series B funding (2022):** In 2022, Sistema.bio raised USD 15.6 million through a mix of equity, debt, and non-dilutive capital to accelerate growth. The equity round was led by KawiSafi Ventures and AXA IM Alts, positioning the company to deepen market penetration.
- **Additional Funding (2024):** Most recently, in 2024, Sistema.bio secured an additional USD 15 million investment led by Electrifi, with continued participation from existing investors Chroma Impact Investment, KawiSafi Ventures, AXA IM Alts, Blink CV, and EcoEnterprises Fund. This funding is intended to further scale biodigester installations across Africa and Latin America.

2X Criteria Alignment

- Representation of women in leadership: **26%**
- Representation of women in managerial positions: **57%**
- Representation of women in employment: **37% full-time equivalent positions, 50% commission-based employees**

Image Courtesy : www.sistema.bio

Social, Environment and Economic Impact[59]

Social	Environment	Economic
▪ **Time saving:** Women using biodigesters gained 47 minutes on average on quality-time per day. On average, women using biodigesters spend 99 minutes less than women not using biodigesters on cooking and fuel related activities. ▪ **Changing gender roles:** Anecdotal evidence suggests that men are increasingly engaging in tasks related to cooking due to the convenience of biogas. ▪ **Health:** Households using biogas experience a 68% reduction in personal exposure to PM2.5, significantly lowering the risk of respiratory illnesses. The improvement in air quality is estimated to avert approximately 578 disability-adjusted life years (aDALYs) per year per 10,000 households—equal to an estimated 21 extra days of healthy life per household each year.	▪ **Biodigesters reduce between 9 and 70 tCO_2e** on average, depending on geography, units' size, and baseline conditions at the farm. ▪ **Decrease in reliance on non-renewable fuels:** Biogas replaces firewood, charcoal, and LPG, while also managing livestock waste to reduce methane emissions.	▪ **Biofertilizer use:** Covers 5,000 hectares of farmland annually, improving soil health and food security. ▪ **Annual cost savings for farmers:** Approximately USD 1,042 in reduced fuel and fertilizer expenses.

Carbon Markets

Voluntary Carbon Markets Projects Overview

Sistema.bio initiated its first carbon project in Kenya in 2018 and has since distributed over 14,000 biodigesters, expanding its operations to Uganda with plans to extend further into Southern and West Africa.

Currently, the company has three projects registered under the Gold Standard—two in Kenya and one in Uganda. The first project in Kenya, registered as 'GS ID 10785 Clean Impact Bond', is in its third monitoring period, with 90% carbon credits issued under it already retired. This project has achieved its first issuance under the Methodology for Averted Mortality and Disability Adjusted Life Years (ADALYs) from Cleaner Household Air which quantifies health benefits resulting from reduced exposure to household air pollution, particularly lowered PM2.5 levels. Data for this will be based on self-reported outcomes collected through end-user surveys and reporting.

Meanwhile, the second project in Kenya, registered in 2023 as 'GS12078 - GS12204 RVPA-1 Sistema.bio Global Carbon Program: Biodigesters in Kenya' is undergoing evaluation. The third project, registered in Uganda in 2022 as 'GS11682 - Uganda Dairy Biogas Program' has entered its first monitoring period, initiating the formal phase of performance tracking and verification.

Compliance Markets Project

Sistema.bio is currently developing a project in Malawi to build biodigesters. The project aims to distribute 10,000 biogas digesters to dairy farmers in Malawi.

It is currently in the final stages of obtaining the LoA from both the Swiss and Malawian governments. The monitoring period has simultaneously begun and Sistema.bio needs to rapidly scale up the installation of gas flow meters, temperature sensors, as well as carry out KPTs and surveys.

Financing Carbon Projects

Sistema.bio leverages a mix of pre-financing mechanisms from investors, development agencies, and carbon markets to support expansion. One example is the Clean Impact Bond (CIB), a results-based financing mechanism launched in 2022 in partnership with IFC, BIX Capital, and Osprey Foundation. The CIB enabled BIX Capital to provide Sistema.bio with USD 300,000 in prefunding which was pivotal in scaling operations in Kenya and catalysing the adoption of biodigesters. The Osprey Foundation serving as the outcome buyer, committing to pay for independently verified health and gender-related co-benefits. Not only did the prefunding enable Sistema.bio to rapidly scale its operations, it also helped create a framework for monetizing health and gender outcomes.

Revenue Monetization and Benefit Sharing for End-Users

- **Upfront subsidy:** Carbon credit revenues are used to subsidize up to 70% of the cost of biodigesters, especially in active markets like Kenya and Uganda. In regions where purchasing power is low, such as Malawi, Sistema.bio provides higher subsidies.
- **Cost towards service, training and installations:** Carbon revenue is also reinvested for improving service delivery, ensuring maintenance, conducting capacity-building programs, and enhancing customer support. Almost 30% of the revenue is used to support operational sustainability.

Carbon Credit Sales

The price of carbon credits generated by Sistema.bio ranges from USD 6.5 to USD 21.7 per credit. In Sistema.bio's experience, carbon credits from Latin America tend to command higher prices as compared to African ones due to market perception and regulations. Some regions report higher CO_2

savings per system which too leads to better credit pricing. Sistema.bio has also been able to obtain higher prices for credits in the compliance market. However, prices have fluctuated over the past year due to regulatory changes and evolving market dynamics.

Carbon Project Measurement

Methodologies

Sistema.bio uses two measurement methodologies: Gold Standard's Technologies and Practices to Displace Decentralized Thermal Energy Consumption v.3.1 and Methodology for Animal Manure Management and Biogas Use for Thermal Energy Generation v.1.1.

Monitoring methods

External auditors independently verify all emission reductions and SDG-related outcomes every five years. This ensures the credibility of carbon credits generated and the accuracy of the project's reported impact.

Digital methods: Sistema.bio collects data across all projects through real-time monitoring using mobile platforms like Taro Works. This further enables the company to leverage Salesforce to track system usage, maintenance, and performance. In addition, data on fuel savings, emission reductions, and gender-related impacts are regularly updated through surveys and continuous monitoring. The enterprise employs robust monitoring and data tracking systems to prevent double counting of emissions reductions and to ensure that the project's carbon credits are issued based on accurate and independently verified data. Each biodigester installation is geo-tagged using GPS coordinates, allowing for the precise attribution of emissions reductions to appropriate locations and beneficiaries.

Traditional methods: Sistema.bio tracks its socio-economic impact by gathering data on fuel savings, improvements in agricultural productivity, and health outcomes, through structured surveys and focus group discussions. This data helps Sistema.bio in improving its product offerings and service delivery, ensuring that they align with the needs of the community. Conducting regular impact assessments enables the company to continuously improve and adapt to market dynamics.

SDG tracking: Sistema.bio also tracks multiple SDG-related (SDGs 2, 3, 4, 5, 7, 8 and 13 in particular) impact indicators such as the time saved on cooking and fuel-related activities and the increase in the time spent on productive tasks and/or rest and leisure as a result of using biodigesters.

Image Courtesy : www.sistema.bio

Strategies Leveraged for the Successful Implementation of Carbon Projects

Rural and regional advantages

Sistema.bio is among the few enterprises that have successfully developed a carbon-credit-based business model while catering to rural markets in Africa. The company's prefabricated biodigester is well-suited to rural settings as it takes just 1 day to install compared to over 30 days for traditional fixed-dome digesters. The cost of production is also lower compared to traditional biodigesters. Often, farmers jointly invest in a digester to reduce their expenses. Sistema.bio's technology is also well-suited for deployment in larger communities, such as refugee camps.

Reduced dependence on intermediaries

Sistema.bio is increasingly developing and registering its own carbon projects to minimize external dependencies. In earlier projects registered through intermediaries, Sistema.bio had to contend with hidden costs that affected overall profitability. The company also had to pay commissions which limited the extent of subsidies that were passed on to end-users. By managing projects in-house Sistema has gained greater control over project implementation and data monitoring.

Revenue diversification

To mitigate risks associated with fluctuating carbon credit prices and regulatory changes, Sistema.bio adopts a diversified revenue strategy. The company combines income from direct sales, carbon credits, and impact investments.

Image Courtesy : www.sistema.bio

Challenges Related to Carbon Markets

High upfront costs of carbon certification

The registration and verification of carbon projects under the Gold Standard require significant financial and administrative resources. The high upfront costs associated with certification— including registration, monitoring, and verification—pose a significant barrier to scaling operations. These challenges are further compounded by the lengthy certification process, with some projects taking up to two years before carbon credits are issued. This extended period places a strain on cash flows and necessitates procuring significant pre-financing or investments before any revenue is realized.

Scaling challenges and limited user base

Many of Sistema.bio's end-users lack the knowledge required to operate biodigesters effectively, requiring extensive training and support. Regional differences further complicate the enterprise's efforts to scale. In Kenya, increased awareness of climate change and biogas programs—driven by government and development organizations—has facilitated user acceptance. In contrast, Sistema.bio's efforts are often met with lingering scepticism in Uganda, largely stemming from negative past experiences with fixed-dome systems. In Malawi, limit purchasing power, compels the enterprise to provide high subsidies to ensure affordability. Ethiopia, with its large dairy farming sector, presents a significant opportunity for biogas adoption, but requires targeted engagement strategies and substantial investment in outreach and education campaigns.

Regulatory challenges in compliance market projects

Differing regulatory requirements across different regions, particularly in Kenya, Uganda, and Malawi, pose significant challenges and often slow down carbon project approvals. In several African countries complex administrative processes and government demands make it difficult to get projects off the ground quickly. Delays in registration and carbon credit issuance not only extend project timelines but also increase compliance burdens. While the company actively engages with governments and regulators to navigate these challenges, complying with multiple regulatory frameworks remains a challenge, hindering its ability to scale operations efficiently.

Methodological challenges

The enterprise's approach primarily focuses on measuring emissions reductions resulting from biodigester use. However, additional agricultural benefits such as increased crop yields due to biofertilizer application, are not comprehensively accounted for in its current impact measurement frameworks. Collecting accurate data for carbon credit verification, particularly the fNRB remains a challenge as it demands a high degree of precision across multiple geographies and regions of operations.

** Insights are based on KIIs conducted with the enterprise team*

Case Study 5: Circle Gas

Enterprise Profile

Year of establishment: 2006

Headquarters: United Kingdom

Regions of operation: Kenya, Tanzania

Business Model

Circle Gas operates a pay-as-you-go LPG distribution model, utilizing its proprietary Smart Meter technology to provide affordable clean cooking solutions. Customers receive an LPG stove, cylinder, and smart meter at no upfront cost, with the option to prepay for gas in small, flexible amounts. Circle Gas' customers are from low-income households and typically use nearly 4 kgs of LPG per month. To increase accessibility, the enterprise has established small depot stations in high-demand neighbourhoods, ensuring efficient last-mile logistics and service delivery. Additionally, home deliveries and scheduled cylinder replacements ensure uninterrupted service for customers. Furthermore, the enterprise conducts regular community training sessions at depot networks to educate customers on efficient cooking techniques and the benefits of using LPG over traditional fuels. Customers pay a 30%-40% premium for an uninterrupted supply of gas through doorstep delivery.

In Kenya, Circle Gas operates through its subsidiary M-Gas. To optimize operations, Circle Gas has entered a strategic partnership with Total for the supply and distribution of cylinders. The company leverages Safaricom's Narrowband Internet of Things network for its smart meter technology; and mobile money platform M-PESA for top-up payments. As of 2024, Circle Gas serves approximately 400,000 households.

Products

Tier 4: LPG cylinder and stoves with integrated smart meters (offering PAYGO option)

Revenue

USD 30 million (2023)

Investments

Equity: Circle Gas has raised USD 170 million in equity from its founding investors. It has further raised equity investment from Safaricom for M-GAS, its subsidiary in Kenya. In 2022, the enterprise raised equity financing from Marubeni Corporation to expand clean cooking services to more households in East Africa.

Debt: Circle Gas has raised debts from an international financier.

2X Criteria Alignment

- Representation of women in leadership positions: 11%
- Representation of women employees: 28%

Image Courtesy : Circle Gas

Social, Environment and Economic Impact[60]

Social	Environment	Economic
▪ **Health:** Circle Gas has enabled improved health outcomes for vulnerable populations, particularly women and children, by reducing household air pollution from firewood and charcoal.	▪ **CO_2 emission reduction:** By replacing inefficient biomass and kerosene stoves, LPG reduces fuel consumption and CO_2 emissions.	▪ **Job creation:** Circle Gas has created over 2,000 jobs through direct employment in the company and indirect employment throughout its supply chain. New jobs are available, particularly for local youth, in field sales, customer service, and logistics.

Carbon Markets

Voluntary Carbon Markets Projects Overview

Circle Gas entered the carbon market in 2020, registering its first carbon project under the Gold Standard, with Climate Impact Partners Limited as the intermediary. A second project with Climate Impact Partner is at the listing stage. The first project has generated 1,014,183 credits issued to date, with 176,905 credits retired. Circle Gas is working to directly register a carbon project in Tanzania.

Financing Carbon Projects

Circle Gas has used its own funds to finance carbon projects. Its carbon credits are sold on the spot market.

Revenue Monetization and Benefit Sharing for End-Users

A significant portion of the income from carbon credits is used to offset the cost of deploying meters and cylinders, and the remainder goes towards supporting operational costs.

Carbon Credit Sales

Carbon credit prices for Circle Gas range from USD 4 to USD 4.50 per ton. These prices are similar to those commanded by credits generated from the use of more efficient charcoal cookstoves, despite the enterprise's use of metered methodology to monitor and demonstrate the impact of LPG usage. While the enterprise's advanced monitoring mechanism has generated positive reviews for the project it hasn't resulted in premium pricing.

Carbon Market Project Measurement

Methodologies

The methodology used for the project is the Technologies and Practices to Displace Decentralized Thermal Energy Consumption version 4.0, which focuses on emissions reductions resulting from the switch to cleaner cooking technologies, particularly LPG stoves equipped with smart meters.

Monitoring methods

Digital methods: Each distributed LPG unit is identified by a unique serial number to prevent double counting across different PoAs,[61] ensuring that each user is counted just once while calculating emissions reductions.

Traditional methods

Survey: The enterprise conducts sample surveys and solicits customer feedback periodically to validate data and assess broader impacts, including improvements in health and time savings.

External Verification: Circle Gas's projects are externally verified by independent auditors to ensure that emissions reductions and SDG-related impacts are accurately measured and validated. This verification follows the Gold Standard's rigorous guidelines enhancing the transparency and credibility of carbon credit reporting. In addition, Circle Gas has partnered with the University of Liverpool to conduct research on the economic, health, and social impacts of adopting clean cooking solutions, particularly through the use of smart meter LPG systems.

SDG tracking

SDG 5 (Gender Equality): 90% of users report a reduction in the time spent on collecting fuel and cooking, allowing women to engage in more productive activities.

SDG 3 (Good Health and Well-being): 100% of users report improved indoor air quality and reduced smoke exposure.

SDG 1 (No Poverty): 85% of users report cost savings on fuel.

SDG 13 (Climate Action): Over 1.9 million tons of CO_2e emissions are expected to be reduced annually.

Strategies Leveraged for the Successful Implementation of Carbon Projects

End-to-End PAYGO model

Circle Gas's usage-based payment and top-up model effectively eliminates upfront costs for customers while generating a steady revenue through small, manageable payments. However, this approach requires strong cash flow management to ensure sustainability, as the company must cover significant upfront investments before recovering them through customer payments. Its partnership with Total has reduced capital expenditure substantially, particularly in relation to the cost of cylinders.

Interventions to ensure regular usage of gas cylinder

Circle Gas has developed a robust mechanism to screen its customers. Sales representatives use mobile applications to collect baseline data on consumers' consumption patterns, which is used to score and assess customers prior to on-boarding. The enterprise primarily targets households that cook regularly, as consistent usage is crucial for demonstrating the additionality and permeance of carbon projects. Through its smart meters, Circle Gas can monitor usage in real-time. Frequent engagement with customers is essential to ensure the consistent use of the LPG system, as cultural preferences and entrenched cooking habits may lead to lower-than-expected adoption rates. To promote adoption and use, Circle Gas also offers its customers several incentives, including discounts on future fuel purchases and reward programs for customers who use the smart meter consistently and maintain regular cooking habits.

Challenges in Implementing Carbon Projects

High Capex

Deploying smart meters and cylinders entails substantial upfront investment, with capital expenditure exceeding USD 120 per customer. This high Capex is essential for scaling operations but delays profitability and places a considerable strain on working capital. Although revenue from carbon credits helps partially offset these costs, securing long-term sustainable financing is critical for ensuring operational stability and supporting future growth.

High project registration and monitoring cost

Circle Gas has had to invest USD 250,000 to register its project. Moreover, the enterprise needs to spend USD 60,000-USD 70,000 on monitoring, annually.

Carbon market volatility

Regulatory uncertainties and fluctuating carbon credit prices make long-term financial planning difficult. The lack of standardization in carbon credit certification processes across local governments under the Paris Agreement adds another layer of complexity. For example, emerging views indicate that certain governments are considering taxing carbon credits at USD 4. This high rate of tax will make carbon credit trading untenable as carbon credits are usually priced at USD 4.50 per credit.

High domestic interest rates

Circle Gas remains heavily reliant on international debt financing, as local interest rates in Africa, particularly in Kenya, can reach up to 20%, rendering domestic debt too expensive and therefore unviable for sustainable operations. Although the enterprise is actively seeking financing from DFIs, it has encountered prolonged timelines in securing such funding due to bureaucratic inefficiencies, which can delay project implementation by 8 to 12 months.

**Insights are based on KIIs conducted with the enterprise team*

Case Study 6: ABPL

Enterprise Profile

Year of establishment: 2020

Headquarters: Kenya

Regions of operation: Kenya

Business Model

The foundations of the Africa Bioenergy Program Limited (ABPL) were laid during the Kenya Biogas Program, a biodigester project that operated from 2015 to 2019 and led to the construction of more than 24,000 biodigesters in Kenya. Over time, ABPL was institutionalized, and began to focus on increasing the adoption of biogas energy solutions. Currently, the enterprise supports small-scale biodigester construction enterprises, known as Biodigester Construction Enterprises (BCEs), by facilitating last-mile linkages and providing after-sales service to end-users.

ABPL has adopted a community-based approach to increase biodigester use by creating and registering Community-Based Organizations (CBOs) that are consolidated to function under Bioenergy Hubs. These CBOs consist of farmers who have adopted biodigesters. ABPL builds the capacity of local CBOs to ensure proper maintenance and optimal use of bioenergy solutions, empowering communities to take ownership, thereby ensuring long-term sustainability. To date, ABPL has created 36 fully registered CBOs, with another 30 Community-Based Producer Cooperatives (CBPCs) in the registration pipeline. The organization focuses on the creation and registration of CBOs, provides community training and extension services related to biodigesters, as well as develops bio-slurry applications and composting solutions, among others. The CBOs also receive entrepreneurial training and sales and marketing support.

Products

Tier 4-5: Biogas digesters ranging from 4 to 12 cubic meters for households with dairy cows and zero-grazing systems.

Revenue

Undisclosed

Investments

ABPL has received funding from Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through the African Biodigester Component (ABC) sponsored by the Netherlands Enterprise Agency. ABPL has also received support from Innovate UK (Smart Biogas pilots) to test remote monitoring kit

solutions on domestic biodigesters. The enterprise has received funding from the European Commission and the Netherlands Enterprise Agency (RVO) under the Horizon 21 & Impact Cluster subsidy program to strengthen market-based solutions for biodigester adoption, enhance supply chain efficiency, and support capacity building for small enterprises involved in clean cooking technology.

2X Criteria Alignment

- Representation of women in senior management: 33%
- Representation of women on the board: 66%

Social, Environment and Economic Impact[62]

Social

- **Timesaving:** Women benefit from time saved on fuel collection, enabling them to pursue education and engage in income-generating activities.

Economic

- **Community institutions:** ABPL has supported the establishment of 36 fully registered CBOs and aims to establish 200 CBOs by 2030 which, in turn, is expected to result in the adoption of 14,000 biodigesters.
- **Job creation and skill development:** ABPL has enabled job creation in the biogas value chain, including in construction, maintenance, and training.
- **Agriculture productivity:** The use of bio-fertilizers has increased agricultural productivity, enhancing food security and income for farming households.
- **Leadership development:** 50% of CBO members are women who have enhanced their leadership skills.

Carbon Markets

Voluntary Carbon Markets Projects Overview

ABPL entered the carbon market in 2018 by registering its first PoA. It primarily serves as an aggregator of carbon credits for biodigester farmers who would otherwise lack access to carbon markets. While APBL acts as the main project developer, implementation is carried out by the BCEs which are equipped with construction, marketing and business development skills.

Currently, ABPL manages carbon revenues from 10,065 of the 24,000 biodigesters installed under the Kenya Biogas Program. The organization also plans to aggregate biodigesters under the ABC-K project, enabling farmers to access the global carbon market. In addition, ABPL has initiated five Voluntary Project Activities (VPAs) in Kenya, Uganda, and Tanzania. To date, ABPL has issued 446,000 carbon credits with ongoing retirements.

Revenue streams include the sale of carbon credits to corporate buyers through partnerships with development agencies such as Fair Climate Fund. The enterprise uses carbon revenue for training, marketing, and providing extension services.

Financing Carbon Projects

ABPL employs a hybrid financing model for its carbon projects. Grant funds are used to register projects and provide subsidies to biodigester installers, while revenue from the sale of carbon credits covers operational costs. The project is not pre-financed. Grant funding has been secured for project registration and management through the Dutch government's Directorate General Internationale Samenwerking (DGIS) via RVO under the Africa Biodigester Component in Kenya and Uganda. ABPL has used 25% of the funds to subsidize the cost of biodigesters for end-users. It has also used a portion of the grant to cover administrative and registration costs, since carbon credit revenue alone is insufficient to cover these costs. The project also offers support to biodigester providers, offering assistance in after-sales services, awareness creation, market activation, and training.

Therefore, ABPL relies on project grants to sustain operations and support CBO activities. The organization has strategically partnered with county governments and development programs to secure complementary funding for providing entrepreneurial training, extension services and increasing biogas technology adoption.

Revenue Monetization and Benefit Sharing for End-Users

Carbon revenue is utilized for market acceleration, BCE support, repair and maintenance, user training, and extension services. The level of support varies annually based on carbon revenue generation.

Market acceleration and support services to BCE: ABPL has worked with over 145 SMEs in Kenya, assisting their transition from informal businesses to registered companies. Under the ABC-K project, 60 businesses have successfully formalized their business. In addition, ABPL uses carbon credit revenue to provide incentives for each biodigester plant constructed, thereby further encouraging adoption and ensuring long-term sustainability.

Direct support services to CBOs: With proper maintenance and upkeep, biodigesters typically have a lifespan of 25 to 30 years. ABPL leverages carbon revenues to provide quality maintenance services which ensures the sustained use of biodigesters. It also supports CBOs by using carbon revenues for long-term biodigester maintenance. ABPL mobilizes CBOs, undertaking awareness campaigns, and educating and training end-users on biodigester use. Instead of direct cash payouts, ABPL provides subsidized services to ensure continued technology adoption.

Direct cash payouts: ABPL is currently working with Fair Climate Fund to help CBOs get certified under Fair Trade Carbon Certification, ensuring ethical, transparent, and equitable benefit-sharing. Under this initiative, registered CBOs with at least 200 members will receive a Fair Trade certification. Carbon credits generated through these CBOs will be sold at a premium, and at least 50% of the resulting income will be redistributed among community-led projects.

Pricing

Carbon credits generated by ABPL are priced from USD 9.7 to USD 15.2 per ton—with factors such as project scale, vintage, co-benefits, and quality influencing the exact price. Obtaining fair trade certifications and demonstrating additional co-benefits, such as gender empowerment and improved health outcomes, will enable ABPL's carbon credits to command premium prices.

Image Courtesy : africabioenergyprograms.org

Carbon Markets Project Measurement

Methodology

ABPL has adopted the Gold Standard methodology: Methodology for Animal Manure Management and Biogas Use for Thermal Energy Generation V1.1.

Monitoring methods

Digital methods: In 2024, ABPL participated in a pilot program focused on small- and medium-sized biodigesters, to test the use of smart biogas meters for data collection and carbon credit sales through the CaVEx digital carbon trading platform. The initiative is ongoing, with the initial testing of the smart meter kit having started in 2021 as part of Innovate UK's project, which is now being led by Inclusive Energy (now Sistema.bio). The CaVEx system was implemented at a medium scale (50m^3), with 18 of the 20 earmarked kits successfully installed. Currently, the project aims to encourage households to test dummy carbon credits based on monitored data, which includes biogas use, gas flow, and consumption patterns such as leakage or venting.

Traditional methods: ABPL undertakes monitoring and verification to ensure compliance with certification standards. It gathers data through an SDG monitoring survey, bookkeeping documents, project databases, baseline performance field tests and kitchen performance test studies. ABPL also undertakes biannual monitoring, costing approximately USD 60,000 to USD 70,000 to track emission reductions, technology usage, and social impact indicators.

SDG tracking: ABPL measures several SDG indicators. It tracks SDG 1 through the reported decrease in expenditure (local currency equivalent of USD/ household) on basic services such as cooking and lightings tracked annually through a survey. It assesses progress on SDG 2 through the number of farmers adopting practices promoted by the project and SDG 3 through an annual survey of households that observed a reduction in PM2.5 and carbon monoxide concentration. It also measures progress against SDG 4 through number of employees who are provided with skill development training, SDG 5 through average time saving associated with cooking time and fuel collection, SDG 7 through the number of households with access to clean energy, SDG 8 through the number of jobs created, SDG 9 through the number of biodigester construction enterprises participating in the value chain, and SDG 15 through ton of NRB saved.

Strategies Leveraged for the Successful Implementation of Carbon Projects

Initiatives to ensure complaint resolution and education of end-users

ABPL employs a grievance mechanism grounded in a people-centered approach, ensuring that field staff engage directly with users to address concerns and build trust in biogas solutions. Reputation management has been a key area of focus, particularly in countering the legacy of poor-quality technology providers and misinformation. At the same time, ABPL leverages digital tools like Salesforce and Taraworks, to enhance grievance tracking and field reporting, thereby improving the efficiency and responsiveness of the resolution process.

Ensure sustainability through a community-led initiative

To strengthen the support systems available to biogas users, ABPL has established CBOs which serve as hubs for after-sales service, technical training, and peer-to-peer support. The CBO model was introduced to improve the efficiency of after-sales support, technical assistance, and training. During its initial phase of operations, ABPL faced challenges in reaching households due to the lack of or changes in contact information, and other logistical barriers, which made providing individualized extension support inefficient. By consolidating users regionally into CBOs, the project ensures easier access to maintenance services, improved peer-to-peer support among members, and better resource allocation from carbon credits. The model has compounded benefits, extending beyond biogas with users collectively engaging in income-generating activities such as mushroom farming and feed formulation for livestock. Moreover, this localized service delivery model enhances user satisfaction and builds long-term trust, enabling the company to increase consumer retention and acquire new consumers through referrals. Beyond clean cooking, CBOs also facilitate access to additional resources by linking members to county-level support programs, external grants, and market opportunities.

Capacity building of small-scale enterprises

The biodigester sector is dominated by several small and informal enterprises and suppliers who lack access to marketing, technological and business support. As part of its market acceleration efforts, ABPL has implemented strategic measures to expand biogas adoption and strengthen the supply side of the market. Recognizing that many biogas technology providers operated as informal enterprises, ABPL has facilitated their transition into registered companies, thereby improving their access to funding and market opportunities.

Challenges in Implementing Carbon Projects

Cost associated with registering projects and monitoring

The cost of a feasibility study ranges from USD 5,000 to USD 10,000; project design expenses range from USD 30,000 to USD 50,000, and ongoing monitoring typically costs USD 60,000 to USD 70,000 per cycle. Verification audits add another USD 20,000 to USD 30,000 to project costs per cycle. While the initial cost of ABPL's carbon project was covered through grant funds, it is challenging for the organization to introduce new VPAs and undertake monitoring, given limited financing.

Smaller enterprises' lack of interest in participating in ABPL's carbon project due to no pre-financing

ABPL does not rely on pre-financing but instead operates through a pay-as-you-go model. Thus, its carbon revenue is exclusively dependent on carbon credit sales—this affects ABPL's ability to continue providing its current gamut of services. Initially, the project sought to aggregate small companies and manufacturers into a carbon project. However, this did not succeed due to the lack of pre-financing. Small companies operate on tight cash flows and are unable to wait long periods for carbon revenue payouts.

Misconceptions about project revenue and operations

ABPL has faced challenges stemming from miscommunication and misconceptions among local stakeholders—particularly small-scall biodigester businesses, potential partners and community members—regarding the nature of carbon credit revenues. Many perceive carbon credits as generating substantial profits without considering the associated investment costs. There is limited awareness of price volatility, and the factors that influence carbon credit value such as buyer negotiations and credit vintage (with older credits typically fetching lower prices). A common misconception is that carbon credits are highly liquid—in reality sales often take months, sometimes years, leading to gaps in cash flow. These misconceptions have led small-scale biodigester businesses to overestimate the revenue potential of carbon credits, while underestimating the high costs of monitoring, validation, and verification (e.g., through kitchen and fuel performance tests). As a result, ABPL has struggled to manage stakeholder expectations, establish long-term partnerships, and securing reliable participation from local businesses that may be unprepared for the delayed and uncertain nature of carbon financing.

Farmer participation in linking biodigesters under the carbon program

Under the carbon program, ABPL has been able to link 14,000 of the ~24,000 biodigesters that were supported through it. ABPL's model resembles an insurance system, where carbon revenues are pooled to provide support such as repairs in case of equipment failures. However, some farmers misinterpret this approach, expecting direct financial payouts, which is not sustainable for the organization. As a result, ABPL has faced challenges in receiving consent from all end-users. Farmers who

have benefited from repairs tend to appreciate the value of the initiative, while those who have not needed support may feel excluded. The voluntary nature of participation and a shrinking pool of eligible biodigesters due to opt-outs further limits ABPL's ability to generate consistent financial returns from its carbon project.

Methodological challenges associated with current standards

Current carbon credit methodologies apply only to domestic biodigesters with a capacity up to 14m^3, excluding larger biodigesters used in commercial and institutional settings. This affects the project's scalability and financial viability. ABPL also faces challenges in calculating VERs due to changes in the baseline scenario used for emission reductions. The baseline scenario is critical for user identification and VER computation. Recent changes in Kenya's energy landscape such as increased LPG adoption —now recognized as a renewable fuel—have reduce the emission reductions attributed to biodigesters. Consequently, the volume of verified reductions is lower than expected, negatively impacting carbon revenue.

Logistical and operational challenges

ABPL operates in 42 of Kenya's 47 counties, a vast geographical footprint that presents several logistical challenges, particularly in last-mile delivery. Expanding biogas adoption is further hindered by the limited awareness in rural communities and the high costs associated with reaching last-mile users. Many of ABPL's consumers are located in remote areas, making project coordination costly and time-consuming. With only 19 county coordinators, the organization faces a resource gap that affects outreach, user mobilization, and training efforts. These constraints also slow down the process of CBO registration and sustained user engagement.

**Insights are based on KIIs conducted with the enterprise team*

Image Courtesy : africabioenergyprograms.org

4.3 Case Studies: Emerging Enterprises in Carbon Markets

This category includes enterprises that are at the exploratory stage of carbon finance. Identified enterprises have a business model that is well-suited for accessing carbon finance.

Such enterprises have either listed their first project or are consulting experts to understand the process, cost, and benefits of participating in carbon markets.

Case Study 7: Bidhaa Sasa

Enterprise Profile

Year of establishment: 2015

Headquarters: Kenya

Regions of operation: Kenya, Uganda

Business Model

Bidhaa Sasa distributes electric pressure cookers to rural communities in Kenya and Uganda. The enterprise procures products from local and international manufacturers and makes them accessible and affordable for its rural customers through a series of value-added services: consumer financing, doorstep delivery, user education on product usage, and after-sales service. Customers can purchase products on credit and repay the enterprise through flexible monthly instalments via mobile money. Bidhaa Sasa provides doorstep delivery of products as well as installation and repairs coupled with a warranty.

Products

Tier 4: Electric pressure cookers

Revenue

USD 1,300,000 (2024)

Investments

Bidhaa Sasa has leveraged a combination of grants, subsidies, and debt financing to support its operations and expansion. The company has successfully accessed results-based financing from organizations such as SNV, GIZ, and CLASP and received grants from entities like Mennonite Economic Development Associates (MEDA), MECS, the Clean Cooking Alliance, AECF, Siemens Stiftung,

GDC, GIZ, and FSD Uganda. Additionally, it has secured debt financing from impact investors, such as Spark+ and SIMA EARF.

Bidhaa Sasa has not raised external funding for carbon projects so far; all carbon projects have been funded by the company.

2X Criteria Alignment

- Representation of women in senior management: 50%
- Representation of women on the board: 50%
- Representation of women employees: 60%

Social, Environment and Economic Impact[63]

Social
▪ 80% of customers served are female. ▪ 11,000 families report reduced indoor air pollution. ▪ 1600 leaders have been created through the network marketing business model.
Environment
Each EPC can reduce 2 to 3 tCO2 emissions per year. With over 11,000 EPCs sold the total estimated emissions reduction amounts to approximately 22,000 to 33,000 tCO_2 annually.
Economic
Savings of up to USD200 per year per family from the replacement of charcoal for cooking.

Carbon MarketJourney

Bidhaa Sasa entered the carbon market in 2024, with a carbon project registered in Kenya under the Gold Standard. The company is also planning to register a new carbon project in Uganda. Both projects focus on increasing the distribution and installation of electric pressure cookers and induction cookers. The initial selection of the Gold Standard registry was driven by its robust methodologies; however, this does not preclude the projects from participating in compliance carbon markets.

Bidhaa Sasa strategically restructured its product portfolio to align with carbon finance eligibility by focusing on e-cooking appliances such as electric pressure cookers, which deliver higher climate benefits. Bidhaa Sasa views carbon markets a natural extension of its business model as lenders and investors increasingly evaluate businesses based on their ability to generate carbon revenues. While carbon finance is subject to some price volatility, it is considered a comparatively stable source of income—particularly during economic disruptions such as currency devaluations—making it an important avenue for revenue diversification.

Image Courtesy : bidhaa.co.ke

Challenges in Leveraging Carbon Finance

High registration or intermediary costs

Bidhaa Sasa faces a significant challenge in mobilizing funds to develop the technical skills and infrastructure required to register carbon projects independently or through intermediaries. The complex and expensive carbon credit registration process, which involves payments to registries, validators, verifiers, and rating agencies, is a significant financial barrier.

Limited access to external funding for carbon projects

Bidhaa Sasa faces challenges in securing external funding for its carbon initiatives. As a relatively small player in the market, it struggles with high upfront costs, complex documentation, and limited access to concessional finance. Local banks often impose strict collateral requirements and fail to address gender-specific barriers, making it difficult for the enterprise to secure viable financing. Additionally, the long gestation period of carbon projects deters investment, restricting Bidhaa Sasa's ability to scale its carbon credit initiatives.

** Insights are based on KIIs conducted with the enterprise team and Care Economy Knowledge Hub, Bidhaa Sasa*

Case Study 8: Xpress Gas

Enterprise Profile

Year of establishment: 2010

Headquarters: Ghana

Regions of operation: Ghana

Business Model

Xpress Gas facilitates access to LPG in the urban and rural areas of Ghana. It also provides regulators and hoses for safe and effective LPG use. It operates an extensive distribution network comprising 52 LPG refilling stations, 62,350 branded cylinder outlets, and 14-cylinder delivery vehicles. The company targets both businesses and households through its refilling stations and franchises, respectively. These franchises are strategically located in densely populated and underserved communities to improve accessibility. Xpress Gas has two customer segments: refilling stations that are B2B partners, and commercial and household customers who form the B2C segment. The latter are served through a branded cylinder circulation model (BCRM) under which customers can own cylinders to swap or, through payment of a deposit, have access to the company's cylinders. Xpress Gas' deposit model eliminates the need for customers to pay the full upfront cost of LPG cylinders (approximately USD 35). The company also cross-subsidizes various customer segments (e.g., residential users, street food vendors, and industrial kitchens) to make its services affordable. The enterprise conducts regular inspections and maintenance of branded cylinders to ensure their safety and longevity.

Products

Tier 4: LPG cookstoves and cylinders in three sizes—6 kg, 14.5 kg, and 50 kg.

Revenue

Undisclosed

Investments

Successfully raised USD 6 million (USD 3 million each) in equity and debt in 2021 from: i) Investisseurs & Partenaires (I&P) (Impact investing group) and ii) Belgian Investment Company for Developing Countries (BIO). The funding aims to increase LPG penetration and expand access across Ghana. These funds have enabled the company to scale its operations.

2X Criteria Alignment

- Representation of women on the board: **33.33%**
- Representation of women employees: **13%**

Social, Environment and Economic Impact[64]

Social	Environment	Economic
▪ Transitioning women-led food businesses to LPG reduces health risks and enhances productivity. An estimated 99% of small food vendors are women. ▪ Xpress Gas' products and services save 1 to 3 hours per day by eliminating the need for customers to commute to and from the nearest LPG refilling station. In rural areas since distances are larger, the time saved on commuting is more.	▪ Xpress Gas' products have a direct positive impact on the surrounding air quality, contributing to reducing CO2 emissions, preventing deforestation, and reducing black carbon emissions.	▪ The enterprise is exploring the possibility of including an insurance component in its business model to protect women-led ventures from financial losses occurring due to accidents or health issues caused by unsafe cooking practices.

Carbon Market Journey

Currently, Xpress Gas does not have any listed carbon projects. It has initiated discussions with intermediaries, such as CO2 Balance and is keen to explore opportunities in the carbon market, which can act a potential catalyst for business growth and impact. Its interest stems from the possibility of generating additional revenue through carbon trading to offset distribution and subsidy costs while continuing to promote a shift from firewood and charcoal to cleaner energy sources like LPG.

Challenges in Implementing Carbon Projects

Impact measurement gaps

XpressGas has a large operational footprint; however, it does not have the technical infrastructure for direct emissions monitoring. The enterprise has attracted investors by showcasing tangible business outcomes, such as its growing customer database, large number of service centers, and the extensive reach of its cylinder distribution model, rather than formal impact data. XpressGas does not currently track individual customer-level consumption data, which limits its ability to accurately quantify CO_2 reductions per cylinder size (e.g., how much a 6 kg or 15 kg cylinder reduces emissions compared to charcoal and firewood). While operational indicators provide a sense of scale and market penetration, the enterprise lacks a structured impact measurement framework and baseline data required for carbon credit project registration.

High cost of registration for carbon projects

Xpress Gas lacks the in-house expertise needed for carbon project registration and must rely on intermediaries for technical support. However, the high costs associated with these services, along with registration and monitoring expenses, pose a significant financial burden. This limits the enterprise's ability to scale its carbon credit initiatives and leverage carbon markets as a sustainable source of revenue.

Limited access to financing

Local banks require stringent collateral, limiting the company's ability to use debt financing for the expansion of its clean energy initiatives. Both local and international investors perceive the sector as high-risk —a view that drives up the cost of capital— further complicating the enterprise's effort to raise funding. Moreover, investor's limited understanding of the LPG sector makes it challenging for Xpress Gas to effectively demonstrate its potential creating hurdles in securing broader financing and scaling clean energy solutions.

Limited resources to scale operations

Serving underserved and remote populations requires substantial investments in distribution infrastructure, which is often resource intensive.

** Insights based on KIIs conducted with the enterprise team and Xpress Gas Website*

Image Courtesy : xpressgas.com

Case Study 9: Nyalore Impact

Enterprise Profile

Year of establishment: 2016

Headquarters: Kenya

Regions of operation: Kenya

Business Model

Nyalore is a last-mile distribution enterprise that provides cooking products, such as biomass cookstoves, briquettes and electric pressure cookers to remote, off-grid communities. Nyalore employs a community-based distribution model that leverages local sales agents and technical teams. Nyalore sources clean cooking products from manufacturers and collaborates with Equity Bank and other micro-credit institutions to offer loans for product purchases. The enterprise offers a PAYGO model with flexible payment options over three, six, and nine months, enabled by a metering solution developed by a partner service provider. This metering component, currently subsidized through grants, facilitates the remote monitoring of product usage and supports PAYGO functionality. Nyalore also conducts cooking demonstrations and awareness campaigns using energy meters to highlight the cost savings and benefits of clean cooking technologies.

To track adoption and usage, Nyalore records the number of cookstoves and EPCs sold. It collects household data, including family size and energy usage patterns, to assess user impact. Customer feedback is used to gauge benefits in terms of energy savings, convenience, and efficiency. The enterprise also use kitchen audits conducted during EPC sales to help estimate the economic benefits for households.

Products

Tier 2 & 3: Biomass briquettes and pellets

Tier 4: Electric Pressure Cookers

Revenue

USD 57,580 (2023)

Investments

The enterprise has received funding from the MECS program to develop innovative solutions for clean cooking and develop supply chains.

2X Criteria Alignment

- Representation of women in senior leadership: 100%
- Representation of women on the board: 50%

Social, Environment and Economic Impact[65]

Social	Environment	Economic
▪ Improved household air quality. ▪ Nyalore's products and services save 1.2 to 3 hours per day. ▪ The enterprise has sensitized 500,000 people through consumer education initiatives and is training women as community champions.	▪ The enterprise has partnered with relevant institutions to establish tree nurseries and conduct tree planting campaigns to increase forest cover. ▪ The enterprise aims to establish youth clubs in educational institutions to promote environmental awareness and responsibility. ▪ The enterprise has contributed to Kenya's Vision 2030 program by promoting reforestation and supporting climate action initiatives.	▪ The enterprise has resulted in creating jobs for 700 women.

Carbon Market Journey

Nyalore currently does not have a carbon market project. However, it has undertaken steps to assess the feasibility of a potential carbon project:

- **Feasibility for aggregation:** Nyalore has initiated conversations with other small enterprises, to encourage the pooling of their sales. Aggregating sales will allow partnering enterprises to collectively meet the volume thresholds required for issuing carbon credits, thereby unlocking sustainable financing opportunities for such enterprises.

- **Product portfolio expansion:** The enterprise has shifted its focus to promoting electric pressure cookers in collaboration with MECS.

- **Digital technology for measurement:** The enterprise has integrated a metering component into its EPCs, enabling remote monitoring of product usage. However, an internal analysis revealed that scaling up metering will require substantial investment, i.e., approximately USD 7,729 to equip 2,000 EPCs, with an additional USD 7,729 needed to complete the next phase of the project.[66] Progress is currently stalled at the community engagement phase due to the lack of funding. However, customers are not being charged for metering services, as these costs are presently covered by grants received from MECS.

Challenges in Implementing Carbon Projects

Limited access to information on carbon projects

Many stakeholders, including potential partners and end-users, lack adequate knowledge about the carbon credit ecosystem. This information gap hampers their participation and limits the enterprise's ability to effectively tap into carbon finance opportunities.

High cost of carbon project registration

The upfront costs for registering a carbon project range from USD 70,000 to USD 160,000 and are often prohibitive for small enterprises.[67] This financial barrier significantly hampers their ability to scale. Additionally, navigating the carbon credit market typically requires engaging intermediaries who can charge high brokerage fees, further reducing potential profits and discouraging participation. Progress on carbon credit projects is also constrained by the substantial resources required for effective community engagement, which is essential for advancing to critical verification stages.

Limited availability of impact data

While customer testimonials offer evidence of impact, there is a lack of formal health and environmental studies which quantify the enterprise's broader impacts, such as reductions in indoor air pollution and carbon emissions. Current assessments of health benefits are primarily based on customer feedback, with limited involvement from health professionals or institutions. The enterprise has also not directly measured its environmental impact, such as the number of trees saved and instead relies on secondary reports and general estimates.

Challenges in scaling carbon projects to reach market viability

Nyalore aims to enter the carbon market but faces significant barriers due to the limited scale of its clean cooking projects. Since carbon credit generation is directly tied to the volume of emissions reduced, Nyalore's current operations do not generate sufficient credits yet to meet the thresholds required for financially viability. Moreover, the regions where Nyalore operates have low awareness and limited engagement with carbon finance, making it difficult to incorporate carbon revenue into its business model. The enterprise also faces challenges in the carbon

credit verification process, which can take up to two years, delaying credit issuance and the realization of potential revenue.

Limited access to funding

Nyalore has faced challenges in securing funding, as most opportunities are geared towards more established businesses. The enterprise has struggled to identify suitable investors and funding mechanisms, limiting its ability to access the capital needed for growth. Efforts to obtain bank financing have also been unsuccessful due to stringent requirements such as audited financial statements, proof of scalability, and a consistent track record. As a women-led business, Nylore has faced additional barriers rooted in systemic gender biases, with banks often favoring male-led enterprises.

**Insights are based on KIIs conducted with the enterprise team and CCA Sector Directory*

4.4 Key Trends in Enterprise Participation in Carbon Markets for Clean Cooking

Improved cookstoves continue to dominate carbon projects, but other cleaner technologies are increasingly gaining traction.

Among the enterprises analysed in this study, improved cooking products (such as Tier 2 and Tier 3 improved biomass stoves) remain the predominant technology used in carbon projects. These products are widely used due to their affordability compared to Tier 4 and Tier 5 technologies, and because they allow continued use of baseline fuels, lowering barriers to adoption.[68] However, there is a growing shift toward cleaner cooking technologies, especially in urban regions, where advancements in electrification and distribution infrastructure have made electric induction stoves and LPG more accessible. In rural regions, biodigesters are gaining popularity as off-grid solutions, offering the added benefit of bio-slurry production for agricultural use. Enterprises such as Bidhaa Sasa, BURN Manufacturing, and Nyalore Impact—traditionally focused on Tier 2 and Tier 3 products—are expanding into Tier 4 and Tier 5 technologies, which deliver greater climate benefits. Additionally, cooking appliances equipped with smart meters and monitoring mechanisms are gaining traction for their ability to ensure carbon credit integrity and command higher prices for their carbon credits.

Intermediaries play a critical role in carbon project registration and management; however, established clean cooking enterprises are increasingly shifting toward self-owned and self-managed carbon projects.

These enterprises are adopting **partnership with intermediaries** to develop, certify, and register their own carbon projects. Historically, intermediaries have played a significant role in project development, registration, and carbon credit trade on behalf of clean cooking enterprises. In Africa, intermediaries remain key players in the carbon market, leading the project development and project aggregation phases of carbon project life cycles. Intermediaries, such as Impact Carbon, Co2 Balance, and myclimate Foundation, support enterprises in developing projects and facilitate carbon credit transactions. By acting as project aggregators, intermediaries assist enterprises in navigating certification processes under standards like Gold Standard and Verra. Intermediaries provide technical expertise, guide enterprises through registration and certification, and connect them to buyers seeking specific types of credits. Some intermediaries also help lower financial risks by handling certification tasks in exchange for a commission or a share of future carbon revenues. Most intermediaries are based in the USA or United Kingdom. Despite their technical expertise and ability to provide market access, costs associated with their services have driven enterprises to develop in-house carbon market capabilities and independently register projects.

Table 6: Top 10 intermediaries in Sub-Saharan Africa

Intermediaries		Total credits issued[69]
impactcarbon	Impact Carbon	1,10,39,605
myclimate shape our future	myclimate Foundation	54,26,970
tasc	TASC SA (Pty) Limited	37,50,418
LIVELIHOODS FUNDS	Livelihoods Fund SICAV SIF	26,18,793
DelAgua	DelAgua Health Rwanda (Voluntary) Limited	24,10,595
co2balance	CO2balance UK Limited	19,86,995
atmosfair	Atmosfair	17,78,038
THE PARADIGM PROJECT	The Paradigm Project	15,77,010
CLIMATE IMPACT PARTNERS	Climate Impact Partners Limited	10,14,183
aera	Aera Group	9,78,690

- **Formation of subsidiaries, joint-ventures and in-house carbon teams:** High-growth enterprises are increasingly taking a proactive role in designing, implementing, and managing their clean cooking carbon initiatives. Enterprises with well-established carbon market projects, such as BURN and UpEnergy, have created independent business units, established subsidiaries or entered joint ventures with investors and buyers to lead their carbon initiatives. Other enterprises have built dedicated in-house carbon teams to monitor and register projects. Enterprises that take control of their carbon projects can tailor methodologies to fit their unique operational models and leverage real-time data to enhance reporting and compliance. Additionally, these companies have diversified their strategies for engaging buyers, including developing direct sales channels, to optimize revenue streams. For product manufacturers and assemblers, end-to-end carbon project management also supports product innovation. For instance, companies like BURN Manufacturing, are exploring innovative ways to embed digital monitoring technology directly into their products to track stove usage and improve overall process efficiency.

- **Partnerships with product manufacturers:** Last-mile distributors of clean cooking products are increasingly partnering with manufacturers to register carbon projects. Distributors, such as Bidhaa Sasa, have formed partnerships with manufacturers, particularly those that lack the resources or strategic focus to navigate the complexities of carbon markets. For many large manufacturers (particularly those based in China with multi-country operations), revenue from carbon credits is relatively insignificant compared to their core business earnings. As a result, these manufacturers are willing to enter partnerships with distributors to unlock carbon market opportunities.

- **Partnerships with development-focused organizations:** These organizations are playing a crucial role in supporting small and medium-sized enterprises by offering both carbon project expertise and broader market acceleration support. Development organization such as SNV, Practical Action, and Fair Climate Fund, are combining carbon project development with market development support to strengthen early-stage enterprises. For instance, the African Biodigester Component in Kenya offers financial and technical assistance to ABPL, helping organize carbon projects while addressing key factors such as demand generation, supply chain optimization, financing, and policy frameworks to enhance biodigester adoption.

Voluntary carbon markets have experienced significant price volatility, with projects that demonstrate higher carbon integrity able to command better pricing.

According to the African Carbon Market Initiative, in 2023, cookstove credits traded at lower than USD 10/ton on average.[70] In 2024, the average price per ton was USD 4.9.[71] While VCMs have experienced significant price fluctuations, certain projects have been able to command higher prices than others. In 2024, Kenya-based EcoSafi issued Africa's first carbon credits under Gold Standard's Metered and Measured Energy Cooking Devices (MECD) methodology. EcoSafi sold its first issuance of cookstove credits at USD 35 each, a significant price premium for high quality credits.[72] Valuation of carbon credits is influenced by multiple factors, including certification quality, verification frameworks, technology type, co-benefits, and the financial stability of project developers. Certain clean cooking technologies such as advanced electric cookstoves and biogas digesters are more attractive due to their proven effectiveness in reducing CO2 emissions. Monitoring and verification methodologies and certification frameworks also play a crucial role in pricing dynamics. Recent carbon credits, particularly those issued under advanced methodologies and strict verification standards, command higher prices. The Gold Standard remains

the preferred certification body for clean cooking projects, with over 70% of clean cooking carbon projects in Africa registered under it. Clean cooking companies with multiple carbon projects such as Sistema. bio and BURN have noted that their projects registered under the Gold Standard attract premium pricing. Buyers in voluntary carbon market are increasingly prioritising projects that deliver measurable benefits beyond carbon reduction, commonly referred to as non-carbon impacts or co-benefits. These projects are evaluated based on their contributions to SDGs or their delivery of additional co-benefits such as improved health outcomes, increased gender equality, and reduction in poverty. According to a dataset compiled by BeZero which analysed projects from four major accreditation bodies—American Carbon Registry, Climate Action Reserve, Gold Standard, and Verra—carbon credits with SDG claims achieved an average price per credit that was 31% higher than those without such claims.[73] Furthermore, in Sub-Saharan Africa, where household device projects account for 85% of credits issues, SDG-tagged credits were priced 1.1 times higher than non-tagged credits, further reinforcing the commercial value of projects aligned with broader sustainability objectives.[74]

Carbon projects require scientific rigor and transparency to establish carbon integrity.

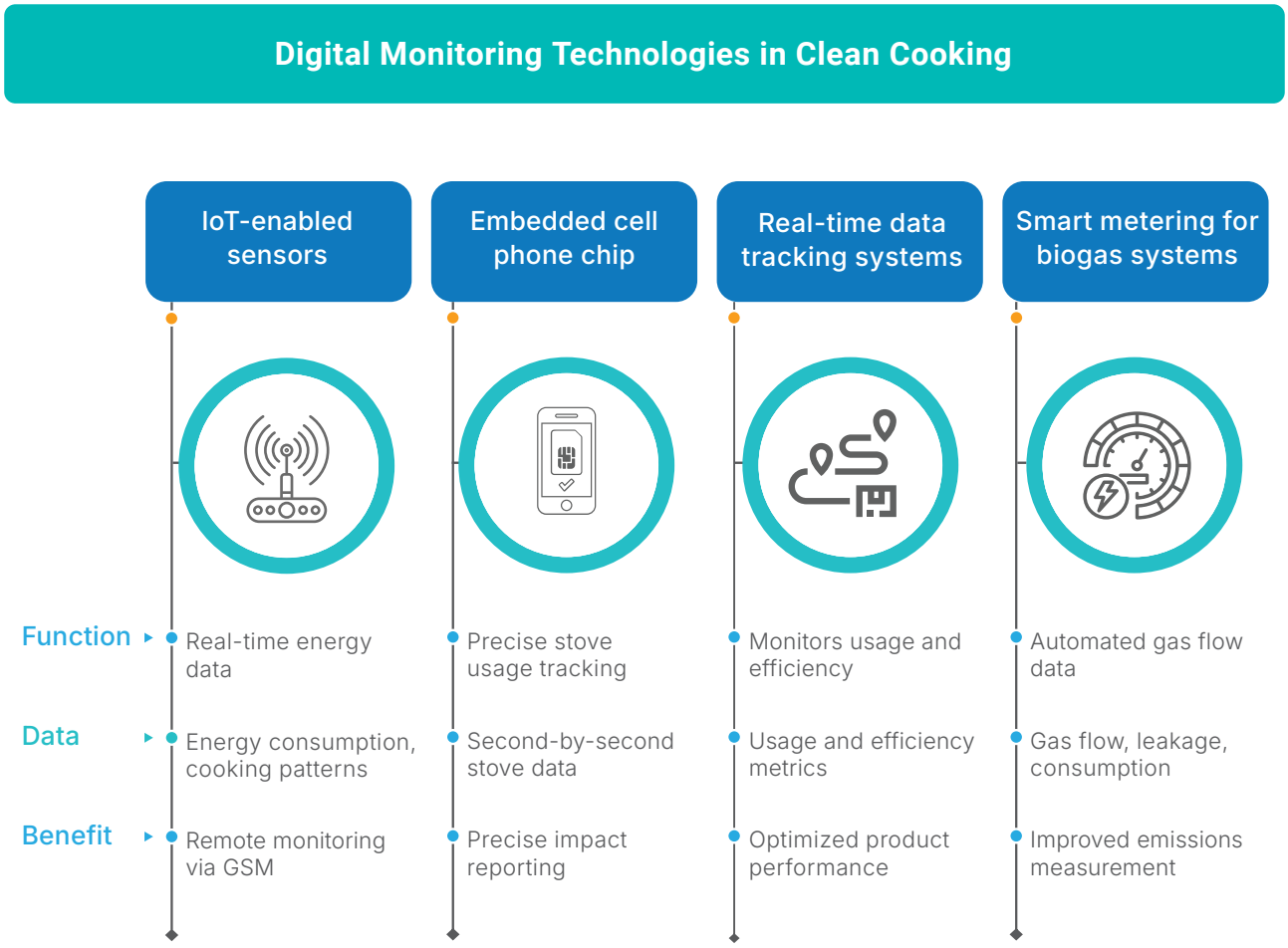
Data collection, monitoring and verification are core to carbon projects. Recent external studies conducted by independent organizations have revealed that carbon credits issued based on estimated emissions reductions from improved cookstoves are often overestimated. Stove adoption, usage and the impact of fuel collection on forest biomass, are often overestimated and the continued use of the original stove is often underestimated. To address these challenges, project developers have traditionally relied on two approaches. The first involves the use of a default fraction of non-renewable biomass (fNRB) value of 30%. The second relies on calculating project-specific fNRB values using the UNFCCC's TOOL30 methodology. However, both approaches have been critiqued for either overestimating or underestimating fNRB values, leading to discrepancies in emissions reduction calculations. In response, clean cooking enterprises and standard bodies are actively using evolving methodologies to improve accuracy. Standard-setting bodies continuously update carbon crediting methodologies to improve the measurement of fuel savings and emission reductions. One such advancement is the Comprehensive Lowered Emissions Assessment and Reporting (CLEAR) methodology, developed by a consortium led by the Clean Cooking Alliance, which aims to improve the accuracy and reliability of emission reduction estimates. Despite the increasing adoption of these improved methodologies, enterprises continue to face significant challenges due to gaps between methodological requirements and on-the-ground realities. The strict requirements for ensuring accurate baseline fuel reduction calculations prevent households from receiving multiple or larger scale cooking solutions, leaving some consumer needs unmet. Additionally, existing methodologies do not adequately address larger biodigesters or integrate co-benefits such as increased crop yields from biofertilizer use. Investors now favour conservative methodologies with lower crediting rates, requiring enterprises to adapt to new fNRB considerations. For enterprises operating across multiple geographies, determining precise fNRB values presents a further challenge, given the variations in regional deforestation rates and fuel consumption patterns. Moreover, changes to baseline scenario calculations directly impact emission reduction estimates, affecting project viability and financial returns. The process of methodological assessment is resource-intensive and requires comprehensive testing, which can be extremely expensive. Emerging enterprises in the carbon market face additional barriers due to the lack of robust data needed to quantify CO_2 reductions per product. Without adequate resources to undertake feasibility studies, these enterprises struggle to generate verifiable emissions reductions, thereby limiting their access to carbon finance.

Digital monitoring, reporting, and verification mechanisms play a crucial role in ensuring and demonstrating carbon integrity.

Emissions reduction data is often collected through both traditional and digital channels depending on whether the fuel is metered or not. Many enterprises depend on traditional channels, such as surveys, to collect data. Data gathered through traditional channels is often limited by the sample size of the survey, associated costs, the presence of a confirmation bias, the choice of questions asked, among others. To address these limitations, leading project developers have adopted digital monitoring, reporting, and verification systems, integrating technologies like IoT sensors into cooking appliances to make data collection more accurate and efficient. Recent industry trends indicate increased investments in dMRV solutions, with companies like Circle Gas and Sistema.bio acquiring firms that specialize in digital monitoring technologies.

Clean cooking enterprises employ various digital monitoring technologies to track energy consumption, enhance efficiency, and improve carbon credit verification for their projects. Key innovations include:

Figure 11: Digital Technologies Used in Clean Cooking



A key advantage of using dMRV systems is that they help enterprises demonstrate transparent and clear data on stove usage. It can also make the process of data collection, verification and validation easier. Digital tools used by dMRV systems can also facilitate the assessment of co-benefits generated by clean cooking projects. Such systems also make it easier to collect data from end-users who reside in remote, inaccessible regions where frequent in -person data collection is difficult.

While digital MRV technologies significantly enhance data accuracy and increase operational efficiency, there exist concerns regarding potential conflicts of interest between project developers and third-party verifiers. Ensuring transparency and independent oversight in data validation is critical for maintaining the credibility of carbon markets.

Forward Purchase Agreements (FPAs) are the most common financing mechanism used by clean cooking enterprises to unlock carbon revenues and support business expansion.

Forward Purchase Agreements are a widely used financing mechanism that clean cooking enterprises use to monetize carbon credits and support business expansion. These agreements are especially valuable in bridging upfront capital needs for carbon project development and monetization, offering predictability in both revenue streams and buyer commitments. Enterprises increasingly depend on carbon financing not only to fund initial project development but also to scale operations and strengthen long-term financial viability. The cost of carbon project development typically ranges between USD 50,000 and USD 200,000, depending on the project's scale and complexity. These costs include project design, validation, registration with a voluntary carbon market standard, implementation, ongoing monitoring, and third-party verification required for carbon credit issuance. Listed below are a few key carbon finance instruments:

Carbon Finance Instruments

Carbon finance refers to the set of financial instruments and mechanisms used to support projects that reduce, avoid, or remove greenhouse gas emissions, by enabling them to generate **carbon credits** that can be sold in carbon markets.

Forward Purchase Agreement: An FPA is a contractual arrangement between an end buyer or intermediary and a carbon credit-generating enterprise that defines the purchase, payment, and delivery of an agreed-upon quantity of credits at a future date under specific conditions. These conditions include the volume of credits to be delivered, timelines, and a pre-agreed price.

Structure & Use Case (Including Clean Cooking Projects)	This instrument is typically used during the early stages of a clean cooking project, particularly when a developer needs upfront capital to manufacture and distribute improved cookstoves, establish supply chains, or initiate monitoring and reporting systems necessary for carbon credit issuance. Our analysis shows that the use of FPA transactions tends to rise during periods of reduced liquidity in carbon markets. Recently, more buyers have begun relying on credit rating agencies for assurance before committing to an FPA. Insights suggest that most clean cooking projects in Africa rely on FPAs, with several transactions channelling millions of dollars in upfront capital. For example, enterprises like BURN Manufacturing and UpEnergy have leveraged FPAs to support their large-scale distribution across the region.
Type of Financiers	FPAs are frequently used by corporate carbon credit buyers — including energy firms, airlines, and consumer goods companies— as well as by carbon aggregators and climate-focused investment funds. **Examples:** **Corporate offset buyers**: Shell, BP **Carbon Aggregators:** myclimate, Aera Group

Pros	Cons
• Provides upfront liquidity to cover project development costs. • Mitigates volatility as the price is locked in at outset. • FPAs can act as collateral to attract additional climate funding	• FPAs limit price appreciation, especially in bullish markets, as buyers seek to compensate for the risks they assume by paying upfront. • Moreover, the earlier a clean cooking project is in its carbon credit development cycle, the steeper the discount on forward deliveries due to uncertainties around project registration and carbon credit certification.[75] • FPAs are subject to stringent legal requirements given the extensive negotiations and complex legal structures involved. • The project developer bears the performance risk of delivering the agreed-upon volume of credits; failure to do so could result in penalties or reputational damage.

Result-Based Financing is a widely adopted funding mechanism in international development, where grant disbursements are contingent on achieving predefined performance-based outcomes. In the last decade, RBF has gained dominance as a preferred instrument for funding clean cooking interventions. It can function as a standalone financing tool or be integrated with other blended finance approaches that combine upfront and results-based payments. The most common RBF mechanism is the performance-based RBF.

Structure & Use Case (Including Clean Cooking Projects)	RBF is commonly used during the implementation stage of a clean cooking project. At this stage, enterprises have demonstrated their ability to track, verify, and monetize emissions reductions, making them well-positioned to meet the eligibility criteria of RBF programs. **Examples:** Through the MCFA RBF facility, Better Cooking Company Limited (EcoSafi), is deploying 25,000 pellet-based cookstoves that use locally produced biomass fuel. This initiative is expected to improve clean cooking access for 125,000 people.[76]
Type of Financiers	**DFIs:** RBF is primarily deployed by DFIs. Key actors that provide RBF to Africa's clean cooking sector include: **World Bank:** It commits over USD 85 million annually[77] to the sector through various RBF programs such as the World Bank's Carbon Initiative for Development (Ci-Dev). **Modern Cooking Facility for Africa (MCFA) led by Nefco (the Nordic Environment Finance Corporation):** As of December 2024, MCFA had committed approximately €44.5 million through RBF to support clean cooking projects seeking to scale their solutions to Tier 4 and 5 across 6 SSA countries.[78] **Impact Investors:** E.g. AECF, through their REACT fund, provides performance-based RBF to clean cooking investees in Kenya. To be eligible enterprises must have secured carbon credit financing before as the performance-based RBF is tied to tangible, verifiable results. The mechanism incentivizes companies to expand into underserved markets and promote the adoption of cleaner technologies.

Pros	Cons
• Performance-based RBF ensures high-quality implementation as it is linked to performance. • Unlocks additional capital for developers as they often use the promise of RBF payments to attract other forms of financing. • It reduces the risk borne by funders as payments are only made when outcomes are achieved.	• It requires initial pre-financing at the early stages. Thus, developers must mobilize other forms of financing to become eligible for RBF. This excludes small enterprises from accessing RBFs. • Monitoring, reporting, and verification requirements associated with RBF can be resource-intensive, requiring expertise and third-party audits. • Delays in verification or disbursement can create cash flow constraints and operational risks.

Carbon Revenue-Backed Loan Facility (CRBLF) is a financing mechanism in which a lender (typically a bank) provides upfront capital to a project developer, with loan repayments structured around the anticipated revenue from future carbon credit sales. This enables project developers, such as those in the clean cooking sector, to secure the funds necessary for project implementation or expansion by leveraging the expected carbon revenues either as collateral or as a repayment source.

Structure & Use Case (Including Clean Cooking Projects)	CRBLFs are primarily deployed during the implementation and scaling phases of clean cooking carbon projects. Banks offer loans to project developers against projected revenue from future carbon credit sales. This approach enables developers to accelerate production without having to wait for carbon credit verification and issuance. The loan's re-payment structure is typically aligned with the project's carbon crediting period, with repayments scheduled to coincide with revenue generation from FPAs or voluntary carbon market deals.
Type of Financiers	**Examples:** This instrument is relatively new in carbon markets but is gaining traction especially among regional banks such as Standard Bank. Our consultations with key stakeholders indicate that these banks offer deep expertise in commodity trading, a strong regional presence, and well-established Environmental, Social, and Governance (ESG) frameworks. In 2024, Rand Merchant Bank (RMB) extended a scalable long-term debt facility to KOKO Networks secured against the company's anticipated future carbon credit revenues. This financing is intended to support the expansion of KOKO's bioethanol cooking fuel solutions across Africa.[79] In 2023, Standard Bank extended a USD 10.6 million carbon-revenue-linked loan to The African Stove Company (TASC) for a carbon credit project aimed at combating climate change and improving social outcomes in rural South African communities. The project involves distributing approximately 750,000 efficient cookstoves to these communities, which will generate carbon credits through reduced emissions.[80]

Pros	Cons
• CRBLFs are easily replicable, especially across the banking community. For instance, CCA in collaboration with Intellecap undertook a capacity-building initiative, training banks on how to provide upfront carbon financing for clean cooking enterprises. • CRBLFs crowds in private capital. • They provide rapid access to funding as compared to other financial mechanisms like RBF which may involve long waiting periods.	• Enterprises must demonstrate creditworthiness and their ability to provide collateral during due diligence. These requirements exclude most early-stage companies from accessing CRBLFs. • Often CRBLFs require enterprises to furnish guarantees or enter into forward contracts to access favorable interest rates. For example, KOKO networks received a guarantee from MIGA, which enabled the enterprise to enter into viable financing agreement.

Image Courtesy : xpressgas.com

Most clean cooking enterprises are leveraging carbon revenues to subsidize the cost of clean cooking products and to expand their market presence and distribution of cleaner technologies.

Carbon revenues, derived from verified emissions reductions, provide a crucial funding source for subsidizing products, supporting service delivery, and financing large-scale community initiatives. Various models have evolved to maximize the benefits of carbon finance.

Table 7: Carbon Revenue Utilization Models

#	Usage of Carbon Revenue	Characteristics	Frequency of usage (3 stars scale with 3 representing most widely used & 1 least likely used)
1	Product subsidy	Carbon finance is used to subsidize the cost of clean cookstoves, reducing upfront costs and enabling wider market coverage. Enterprises typically subsidize 50%–85% of product costs via carbon revenues to facilitate wide-spread adoption.	✳✳✳
2	Cost of service	Carbon revenue is used to finance service delivery, including user training, after-sales support, maintenance, customer engagement, sensitization campaigns, and community meetings to encourage sustained product usage. Biodigester enterprises often use carbon revenues to cover the cost of maintenance.	✳✳✳
3	Project management cost	Carbon revenue covers project management costs, including monitoring, reporting, and verification.	✳✳
4	Community Development Programs	Some organizations reinvest carbon credit revenues into community development projects, supporting social and environmental outcomes. Example: UpEnergy's Community Carbon fund supports health, education, and job creation.	✳
5	Hybrid of subsidy & cash-back	Carbon revenue is used to subsidize product cost and to offer cash-back incentives. These incentives encourage the consistent use of clean cooking solutions, promoting long-term behavioural change. However, recurring cashbacks remain limited in amount due to the currently low prices of carbon credits.	✳

Box 8: ATEC's 'Cooke to Earn' program

ATEC's model for women end-users: Cook to Earn

ATEC, a social enterprise, is serving underserved communities in Cambodia and Bangladesh through innovative and inclusive solutions. ATEC's eCook induction stoves are equipped with IoT technology that tracks real-time usage data. This validates carbon emissions reductions. The model integrates carbon credit revenue to offset stove costs, reducing the financial barrier to adoption. 70% of carbon credit revenue supports households—reaching them directly through mobile micropayments. This empowers them economically and improves their standard of living. The remaining 30% of carbon revenue covers operational and credit generation costs. ATEC has also collaborated with FairClimate Fund and MECS to pilot a carbon credit revenue-sharing model that ensures transparent and equitable cost flows.

Carbon projects must enhance measures to ensure fair, transparent, and equitable revenue sharing, competition, and community consent.

The increasing scrutiny of carbon markets has underscored the need for greater transparency, equitable benefit distribution, and fair competition. Various stakeholders, including investors, rating agencies, and enterprises, have raised concerns regarding current revenue-sharing mechanisms, competitive imbalances, limited local ownership, and the adequacy of the consent processes.

Many end-users and communities remain uninformed about the transferability of carbon rights and how the associated benefits are distributed. Typically, the rights to carbon credits are retained by the entities or individuals responsible for generating emission reductions unless explicitly transferred through a process of fair and informed consent. While project development processes mandate stakeholder consultations, these discussions sometimes do not adopt a participatory approach to revenue utilization and distribution. Instead, decisions on benefit-sharing are primarily undertaken by project developers and enterprises through a top-down approach, leaving communities and end-users with little influence over how carbon revenues are allocated.

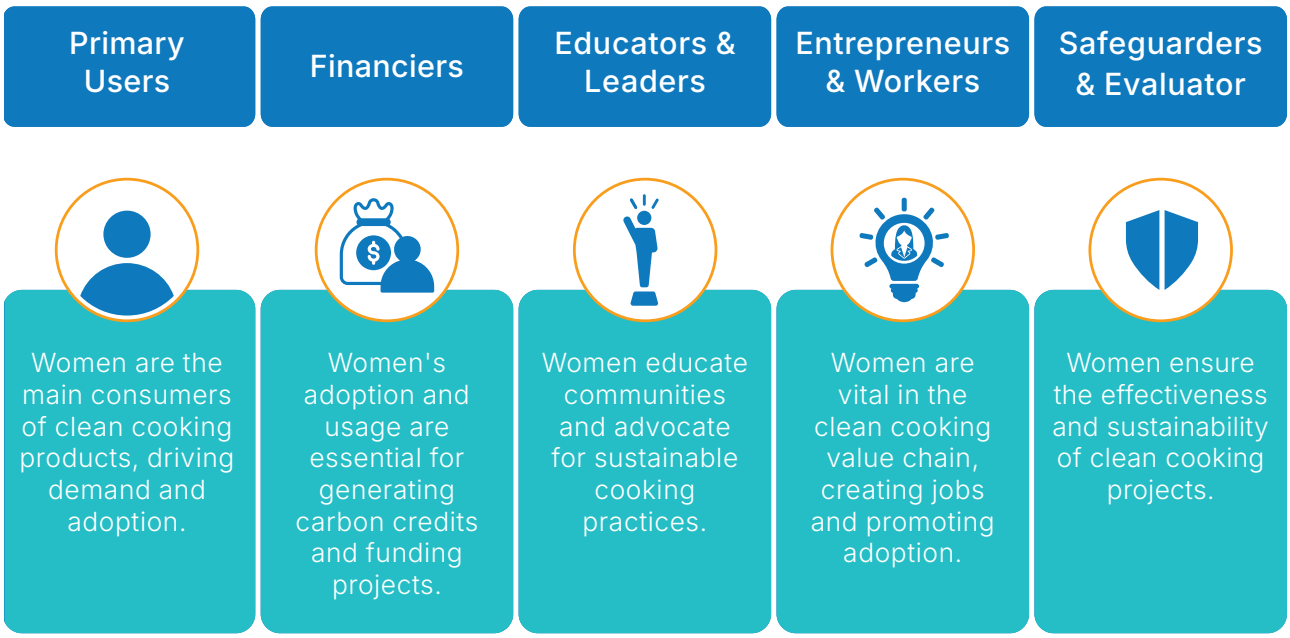
Another pressing issue relates to the unequal distribution of carbon revenue across the value chain. Enterprises consulted during assessments noted that some developers appear to prioritize maximizing financial returns over sharing benefits with consumers or project implementers. There exist challenges related to revenue utilization through subsidies, which are uniformly provided to all customer groups irrespective of their usage of clean cooking solutions. In many instances users of clean cooking products exceed the baseline usage threshold, thereby generating additional carbon credits, yet they continue to receive a fixed subsidy. Most end-users are unaware that product discounts are made possible through carbon finance, and often assume that such pricing is standard. In households seeking to buy multiple appliances from the same provider, subsidies usually only apply to products that are included in the carbon project, leading to confusion and dissatisfaction when additional items are not similarly discounted.

With the rising awareness of the ethical and social impact of carbon projects, buyers and investors are keen to adopt safeguards that align with human rights, labour standards, environmental protection and anti-corruption. Buyers are increasingly relying on extensive due-diligence and external assessments to verify the credibility of project claims and identify potential risks before making purchases. Rating agencies are frequently used to assess project credibility, which can directly influence pricing. Several standard-setting bodies have integrated the "Do No Harm" principle into their frameworks. Moreover, organizations such as the Integrity Council for the Voluntary Carbon Market[81] have developed guiding principles to support transparency, accountability, and sustainability in carbon markets.

Women's role in the carbon market extends beyond being end-users of clean cooking products.

Women play a critical role in the clean cooking sector, both as primary end-users and key stakeholders in the financing, adoption, and sustainability of clean cooking solutions. The multiple roles played by women in clean cooking industry include:

Figure 12: Women's Role in Unlocking Climate Finance



Women are the primary users of clean cooking products

Carbon revenues have been crucial for making products affordable and accessible to women and girls. Our consultations show that women comprise a significant portion of customers across enterprises such as BURN Manufacturing (90%) and Bidhaa Sasa (75%).[82] Women are also largely responsible for the maintenance and upkeep of products. For example, in Nepal, women's work in maintaining biogas digesters has been essential for generating carbon units under government-led carbon projects.

Women are the primary financiers of carbon projects

Women are also indirectly responsible for financing carbon projects, since their adoption and usage are necessary to ensure the permanence and additionality of carbon credits. A clean cooking product can generate 10–28 carbon credits over its lifespan,[83] translating to a potential revenue of USD 40–USD 112 at the current rate of USD 4 per credit. These revenues are crucial for ongoing product maintenance and scaling operations, highlighting the role of women as both users and indirect financiers of clean cooking solutions. Through their regular use of clean cooking technologies, women are unlocking carbon finance for their households and communities.

Women as key educators and leaders

Women play a critical role in ensuring the long-term sustainability of carbon projects through advocacy, peer-to-peer awareness campaigns, and community engagement. When women are trained and empowered as users, educators, and technicians, adoption and continued use of clean technologies improves significantly. For instance, programs like the African Biodigester Component in Kenya, which trained over 21,000 farmers—many of them women—not only provided technical knowledge but also enabled peer-to-peer learning networks that contributed to over 80% functionality of installed biodigesters.[84] This showcases the importance of sustained user engagement, especially when women are at the center. Similarly, training women in stove maintenance, safety, and alternative cooking methods helps overcome cultural barriers and ensures long-term adoption. Without such gender-responsive interventions, the risk of technology abandonment remains high, undermining the intended environmental and health benefits.

Women as entrepreneurs and service providers

Women's participation extends beyond end-use to employment and entrepreneurship across the clean cooking value chain. The sector is projected to create up to 1.5 million jobs, with women playing key roles as last-mile distributors, sales agents, and technicians.[85] Studies show that women sell three times as many stoves as men, underscoring their effectiveness in driving adoption and building trust within communities.[86] These trends demonstrate the economic and social potential of integrating gender-inclusive strategies into clean cooking enterprises.

Women as safe guarders and evaluators

Women play a pivotal role in safeguarding and evaluating carbon projects. Their close interaction with clean cooking technologies provides them with valuable insights into product performance and project effectiveness. In carbon registered projects, women play a crucial role in baseline assessments through kitchen performance tests and other monitoring activities. Women's organizations have been successfully leveraged to carry out key carbon market tasks, such as project evaluation and data collection. For example, women sales agent and community workers have been employed to collect data for W+ Standard projects. Their participation ensures accurate tracking of emissions reductions and supports transparent revenue utilization. Moreover, women's involvement in project design and ownership enhances accountability, as they help align project outcomes with local needs.

5.

Carbon Finance Meets Impact

Recommendations for Clean Cooking Enterprises, Investors and Policymakers

This study seeks to deepen the understanding of pathways through which clean cooking enterprises can unlock climate finance and access carbon markets to scale their operations and maximize their impact—particularly in improving outcomes for women and girls in Africa.

5.1 Recommendations for Entrepreneurs and Project Developers

Prioritize product quality and after-sales service: Ensuring that clean cooking products are of a high-quality is integral to maintaining long-term carbon offset benefits. The durability and efficiency of clean cooking products directly impact their ability to reduce emissions, as poor-quality products may lead to increased wastage and negative environmental consequences. Enterprises must prioritize technical innovation and engage in continuous product improvement to ensure reliability and longevity. As such, businesses should focus on delivering high-performance products backed by effective after-sales support services.

Develop a strong value proposition for carbon market programs in Africa: To secure financing, enterprises should engage with carbon credit buyers early in the project development process, as buyer interest serves as a key indicator of a project's investment potential. Market trends indicate that buyers increasingly prioritize projects with demonstrate integrity, generate substantial credit volumes, and deliver tangible co-benefits. To distinguish themselves, project developers should leverage technological innovation, establish robust distribution models, integrate digital measurement tools, and adopt transparent methodologies.

Ensure carbon integrity through rigorous monitoring and verification: Clean cooking enterprises must implement robust and transparent methodologies to track their climate-related impact. Utilizing third-party verification, such as through partnerships with academic institutions (e.g., BURN Manufacturing, Circle Gas), and integrating digital monitoring tools (e.g., Nyalore Impact) enhances buyers' confidence in the quality of credits and mitigates risk. Enterprises can also engage carbon credit buyers during project initiation, allowing their inputs to shape the development of methodologies, thereby enhancing credibility and alignment with market expectations.

Diversify revenue streams beyond carbon markets: Given the volatility of carbon credit prices, enterprises should avoid over-reliance on voluntary carbon markets by exploring compliance markets and diversifying revenue streams. A well-balanced business model should focus on generating revenue through multiple channels while sustaining viable carbon projects. For instance, Biolite has expanded its customer base by targeting different market segments, selling clean energy products to those who can afford them. SMEs should conduct feasibility assessments before scaling carbon projects to ensure the sustainability of their core business operations.

Ensure fair and transparent consent and revenue sharing practices: Enterprises must ensure that carbon projects deliver equitable benefits to local communities through fair and transparent revenue-sharing mechanisms. Successful examples include UpEnergy's use of structured community funds for community projects, and ABPL's support to CBOs through an integrated climate and livelihood program. Some enterprises have successfully experimented with cash-back models—when aggregated across regions, such benefits can contribute significantly to community development funds that support ecosystem restoration, climate adaptation, and other collective priorities. In designing benefit-sharing models, businesses must account for behavioural drivers and community preferences. Depending on what fosters long-term engagement and trust, enterprises may adopt either continuous revenue disbursements or upfront subsidies. To asses which incentive structure is most effective in a particular context, enterprises should invest in research and community consultations. In

addition, strengthening governance within carbon projects is essential. Enterprises should establish grievance redressal mechanisms, formal complaint procedures, and transparent information sharing processes to ensure accountability. Certification systems such as Fair Carbon can further enhance transparency and credibility.

Early players in carbon markets should adopt low-risk market entry strategies: Enterprises exploring participation in carbon markets should begin by assessing their viability through feasibility studies. These assessments should include baseline fuel testing and adoption rate analysis and evaluate the effectiveness of the technology in delivering measurable climate impact. Aggregation models can help smaller businesses consolidate carbon credits, thereby improving market access and participation. Distribution entities may also consider partnering with experienced project developers that can act as implementing partners for key tasks such as last-mile distribution, data collection, behavioural awareness, and related activities.

Image Courtesy : www.upenergygroup.com

Promote gender inclusion in clean cooking projects and business models: Clean cooking solutions have a direct, largely positive impact on women's health and unpaid care work. Enterprises can amplify this by recognizing that stoves are also carbon-finance assets and ensuring equitable asset ownership for women. Ownership is often overlooked during sales, which can disadvantage women, especially in joint-ownership models like biodigesters where women may not own livestock. To address these gaps, enterprises should use gender-disaggregated data to adopt targeted subsidies for marginalized groups, especially female-headed households. They should also ensure that women are direct beneficiaries of such incentives and have access to mobile technology to directly receive benefits from cashback models. Moreover, women should be trained in after-sales services, creating opportunities for green employment.

There is significant potential to employ women across the clean cooking value chain, especially in manufacturing and distribution, as demonstrated by BURN Manufacturing and Biolite. Enterprises should also acknowledge that women often take on additional responsibilities in device maintenance, such as cleaning biodigesters, which may increase their workload. Gender inclusion must extend to internal policies on hiring, procurement, and representation. In carbon project design, enterprises must ensure equal participation, account for time constraints that may limit women's involvement, and apply "do no harm" principles to safeguard women against harassment.

5.2 Recommendations for Investors and Buyers

Measure and communicate co-benefits: Enterprises must effectively communicate their broader impact such as increasing economic opportunities, improving health outcomes, promoting local economic development, and ensuring gender equality. Demonstrating measurable benefits, such as returns on investment and income generation, enhances an enterprise's credibility and attracts potential investors. Increasingly investors are looking beyond carbon reduction metrics and prioritizing projects that align with broader social goals including gender equality, child welfare, and community development. To attract such investment, enterprises should develop impact metrics that reflect these investor priorities, and clearly articulate their contribution to inclusive and sustainable development.

Strengthen enterprise capacity through technical assistance: High costs and complex methodologies often exclude SMEs from participating in carbon markets. Due to this complexity, many SMEs are compelled to engage technical consultants, whose fees and commission structures can be prohibitively expensive. Consequently, there is a growing demand for direct capacity-building initiatives and knowledge-sharing platforms to help these enterprises overcome technical and financial barriers. While established businesses have benefited from concessional and blended finance to implement their carbon programs—allowing them to build internal capacity and directly register their projects—they still require support to access emerging compliance markets. With many countries and the UNFCCC still in the process of finalizing registries and regulations, enterprises will need targeted assistance to navigate these evolving carbon market systems.

Moreover, early entrants in the carbon market often lack the expertise required to manage measurement, monitoring, and reporting processes effectively. Investors can play a critical role by helping enterprises set up reliable data systems and providing technical support that facilitates accurate emissions accounting in line with standards such as Verra.

Support project aggregation through decentralized models: Sectors such as clean cooking, which are composed of numerous small-scale players, can benefit substantially from project aggregation as it reduces transaction costs and streamlines the development of carbon credits. Investors can support multiple enterprises by facilitating collective registration under standards such as Verra and the Gold Standard. This approach reduces costs and increases operational efficiency by establishing a coordinating body responsible for managing data collection, verification, and other essential processes. AECF, for example, is currently developing a carbon market access program to support its investees whose products qualify for carbon credits. Such initiatives enable smaller enterprises to improve their business models while moving towards scalability.

Enhance the banking sector's capabilities for carbon market financing: Commercial banks have made limited efforts to pre-finance carbon projects, primarily because they lack an understanding of climate finance, project design, revenue models, and associated risks. This knowledge gap combined with limited incentives have contributed to banks' hesitation to finance carbon projects. Organizations such as the Clean Cooking Alliance are actively working to engage and educate banks to bridge these gaps; however, further efforts are needed to develop the banking sector's capacity to support carbon projects.

Provide patient capital to enable market development: Clean cooking enterprises that have successfully scaled, often owe their growth to sustained support over several years, frequently backed by patient capital spanning a decade or more. Investors can play a pivotal role in accelerating

the growth of emerging enterprises by offering innovative financing instruments, such as carbon streamlining, quasi-debt, and blended finance instruments. Blended finance approaches that incorporate de-risking mechanisms for climate and gender-focused investments can further catalyze market development. Investors can also facilitate market participation by offering grants to cover certification and monitoring costs, reducing the financial barriers to accessing carbon markets.

Incentivize projects and finance that prioritize women's participation and inclusion: Although clean cooking technologies are widely perceived to benefit women, they do not automatically lead to gender-equitable outcomes. Currently, very few financial instruments or buyers intentionally reward business models or projects that prioritize women's inclusion. To drive more meaningful outcomes for women, investors and buyers must take deliberate actions such as supporting job creation, adopting intersectional approaches, promoting asset ownership, enabling women's entrepreneurship, and advancing women-led businesses. These goals can be achieved by requiring enterprises to adhere to gender equity standards such as the Women's Empowerment Principles and integrating due diligence processes that assess potential gender risks and benefits. Moreover, buyers can integrate impact measurement frameworks and gender-sensitive value propositions into their project selection processes, prioritizing initiatives that deliver additional value to women and girls beyond their role as end-users of the product.

Image Courtesy : www.upenergygroup.com

5.2 Recommendations for Policymakers

Develop national frameworks and carbon registries for carbon projects in Africa: Currently, many African countries lack the regulatory frameworks or registries required to support participation in compliance carbon markets, limiting project developers to voluntary carbon markets, where credit prices are typically lower. Recognizing projects under Article 6 of the Paris Agreement can help unlock premium prices for carbon credits. To facilitate this, governments should establish national regulatory frameworks and carbon registries that align with the Paris Agreement's protocols. Governments can undertake bilateral discussions with established Article 6.2 players, such as Switzerland and South Africa to design and build robust compliance market mechanisms.

Implement sound policies for SMEs: Governments should foster an enabling environment to support the growth of clean cooking SMEs through targeted incentives. Tax waivers and subsidies for early-stage enterprises engaged in climate action can accelerate innovation and market expansion. Providing tax incentives—such as subsidies and rebates—to local manufacturers can stimulate domestic production, reduce retail prices of cookstoves, and improve affordability.

ANNEXURES

Annexure 1: Stakeholders Consulted

#	Stakeholder	Names of Entities
1	**Clean Cooking Enterprises & Carbon Project Developers**	Circle Gas, Sistema.bio, ATEC, Biolite, UpEnergy, BURN Manufacturing, Bidhaa Sasa, ABPL, Ecobora, Biofranca, Nyalore Impact, Xpress Gas, SunBucket, Biosys, Solar Sister, Fair Climate Fund
2	**Think Tanks**	Clean Cooking Alliance, Modern Energy Cooking Services-Loughborough University, Strathmore University, Practical Action, SD Direct & PwC United Kingdom
3	**Investors and Donors**	Bix Capital, Kua Ventures, Kenya Climate Ventures, AECF, GIZ Kenya, SNV-Uganda & Kenya
4	**Carbon Market Players**	BeZero, Bowmans (law firm), Buyers (names confidential)

Image Courtesy : www.upenergygroup.com

Annexure 2: Study Methodology

Primary Data Collection		
Method of Data Collection	**KIIs (Key Informant Interviews)**	**Quantitative: Carbon Project Level**
 **Target Group/ Source of Information**	• **Enterprises:** Burn Manufacturing, Sistema.Bio, ATEC, Biolite, UpEnergy, Solar Sister, Circle Gas, Bidhaa Sasa, ABPL, Nytore Impact, Biofranca, Biosys, Sunbucket, Xpress Gas • **Think Tanks:** Clean Cooking Alliance, SNV-Uganda & Kenya, Strathmore University • **Ecoystem Enablers:** GIZ, Convergence Finance Fair Climate Fund, Bowmans Law Firm, beZero, Modern Energy Cooking Service-Loughborough University SD Direct, PwC UK • **Investors:** AECF, Kua Ventures, Bix Capital, Kenya Climate Ventures	Project Analysis registered or listed in Gold Standard and Verra
 **Line of Enquiry**	• Snapshot of Clean Cooking and MECS businesses in Africa • Business, Financing and Tech models in carbon & non-carbon projects • Pricing & Costing associated with carbon projects • Capital raise and instrument raised by enterprise • Enterprise experience of investment raising • Bottlenecks and navigation strategies by enterprises • Monetization of carbon credit • Impact on women and girls	• Regional distribution of carbon projects • Scale of projects • Technology types of carbon projects • Project development process • Co-benefits and measurement

Secondary Review

- The State of the Global Clean and Improved Cooking Sector- ESMAP
- Modern Energy Cooking : Review of the Funding Landscape- MECS
- Clean Cooking RBFs: Clean Cooking Alliance & MECS
- The Role of Voluntary Carbon Markets in Clean Cooking
- A Carbon Market Guidebook for Kenyan Enterprises
- 2023 Clean Cooking Industry Snapshot, CCA
- Clean Cooking for Climate Action Introductory Framework for MRV, Clean Cooking Alliance
- Clean Impact Bond: Mobilizing Finance for Clean Cooking
- Integrating gender into the design, implementation and monitoring of carbon credit projects, UK Aid, WOW
- Advancing Renewables-Based Clean Cooking Solutions, IRENA

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