



AFREC

African Energy
Commission

Sustainable Scaling: Meeting the Clean Cooking Challenge in Africa

SUMMARY BRIEF

November, 2024



MECS
Modern Energy
Cooking Services



**Loughborough
University**



ESMAP
Energy Sector Management
Assistance Program



AFREC
African Energy
Commission

**Securing Africa's
Energy Future**

Sustainable Scaling: Meeting the Clean Cooking Challenge in Africa

Summary Brief 2024

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About Publication

This summary is an extract of the publication developed as a collaborative effort between the African Energy Commission (AFREC) under the African Clean Cooking Programme, and Modern Energy Cooking Services Programme (MECS) initiated at the margins COP 28. The African Clean Cooking Programme is an AFREC lead initiative called for by the African Ministers responsible for Transport and Energy during the 4th Ordinary Session of the Specialised Technical Committee on Transport, Transcontinental and Inter-regional Infrastructure, and Energy held on 12-15 September 2023 in Zanzibar, Tanzania in response to the clean cooking challenge in Africa. The intent is to help establish a baseline and track progress on clean cooking in the continent; disseminate information on the status of clean cooking across Africa, support the development of evidenced based and targeted clean cooking programmes, and establish an African Clean Cooking Facility to raise funds and support African Union Member States in the transition to clean cooking.

About African Energy Commission

The African Energy Commission (AFREC) is a specialized technical agency of the African Union Commission (AUC), under the Department of Infrastructure and Energy created by Decision of the 37th Summit of the OAU African Heads of States and Governments in July 2001 and officially launched by the African Union Ministers in charge of Energy in February 2008 in Algiers, Algeria. As per its convention, AFREC has a broad mandate to develop and recommend policies, strategies, research and plans based on AU Member states, sub-regional, regional and continental development priorities including on clean cooking, energy transition, energy efficiency, data and statistics, oil and gas, and bioenergy.

About Modern Energy Cooking Services programme

Modern Energy Cooking Services (MECS) is an eight-year programme funded by UK aid (FCDO) which aims to accelerate the transition in cooking away from biomass to modern energy. By integrating modern energy cooking services into energy planning, MECS hopes to leverage investment in clean electricity access, both grid and off-grid, to address the clean cooking challenge. Modern energy cooking is tier 5 clean cooking, and therefore MECS also supports new innovations in other relevant cooking fuels such as biogas, LPG (bio) and ethanol, though the evidence points to the viability, cost effectiveness, and user satisfaction that energy efficient electric cooking devices provide. The intended outcome is a market-ready range of innovations (technology and business models) which lead to improved choices of affordable, reliable and sustainable modern energy cooking services for consumers. We seek to have the MECS principles adopted in the SDG 7 global tracking framework, including integrating access (7.1) , renewables (7.2) and energy efficiency (7.3) and promote an informed integrated approach.



Traditional Cooking on Charcoal Stoves - Image by: Centre for Research in Energy and Energy Conservation (CREEC), Uganda, 2022.

Special Foreward

Her Excellency Dr. Samia Suluhu Hassan, President of the United Republic of Tanzania

The world is presented with a unique opportunity to address energy poverty, as over 2.1 billion people still rely on traditional cooking methods globally, with more than 900 million in Africa. This situation calls for collaborative efforts from all stakeholders, paving the way for transformative change. The clean cooking transition offers a promising pathway to support Africa's aspirations for socio-economic development, in line with the goals of Agenda 2063.

The theme of this publication - **Sustainable Scaling: Meeting the Clean Cooking Challenge in Africa** - underscores the global call for a pivotal shift to clean cooking. As emphasised during the inaugural Summit on Clean Cooking in Africa, which I co-chaired with H.E. Jonas Gahr Støre, Prime Minister of Norway, Dr. Akinwumi A. Adesina, President of the African Development Bank Group, and Dr. Fatih Birol, Executive Director of the IEA, effective leadership, multisectoral collaboration and access to finance are vital for achieving universal access to clean cooking. The Summit declaration, adopted by all African countries present, was a significant first step in addressing clean cooking challenges in Africa for years to come. Moreover, through that Summit, a total of USD 2.2 billion in financial pledges was mobilized from governments and the private sector to support clean cooking initiatives in Africa.

In tackling the pressing challenges posed by traditional cooking fuels and technologies, African countries continue to demonstrate strong political commitment and collaboration by implementing policies, strategies, and plans at both national and continental levels. In line with Tanzania's commitment since COP28, and as part of the Generation Equality Forum's Action Coalition on Economic Justice and Rights, my country has taken a leading role in championing clean cooking initiatives in Africa and beyond.



The African Women Clean Cooking Support Programme (AWCCSP), which I launched at COP28, aims to provide well-coordinated and institutionalized political leadership on the clean cooking agenda in Africa, targeting the critical gender, environmental, health, and economic challenges that women and girls face due to traditional cooking methods. Through this initiative, Tanzania and other member states continue to make progress by developing specific policies, strategies, and programmes on clean cooking, mobilizing resources and promoting a conducive environment across Africa in partnership with international organizations.

The initiative by the African Union Commission to prepare this publication augments these ongoing efforts and is highly commendable. The proposed African Clean Cooking Programme (ACCP) complements the political leadership pioneered by Tanzania, strengthening current initiatives under the

AWCCSP with the support of partners. The ACCP provides an additional platform for continued strides towards awareness creation, education, training, research and technological innovations necessary for advancing clean cooking at a continental level in a more coordinated and institutionalized manner. The ACCP is therefore anchored in this publication. I am pleased that this publication outlines practical recommendations for accelerating clean cooking in Africa.

Key recommendations from the publication for advancing the clean cooking transition in Africa emphasize on the importance of African leadership in driving this vital initiative across the continent. This shall be the focus of the African clean cooking initiatives including my advocacy work: To support a just and sustainable transition, it is crucial to develop coordinated national initiatives such as fuel baskets that leverage local and international resources and value chains. Integrating clean cooking into national energy and socio-economic development plans will further enhance its impact. It is also essential to tailor clean cooking strategies to the unique contexts of each region, taking into account cultural preferences, the needs of women, and the challenges faced by vulnerable groups.

Through the Tanzania National Clean Cooking Strategy (2024-2034), Tanzania aims to leverage local resources, such as natural gas and other options, to achieve 80% universal access to clean cooking by 2034. Similar initiatives in Kenya, Ghana, and India provide valuable lessons, as documented in this publication.

Therefore, this publication serves as a valuable reference for governments, financiers, industrial players, international organizations, development partners, and civil society involved in development of clean cooking programs.

I believe it is our collective responsibility, through coordinated efforts, to bridge the gap while expanding the use of clean cooking fuels and technologies to significantly reduce household air pollution and safeguard health. Through the use of various suitable technologies locally available, promoting energy efficiency in both technologies and fuels is also essential. To successfully implement these initiatives, we need access to adequate financing, transformation of the clean cooking value chain in Africa, development of skills and institutional capacities, policy changes and enhanced collaboration and partnership among African and international stakeholders. This will ensure a more inclusive and sustainable clean cooking transition that aligns with African needs and national contexts.

By working together in solidarity, we can unlock the full potential of clean cooking transitions, ensuring a sustainable, healthier, and economically prosperous future for all. I urge all stakeholders to embrace the recommendations in this publication as a complement to those in the AWCCSP and the Africa Clean Cooking Summit Declaration and let you all join us in taking action to implement these and other programs at the continental, regional, and national levels in a complementary manner.


H.E. Dr. Samia Suluhu Hassan
President of the United Republic of Tanzania

Foreward

By the African Union Commission, Commissione for Infrastructure and Energy

At the heart of our global aspiration for peace and prosperity of people and the planet, is access to clean, affordable and sustainable energy for all. This is enshrined in Sustainable Development Goal Seven (SDG7), that among others aims at achieving universal access to clean cooking technologies and fuels for all by 2030.

Access to clean cooking solutions remains a major global challenge with over 2.3 billion still relying on traditional cooking methods but there is nowhere in the world that this problem is more pronounced than in Africa where almost one billion still rely on three-stone open fires and other traditional stoves to cook their meals. This continued use of traditional cooking methods has dire impacts on health, gender equality and the environment, with women and children bearing the worst consequences.

Advancement in clean cooking solutions aligns well with Africa's aspiration of a "prosperous Africa based on inclusive growth and sustainable development" as envisaged in the continent's development blueprint: Agenda 2063. The benefits of clean cooking extend far beyond environmental sustainability to include creation of new opportunities for economic growth, job creation, and social development. For instance, by shifting manufacture, distribution and supply chain of clean cooking technologies from outside the continent and closer to the people who need it the most, we can stimulate local economies, empower communities, and improve energy access for all.

However, the current policies and level of financing are nowhere near what is needed to tackle the challenge with projections showing that a significant proportion of Africa's population will remain without access to clean cooking beyond 2030; thus, the need to revitalise focus in the sector.



Responding to this urgent need, the African Union Heads of State through the 2023 Nairobi Declaration on Climate Change and Call to Action committed to create an enabling environment, enact policies, and facilitate investments in climate conscious sectors including clean cooking. Concerted efforts are required at all levels by governments, industry, development partners, international organizations, philanthropies, and civil society to prioritize the agenda of clean cooking. Moreover, we need to foster meaningful partnerships to address financing constraints, improve existing clean cooking technologies and skills, and create an enabling policy and regulatory environment. At the same time, we must explore convergence of our clean cooking goals and climate change mitigation targets at the global level.

In view of this, the Africa Union is working on a comprehensive clean cooking initiative under the African Clean Cooking Programme (AfCCP). The

AfCCP creates a platform for synergizing our efforts at regional and continental level while complementing some of the successful stories already beginning to emerge in African Union Member States. This is to address barriers and create enabling factors for Africa to leverage on its natural resources, existing and emerging solutions and technologies, all available funding options, and develop manufacturing value chains for the clean cooking technologies in addressing the clean cooking challenge.

This publication, therefore, serves as a compass for Africa's clean cooking future trajectory in two dimensions. First, it defines the priorities of the AfCCP being designed by the African Union and secondly, it demonstrates practically the potential of collaboration given that it is produced through a partnership of multiple stakeholders. The publication provides a baseline of the status of clean cooking in the continent; the health, gender and environmental costs of inaction; ongoing

efforts to transition to clean cooking; and specific lessons from case studies in the clean cooking transition journey.

Furthermore, the publication spurs future action through specific recommendations that include pivoting clean cooking in both economic and electricity planning and the need to leverage on both co-benefits and carbon financing in bridging the funding gap.

I invite all our stakeholders to carefully consider the recommendations in the publication and partner with us in implementing the actions. Through this collective action, we have an opportunity to contribute to a prosperous and more sustainable world that secures our environment, reduces inequalities and drives our development agenda.



H.E. Dr. Amani Abou-Zeid
Commissioner for Infrastructure and Energy
African Union Commission

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Acronyms

AU	- African Union	GoB	- the Government of Benin
AC	- Alternating Current	GS	- Gold Standard
ACCC	- the Africa Clean Cooking Consortium	HAP	- Household Air Pollution
ACCF	- African Clean Cooking Facility	HEPA	- Health and Energy Platform for Action
ACMI	- African Carbon Market Initiative	HICs	- high-income countries
AD	- Anaerobic Digestion	IAEA	- International Atomic Energy Agency
aDALYs	- averted disability-adjusted life years	ICCPT	- Integrated Clean Cooking Planning Tool
AfDB,	- African Development Bank	ICS	- Improved Cookstove
AFREC	- African Union's African Energy Commission	IEA	- International Energy Agency
BAU-S	- Business as Usual	IFIs	- International Finance Institutions
BGFA	- Beyond the Grid Fund for Africa	IIASA	- International Institute for Applied Systems Analysis
BMZ	- German Federal Ministry for Economic Cooperation and Development	IP-S	- Implemented Policies
CAPEX	- Capital expenditure	IRENA	- International Renewable Energy Agency
CCA	- Clean Cooking Alliance	IRP	- Integrated Resource Plan
CCG	- Climate Compatible Growth	ISO	- International Organization for Standardization
CIB	- Clean Impact Bond	ITMO	- Internationally Transferred Mitigation Outcomes
CIP	- Industrial Performance Index	KNCTS	- Kenya National Cooking Transition Strategy
COP	- UN Climate Change Conference	LMICs	- low-middle-income countries
CP-S	- Composite Policy	LNG	- Liquid Natural Gas
CSP	- Concentrated Solar Thermal Power	LPG	- Liquid Petroleum Gas
DALYs	- deaths and disability-adjusted life years	MAED	- Model for Analysis of Energy Demand
DFIs	- development finance institutions	MCFA	- Modern Cooking Facility for Africa
DGIS	- Netherlands Ministry of Foreign Affairs	MECS	- Modern Energy Cooking Services Program
dMRV	- Digital Measurement, reporting, and verification	MEDEE2	- Model for Long-Term Energy Demand Evaluation
DRC	- Democratic Republic of Congo	MESSAGE	- Energy Supply System Alternatives and General Environmental Impacts
EAG	- Energy Sector Advisory Group	MFIs	- Micro-finance institutions
ECOWAS	- Economic Community of West African States	MoEP	- Kenya National eCooking Strategy
EESL	- Energy Efficiency Services Ltd	MT	- metric tons
EHR	- Off-Grid Electrification Policy	MTF	- Multi-Tier Framework
EnDev	- Energising Development	NDCs	- Nationally Determined Contributions
EPCs	- Electric Pressure Cookers	NGOs	- non-governmental organisations
ESMAP	- Energy Sector Management Assistance Program	NORAD	- Norwegian Ministry of Foreign Affairs, the Norwegian Agency for Development Cooperation
ETP	- and Energy Technology Perspectives	NP-AEEA	- National Plan for Advancing Environmental-Economic Accounting
fNRB	- fraction of non-renewable biomass	NZ-S	- Net Zero
FX	- Foreign Exchange	NZE	- Net Zero Emission
GEAPP	- Global Energy Alliance for the People and Planet	OBF	- on-bill financing
GEC	- Global Energy and Climate	OBR	- on-bill repayment
GeCCo	- Global Electric Cooking Coalition	ONEE	- National Office of Electricity and Water
GF-S	- Gas-Focussed	PANCP	- National Clean Cooking Action Plan
GHG	- Greenhouse gas	PANER	- National Action Plan for Renewable Energies
GIS	- Geographic Information System		
GMA	- Global Market Assessment		

PAYG	- Pay as You Go	SDGs	- Sustainable Development Goals
PDEHR	- Off-Grid Electrification Master Plan	SHS	- Solar Home Systems
PforR	- Program-for-Results	SIDA	- Swedish International Development Agency's
Pivot	- Global Bioethanol Coalition	SMEs	- Small and Medium Enterprises
PMUY	- Pradhan Mantri Ujjwala Yojana	SOLCO	- Solar-Electric Cooking Partnership for Displacement Contexts
PoA	- Program of Activities	SSA	- Sub-Saharan Africa
PONADER	- National Renewable Energy Development Policy	UEF	- Universal Energy Facility
PONAME	- National Energy Management Policy document	UNEP	- United Nations Environment Programme
RBF	- Results Based Financing	VCMs	- voluntary carbon markets
REDD+	- reducing emissions from deforestation and forest degradation in developing countries	WEM	- World Energy Model
REM	- Reference Electrification Model	WEO	- World Energy Outlook
RISE	- Regulatory Indicators for Sustainable Energy	WHO	- World Health Organisation
RNM	- Reference Network Model	WRI	- World Resources Institute
RVO	- Netherlands Enterprise Agency's		
SDC	- Swiss Agency for Development and Cooperation		

CHAPTER ONE

CLEAN COOKING STATUS, COST OF INACTION, ECONOMIC OPPORTUNITIES AND BARRIERS TO TRANSITION

CHAPTER ONE

CLEAN COOKING STATUS, COST OF INACTION, ECONOMIC OPPORTUNITIES AND BARRIERS TO TRANSITION

1.1. Introduction

Africa's development blueprint: Agenda 2063 seeks to transform the continent into a global powerhouse. The transformation should among other things deliver an inclusive and sustainable development by leveraging on the immense natural and human resources in the continent. Against this backdrop of ambition an often-neglected contributor to a healthy economy is the role of clean cooking services in supporting a healthy population.

This report delves into the challenges and potential solutions regarding clean cooking in Africa, emphasizing on the Sub-Saharan region, the most challenging area globally for clean cooking access.

Key messages from first chapter include:

- **Off-track on SDG7 Targets** Progress towards Sustainable Development Goal 7 (SDG 7), which includes access to clean cooking, is significantly lagging. Without substantial acceleration, SDG 7.1.2 will not be met in **Africa**.
- **Disproportionate Access** From 2010 and 2021, access to clean cooking fuels and technologies in Africa increased at an average annual rate of 1.76%. While some individual countries have made significant advances, the successes are overshadowed by the alarmingly slow

- progress in Sub-Saharan Africa where progress has not managed to keep up with population growth.
- **Rural-Urban Divide** The access gap between urban and rural areas has widened over the last two decades. Significant progress has been made in urban settings—although 58.3% still relied on polluting fuels to meet their cooking needs in 2021— but uptake in rural areas has been slow with only a 5.8 percentage point decrease in the use of polluting fuels for cooking over the past twenty years (down from 86.6% in 2000 to 80.8% in 2021).
- **Cost of Inaction** The costs of continuing the current state of access sums up to **US\$ 791.4 billion** per year calculated from the negative externalities of gender equality, health, and climate.

The continued use of traditional cooking methods imposes severe financial and health costs. Women and children, who spend more time near cooking areas, are disproportionately affected by health issues like respiratory diseases. Economically, the lack of clean cooking fuels results in productivity losses and increased medical expenses. Environmentally, traditional cooking methods contribute to deforestation and greenhouse gas emissions.

1.2. Overview of the Clean Cooking Challenge in Africa

There has generally been more investment, growth, and policy attention in electricity access (SDG 7.1.1) than clean cooking. (SDG 7.1.2.). Yet, according to the latest data about 2.3 billion people globally—nearly one in three individuals—still rely on three-stone open fires and other traditional stoves to cook their meals, using wood, charcoal, kerosene, coal and even animal waste (IEA, 2023) and hence remain in cooking poverty. Globally, the clean cooking challenge is most prevalent in Sub-Saharan African countries, where the access rate to clean fuels and

technologies for cooking was only 18% in 2021 (Global Health Observatory, 2023).

Based on the World Health Organisation's (WHO) data on 53 African countries, the continent-wide rate of access to clean cooking fuels and technologies increased at an average annual rate of 1.76% between 2000 and 2021. Figure 1 depicts the change of access rates across the five African regions from 2000 to 2021, with arrows indicating the direction of progress. While significant advances have been

made in countries like Cabo Verde, the Congo Republic, Egypt, Eswatini, Gabon, Ghana, Lesotho, Mauritius, and South Africa, progress in Sub-Saharan Africa remains slow. Moreover, in some countries the population growth has outpaced the annual increase in access to clean cooking, showing arrows pointing backward. If current trends continue, projections indicate that by 2030, four out of every five people in Sub-Saharan Africa will still endure the health and socioeconomic burdens associated with cooking poverty (Stoner et al., 2021).

The transition to a more sustainable and equitable future requires addressing the widening access gap

between urban and rural areas. At a regional scale, this gap has been growing over the last two decades, posing challenges to a just transition. The percentage of people in rural areas in cooking poverty decreased only by 5.8 percentage points between 2000 (86.6%) and 2021 (80.8%). Conversely, progress has been made in urban settings, where the population of those in cooking poverty appear to have fallen from 69.1% in 2000 to 58.3% in 2021. This could be explained in part due to rural communities often lacking access to essential services, infrastructure, and economic opportunities compared to their urban counterparts, making it more difficult to rural residents to advance to higher tiers of access.



Traditional cooking with charcoal - Scripted generated image (Midjourney)

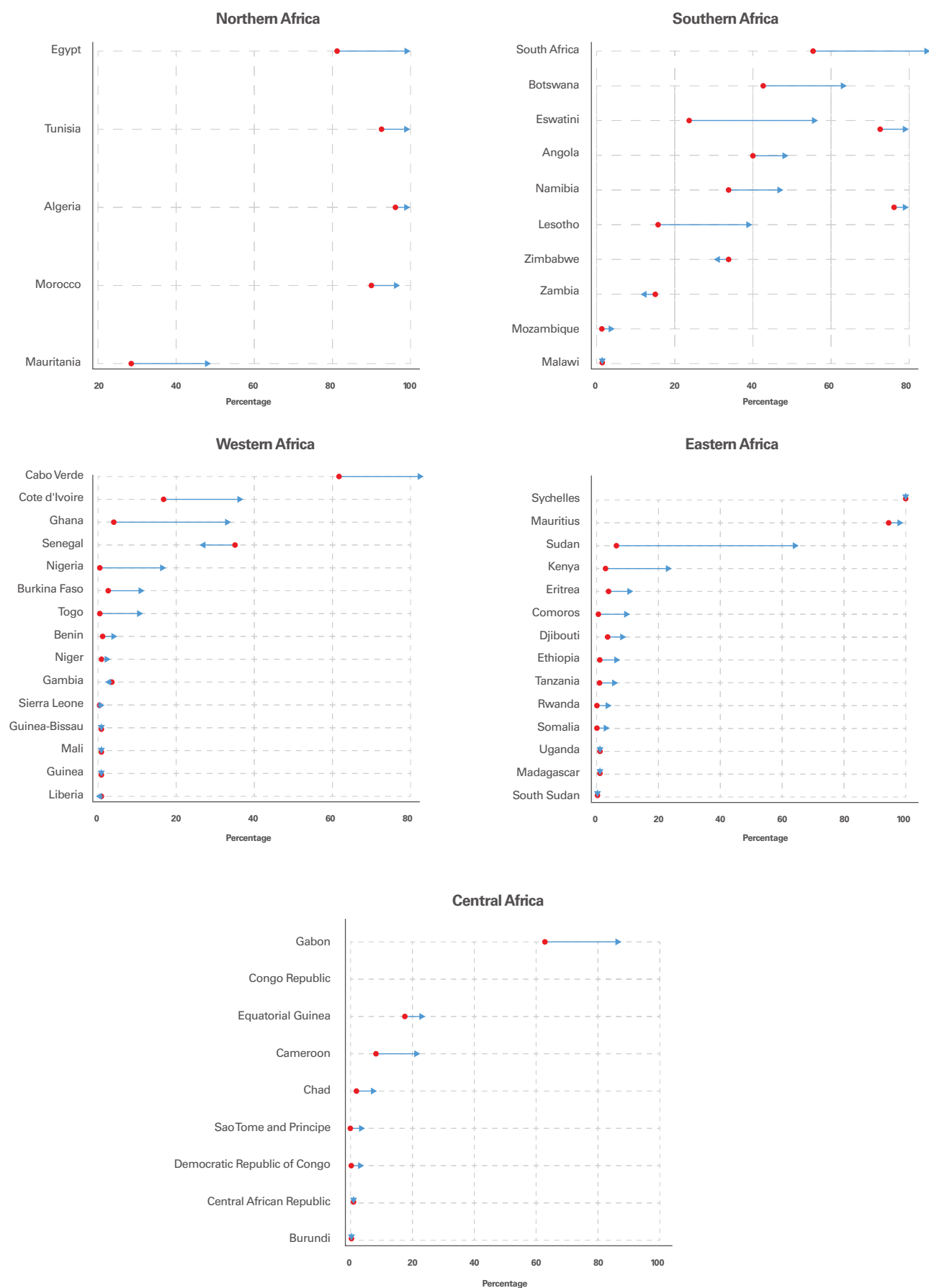


Figure 1. Access rate to Clean Fuels and Technology for Cooking, 2000-2021. (Authors' own elaboration based on WHO, Global Health Observatory. The figure uses AU regions and associated country classification.)

The graphs in Figure 1 also illustrate the diversity of experience across Africa, with some countries already enjoying high levels of access (mainly Liquid Petroleum Gas (LPG) or Liquid Natural Gas (LNG) based) at the start of the period (e.g. most North African states, Cabo Verde, the Seychelles, Mauritius and Gabon). Elsewhere, increases in the use of clean fuels as the primary cooking

fuel appears to be principally attributed to a considerable decrease in the use of unprocessed biomass and a shift to LPG, driven by the growth of LPG programs in some countries (e.g. Ghana, Cameroon). However, the primary reliance on charcoal persists and is increasing in urban areas of Sub-Saharan Africa, where it was used by 30 percent of people in 2021 (IEA, 2023).

1.3. Estimating the Cost of Inaction

The Multi-Tier Framework (MTF) is used to assess access to clean cooking by considering six technical and contextual attributes of the cooking experience. In Sub-Saharan Africa, more than two-thirds of households fall below Tier 2, indicating inadequate access (Figure 2)

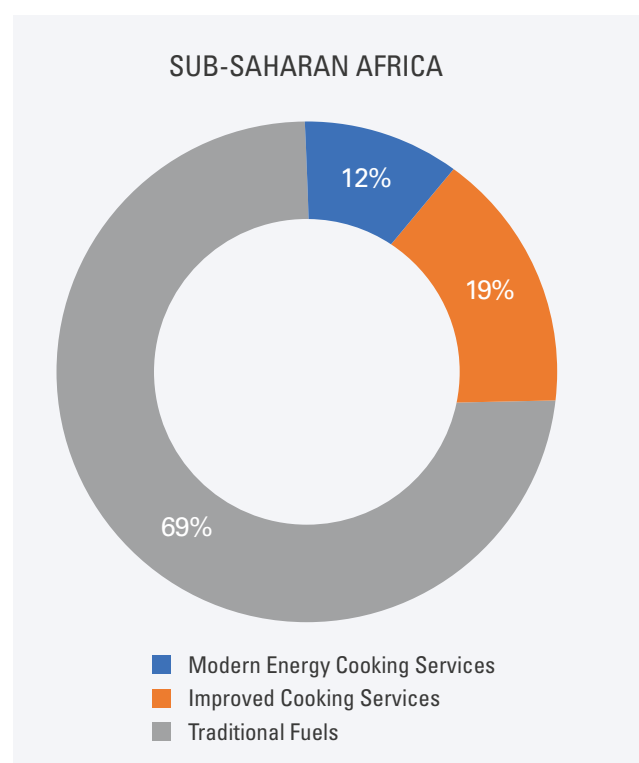


Figure 2: Sub-Saharan MECS Access using the Multi-Tier Framework (Author's own analysis derived from ESMAP's methodology (2023)).

The cost of inaction, primarily due to health, gender, and climate impacts, is estimated at USD 791.4 billion annually.

The health impact, including diseases from indoor air pollution, accounts for USD 526.3 billion annually. Gender inequality, manifesting in lost productivity due to time spent collecting fuel and other cooking-related unpaid activities, adds another USD 225.8 billion. Environmental impacts, particularly greenhouse gas emissions, contribute USD 39.3 billion. This is as illustrated in Figure 2.

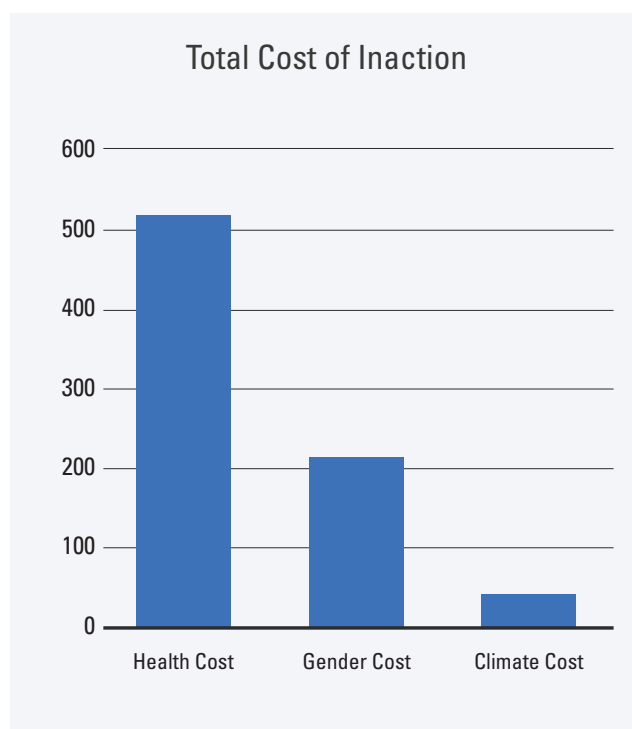


Figure 3: Sub-Saharan Cost of Inaction: Health, Gender, and Climate (Authors' own analysis derived from ESMAP's methodology (2023))

Low adoption rates for clean cooking technologies are attributed to factors like **affordability**, **unreliable supply**, and **low perceived benefits**. While awareness campaigns are essential, they must be complemented by supportive financial strategies to effectively increase adoption rates.

In well-functioning markets, even individuals with financial constraints would choose to invest in fuel-efficient cookstoves if the savings on fuel expenses outweighed the initial capital costs. However, supply chain issues and logistical barriers hinder widespread adoption. Investment in clean energy infrastructure and reliable supply chains is essential for progress.

SDG 7.1.2 aims for universal access to clean cooking as part of a broader goal of sustainable energy for

all. The significant annual cost of inaction underscores the need for clean cooking to be integral to energy planning.

Policy and financial mechanisms must prioritize clean cooking to enhance economic, health, and environmental outcomes. Coordinated efforts at national and regional levels are essential to overcoming the current barriers and achieving universal access to clean cooking solutions.

Achieving universal access to clean cooking is critical for Africa's economic growth, public health,

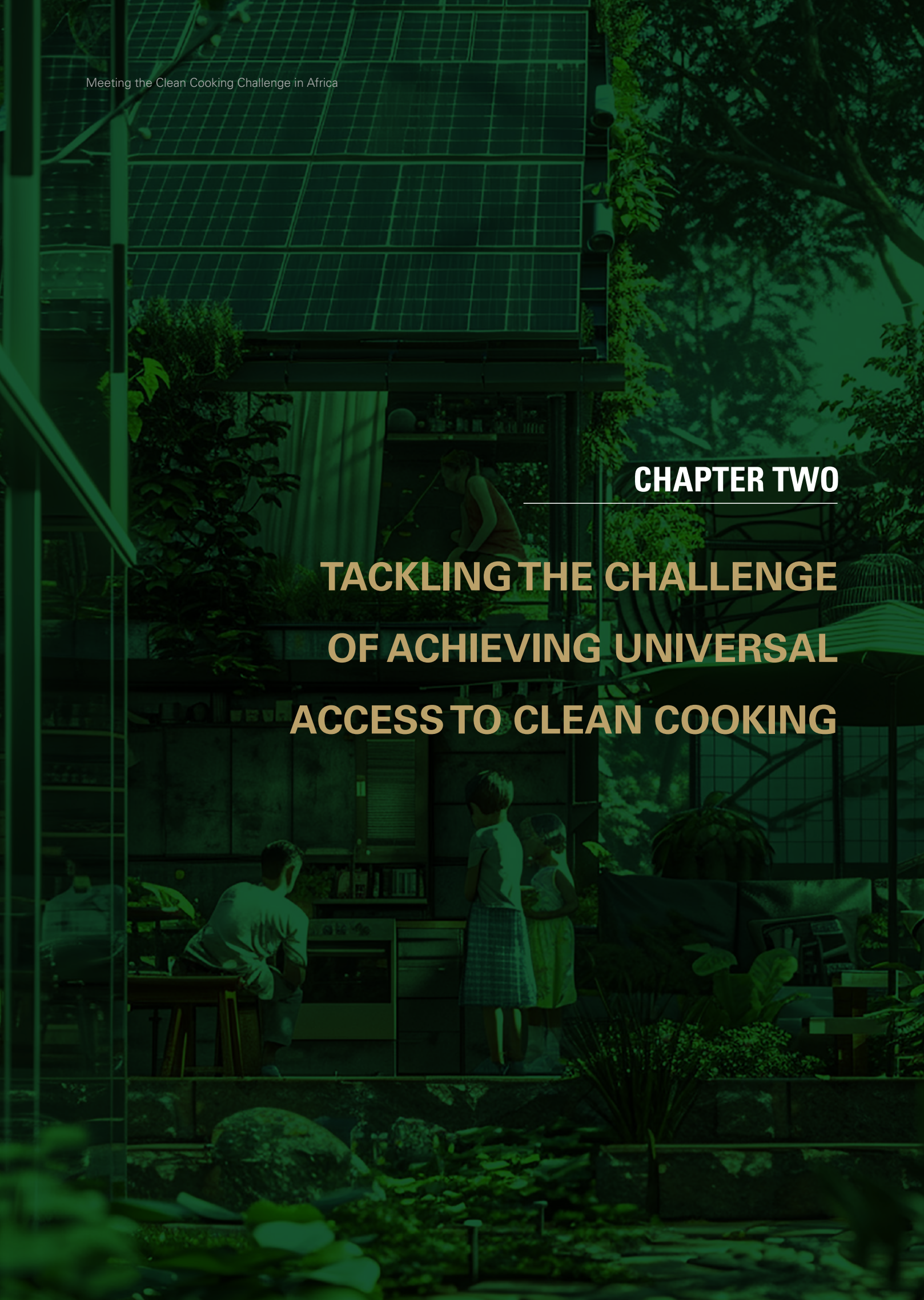
and environmental sustainability. The current state of access is insufficient, resulting in substantial financial, health, and environmental costs. Addressing these challenges requires a multifaceted approach, including increased public awareness, innovative financing, and improved supply chain infrastructure. Only through coordinated and sustained efforts can Africa meet its ambitious growth targets and ensure a healthy, equitable future for its population.



Cooking with an electric oven

CHAPTER TWO

TACKLING THE CHALLENGE OF ACHIEVING UNIVERSAL ACCESS TO CLEAN COOKING



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This chapter synthesizes key insights on the future of clean cooking pathways, highlighting progress, climate solutions, finance expansion, and the roles

of public and private sectors in achieving universal access to clean cooking. The **messages** :

1. Insufficient Financing:

Despite technological and business model advancements, financial support remains inadequate. Achieving universal access by 2030 requires an estimated \$150 billion annually.

2. Integrated Approach in Africa:

Clean cooking should be part of broader energy planning, leveraging investments in other sectors such as digital services and food security.

3. Climate Finance:

Extending access to modern energy cooking can combat climate change. Carbon finance and co-benefits provide additional revenue streams, critical for market support.

4. Multi-Stakeholder Partnerships:

Universal access requires collaboration across sectors and stakeholders to drive research and development and galvanize action.

Significant efforts are needed to transition to universal clean cooking access due to its importance for Sustainable Development Goals (SDGs) and climate agendas. Cooking accounts for about 2% of global greenhouse gas emissions. Universal adoption of electric cooking (eCooking) by 2040 could reduce emissions by 40% compared to 2018 levels. Renewable cooking solutions, including bioenergy and renewables-based eCooking, align with both SDG and climate mitigation objectives.

Technological Innovations:

- **Electric Pressure Cookers (EPCs):** Offer substantial energy savings.
- **Modern Cooking Fuels:** Cost-competitive with biomass; eCooking is becoming accessible even

in off-grid areas due to advancements in battery-supported appliances.

- **IOT enabled appliances:** eCooking offers great opportunities for remote monitoring, comprehensive use data and digitalised carbon financing
- **Renewable Solutions:** Biogas, bioethanol, and bioLPG are viable options, particularly in countries with bioenergy targets.

Clean cooking technologies can significantly mitigate GHG emissions, supporting Africa's Net Zero ambitions. Interventions promote health, gender equality, and livelihood improvements contributing to economic growth. Many low-middle-income countries (LMICs) include clean cooking in their Nationally Determined Contributions

(NDCs) under the Paris Agreement. Clean cooking is recognized as a nature-based solution, integrating with programs like REDD+ for forest conservation.

Despite progress, investments fall short of the required levels for universal access by 2030. Recent years have seen notable investments, with a record \$215 million in 2022. However, financing remains concentrated, with a significant portion directed towards LPG enterprises. Philanthropic organizations and initiatives like the World Bank's Clean Cooking Fund aim to attract private sector financing and stimulate innovation.

Challenges:

- **High Perceived Risks:** Clean cooking enterprises face challenges in attracting investment.
- **Carbon Finance:** Provides a dependable revenue stream by linking payments to verified CO2 reductions. Despite market fluctuations and legitimacy crises, efforts are underway to enhance the quality and credibility of carbon credits through digitally and remote monitored methodologies.

Innovative Financing Mechanisms:

- **Carbon Finance:** Essential for propelling clean cooking transitions. High integrity carbon credits and advanced methodologies for calculating emissions reductions are crucial.
- **Clean Impact Bond (CIB):** Offers results-based finance, generating tradable health and gender credits for additional funding.

Universal access to clean cooking could save millions of lives and trillions of dollars annually by reducing health impacts, climate damage, and improving productivity. Initiatives aim to provide finance instruments that achieve tangible development impacts, making clean cooking solutions more affordable for low-income consumers.

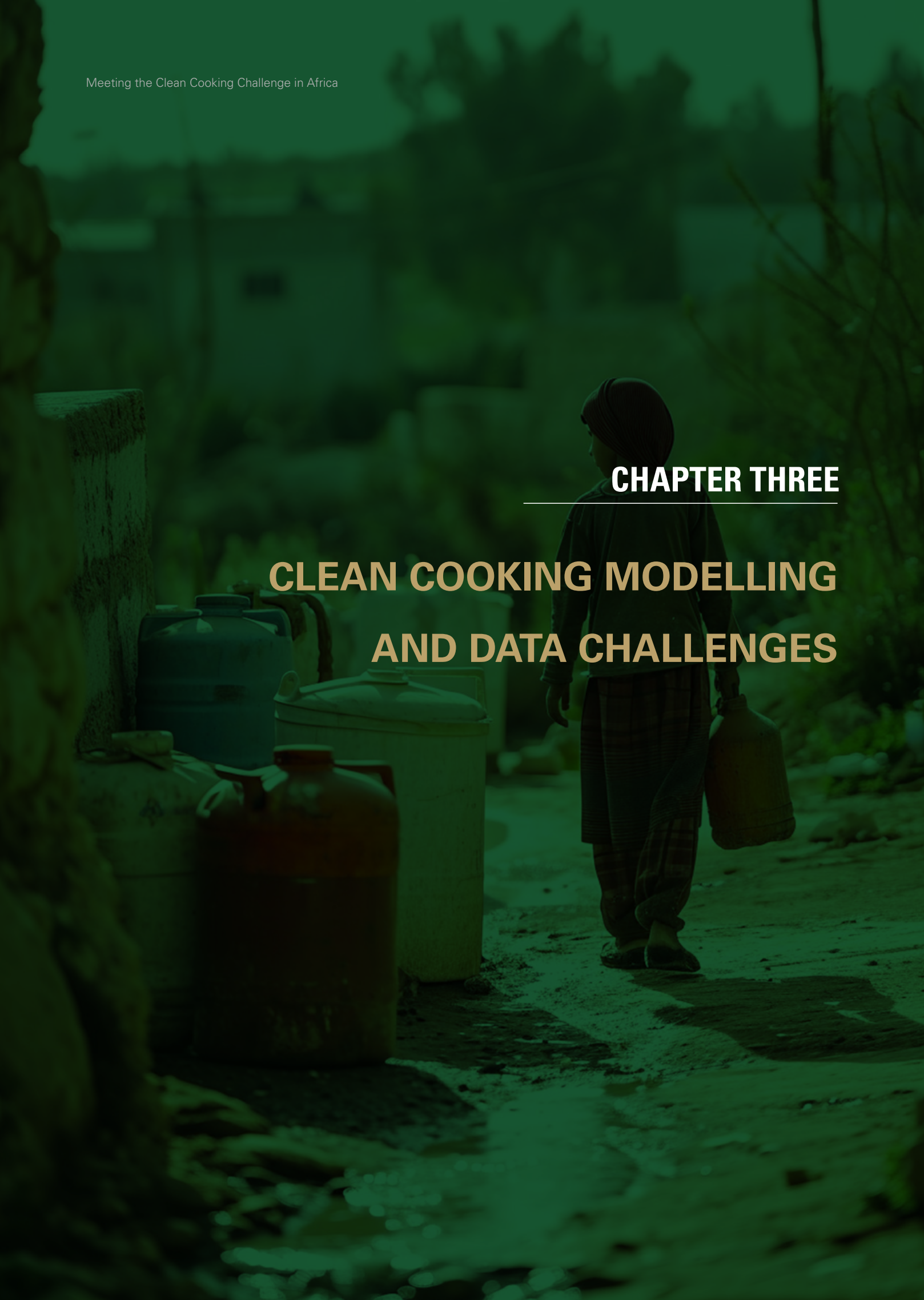
Achieving universal access to clean cooking requires substantial financial investments, integrated planning, and leveraging climate finance. Technological advancements in modern energy cooking solutions and renewable options play a critical role. Multi-stakeholder partnerships are essential for research, development, and scaling up clean cooking initiatives. Despite challenges, innovative financing mechanisms and recognizing clean cooking's co-benefits offer promising pathways towards a sustainable and inclusive energy transition.



Clean Cooking, Woman Cooking on an EPC - Image by: Centre for Research in Energy and Energy Conservation (CREEC), Uganda, 2022.

CHAPTER THREE

CLEAN COOKING MODELLING AND DATA CHALLENGES



CHAPTER THREE

CLEAN COOKING MODELLING AND DATA CHALLENGES

This chapter explores integrating clean cooking into energy system models for global, regional, and national energy planning, emphasizing the need for

high-quality data. By reviewing current and developing energy planning tools, it identifies best practices and key challenges. The key messages are:

1. Integrated Energy Planning:

Energy planning must include clean cooking transitions, crucial for addressing significant challenges in Africa and ensuring connections to other parts of the energy system and **economy**.

2. Context Understanding:

High-level energy planning must explicitly link with location-specific energy and cooking access planning. Emerging hybrid models and open-access tools help scale up successful experiences.

3. High-Quality Data:

Access to high-quality, standardized data is crucial, including data on complex cooking behaviours like fuel and stove stacking.

Energy planning involves developing long-term strategies to shape the future of energy systems at different scales (global, regional, national, or local). For African economies, expanding energy access is

a key planning priority, balancing multiple objectives, costs, reliability, and socio-environmental impacts. Historically, energy planning practices are categorized into:

1. Energy System Planning:

Examines interactions within the energy sector, focusing on security, access, efficiency, and sustainability. It informs national targets and policies.

2. Sub-Sector System Planning:

Focuses on individual energy sub-sectors (e.g., oil, electricity) to identify investments and technologies to meet aggregate demand.

3. Energy Access Planning:

Adopts a geospatial perspective, considering local factors to deliver energy services to end-users effectively. It increasingly incorporates cooking energy needs.

Energy planning uses models to develop scenarios and explore trade-offs. Models can be national-specific or part of broader international studies; multi-national models offer regional or global insights but may lack local context vital for clean cooking planning. Historically, energy access planning focused more on electricity than clean cooking, but recent efforts integrate clean cooking systematically across planning approaches.

Energy system planning, particularly since the 1970s oil crises, has evolved to include clean cooking considerations, initially framed as inter-fuel substitution and efficiency enhancement. Early models like MEDEE2 and the IAEA's tools incorporated clean cooking aspects. Key historical milestones include the IEA's World Energy Outlook (WEO) reports, which

initially offered basic clean cooking considerations. By 2017, the WEO included detailed analyses of clean cooking solutions and their growth trajectories. The IEA's latest Global Energy and Climate (GEC) Model fully integrates access to electricity and clean cooking, including eCooking, recognizing improved appliance efficiencies and with more robust analysis. Electricity sub-sector planning requires detailed demand estimations with spatial and temporal granularity to assess implications for eCooking power generation, transmission, and distribution. Modelling demand is crucial, considering household adoption levels and usage patterns. However, clean cooking modelling remains nascent in many contexts, limiting such analyses for power sector planners.

Local energy access and clean cooking modelling must consider the following complexities:

1. Affordability and Accessibility:

Evaluate the affordability and accessibility of different clean cooking solutions, considering upfront costs, ongoing expenses, fuel availability, and infrastructure requirements.

2. Cultural and Cooking Preferences:

Tailor solutions to local cooking practices and preferences to ensure acceptance and adoption.

3. Health and Safety Considerations:

Prioritize solutions that improve household air quality and reduce exposure to harmful pollutants and accident risks.

4. Infrastructure and Energy System Integration:

Ensure compatibility with existing energy infrastructure and systems, considering grid capacity and stability, and potential for decentralized solutions.

5. Long-Term Sustainability:

Assess the sustainability of fuel sources, environmental impact, and scalability to meet future energy demands. Prioritize solutions that contribute to reducing greenhouse gas emissions and promoting resource efficiency.

By understanding local contexts and considering the complexities of clean cooking solutions, energy planners can develop effective strategies to achieve universal access to clean cooking. This approach not

only addresses immediate energy needs but also contributes to long-term sustainability goals, reducing greenhouse gas emissions and promoting resource efficiency.

Pathways to Integrated Modelling of Electrification and Clean Cooking

Integrated energy planning requires a thorough definition of the energy system to be modelled, linking primary energy sources to end-user services. This process involves upstream activities like primary energy supply and transformation into secondary sources, and downstream activities that focus on energy demand and delivering services to end-users.

Modern energy system planning tools, such as MESSAGE, OSeMOSYS, and SPLAT, use optimisation approaches to identify cost-effective pathways for meeting future energy demands under specific constraints. Optimisation is crucial for clean cooking, as it helps determine the optimal mix of cooking technologies (e.g., eCooking, improved biomass, LPG) and integrates this information into electricity sub-sector planning. Tools like IAEA's MAED generate demand projections that feed into these models, which rely heavily on accurately modelling system constraints and relationships.

Simulation approaches are particularly suited for contexts with high informal activity and complex behavioural patterns, common in clean cooking issues. Simulations project scenarios from baselines, exploring the implications of different policies on investment, climate, and economic or health benefits. The Integrated Clean Cooking Planning Tool (ICCPT), for instance, simulates pathways to universal clean cooking access, helping visualize potential scenarios and policy impacts.

Energy access modelling typically focuses on technology options for specific end-user categories and locations, emphasizing the distribution segment of the supply chain. This approach considers supply-side factors (technical constraints, component costs) and demand-side inputs (consumer behaviour, affordability), using geospatial analytics to achieve detailed spatial and technological granularity considering local characteristics such as population distribution, affordability, and resource availability. Given households often use multiple cooking technologies and fuels, the focus is on identifying an appropriate mix of technologies rather than a single solution.

Geospatial modelling is essential for capturing local

variations in drivers and barriers to different clean cooking solutions. Tools like OnStove and ICCPT play critical roles here. Efforts are underway to integrate various planning tools, such as linking OnStove with OnSSET for studies like those in Kenya, to enhance cross-sectoral and vertical integration in energy planning.

High-quality, standardized data is essential for effective energy planning and modelling, especially for complex cooking behaviours like fuel and stove stacking. Such data allows for accurate modelling and informed decision-making. However, obtaining comprehensive datasets remains a significant challenge, particularly in regions with limited energy access. Key data-related issues include:

- **Estimating Energy Demand:** Accurately estimating energy demand for cooking requires detailed baseline data on population density, lifestyle, household sizes, and affordability.
- **Stove and Fuel Characteristics:** Capturing characteristics such as lifetime, cost, efficiency, emissions, and safety is crucial for estimating the socio-economic and environmental benefits of modern cooking options.
- **High-Granularity Infrastructure Data:** Quality data at a high level of granularity is often lacking and primarily accessible through government agencies.
- **Local Energy Resource Availability:** Data on local availability of various energy resources, like agricultural residues for biogas production, is essential.

Poor data quality and completeness are compounded by complex cooking behaviours, such as fuel and stove stacking. To address these challenges, promoting transparency, auditability, and data accessibility is crucial. Organizations like CCG and SEforALL provide guidance on data governance, and platforms like the IEA's Africa GIS Catalogue offer open-access data for geospatial energy planning. **Promoting integrated energy planning approaches that consider electrification and clean cooking simultaneously is vital.**

Collaborative efforts across sectors and stakeholders are necessary to develop integrated energy plans that address socio-economic needs at local and national levels. Inter-ministerial coordination is essential, particularly in clean cooking planning.

Recent efforts to achieve cross-sectoral and vertical integration in energy planning have increased, with more open-source energy modelling tools becoming

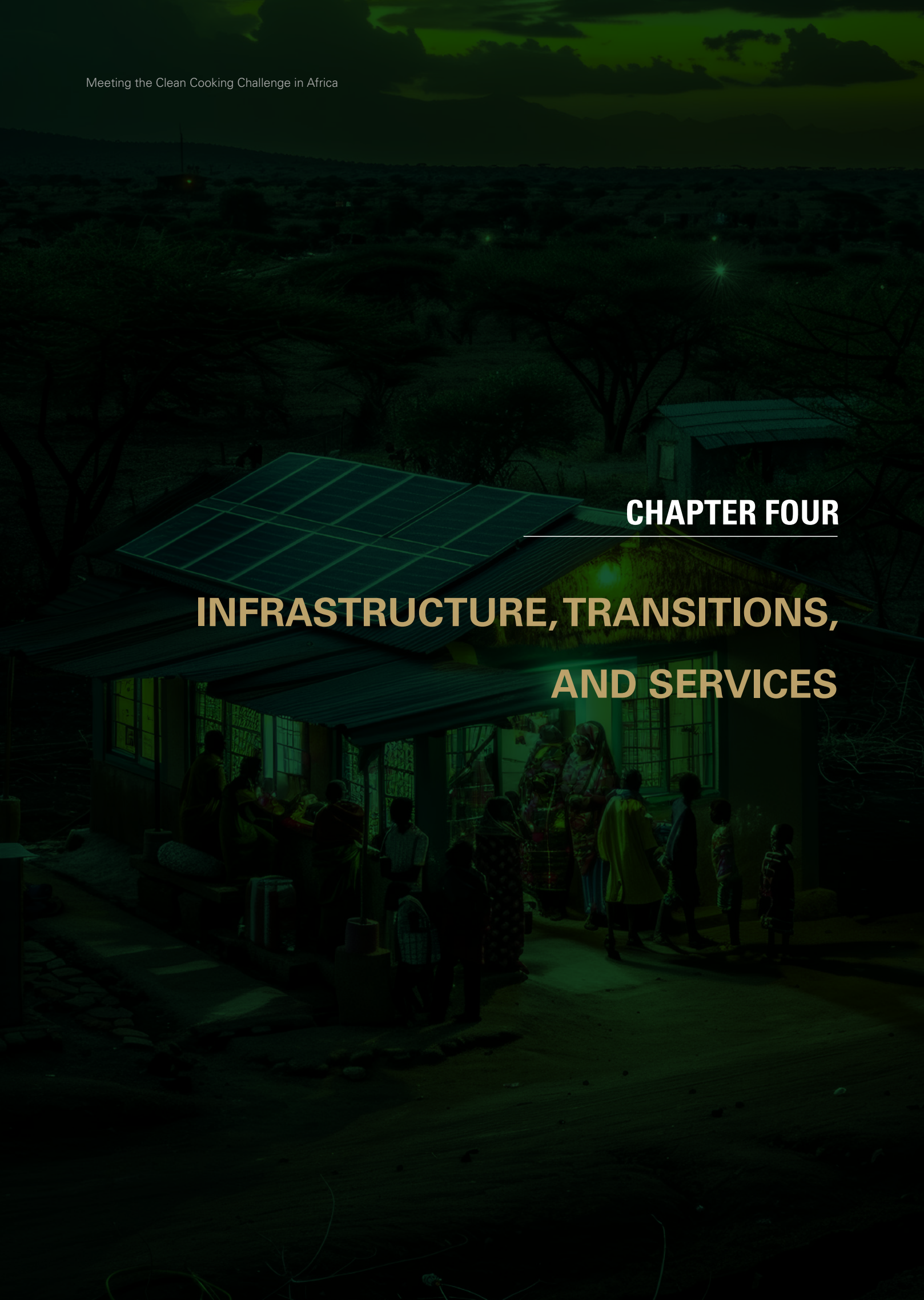
available, and efforts to gather better data, capturing local contexts. Combining tools like OSeMOSYS, OnSSET, and OnStove into a holistic energy modelling workflow can provide critical financial, technical, and climate insights, leading to more robust, data-driven political and financial decision that promote sustainable clean cooking solutions and contribute to achieving national and global net-zero goals.



E-cooking in a smart kitchen

CHAPTER FOUR

INFRASTRUCTURE, TRANSITIONS, AND SERVICES



CHAPTER FOUR

INFRASTRUCTURE, TRANSITIONS, AND SERVICES

This chapter examines the impact of multi-fuel clean cooking choices on Africa's economy and the broader Just Transition. Investments in infrastructure that support modern energy cooking services are crucial for economic growth. Traditionally, clean cooking has been viewed through the lenses of household health and environmental concerns, which has often

underestimated its wider economic impact. This section approaches clean cooking strategies with a focus on economic implications, considering the need for supporting or creating new infrastructure and the role of sustainable services. The key messages are:

1. Multi-Fuel Strategy:

Essential for a Just Transition, providing diverse options to cater to different socio-economic markets within a **country**.

2. Match Infrastructure Planning with Energy Services:

Integrate energy planning with climate commitments and infrastructure planning to support economic growth.

3. Economic Lens Integration:

Consider the economic growth, vulnerability to global price volatility, and climate commitments when choosing clean cooking strategies.

This chapter provides an overview of clean cooking fuels and appliances with significant scaling potential to meet the clean cooking dimensions of SDG7. It includes Tier 3 and 4+ Improved Cookstoves, LPG, biogas, bioLPG, hydrogen, electricity, and ethanol. Each is analyzed from

an economic perspective while considering health and environmental impacts. The analysis highlights the need for a multi-fuel strategy due to the complexity of cooking needs driven by socio-cultural contexts, resulting in fuel and appliance stacking.

4.1. Traditional & Modern Fuels – The Current Market Share

This section addresses transitions from biomass to improved cookstoves and modern fuels, outlining key infrastructure developments and services required to align with Net Zero Emission (NZE) pathways. It also considers the implications for Africa's economy, vulnerability to global volatility, and investment needs.

In 2021, Africa's primary energy supply was 808,768 kilotons of oil equivalent (ktoe), with biofuels and

wastes representing 45.3% of the total. For energy consumption, biomass drives household consumption (51%), petroleum powers transportation (27%), electricity accounts for 11%, natural gas 8%, and coal 3%. The share of biofuel consumption varies significantly across the continent. In IEA's "Access for All" scenario, 2.3 billion people gain access to clean and modern cooking by 2030, with 45% using LPG, 32% improved biomass

cookstoves, 12% electricity, and 10% biogas or ethanol. This scenario emphasizes the need for gas in Africa's energy transition, with clean cooking as a central part of a multi-fuel strategy. Through health and environmental lenses, natural gas is a higher-tier solution that minimizes health and environmental

impacts compared to unsustainably sourced biomass fuels.

Figure 4 illustrates the performance characteristics of various modern fuel types, highlighting different barriers and enablers to adoption.

	Type of stove	Health	Gender	Environment	Upfront cost	Fuel cost	Disruption risk	Scalability	Efficiency and cooking time
Basic	Gathered biomass	Low	Low	Low	High	High	Medium	Not applicable	Low
	Charcoal and fuelwood	Low	Low	Low	High	Medium	High	Not applicable	Low
	Coal	Low	Low	Low	Medium	Medium	Medium	Not applicable	Low
	Kerosene	Low	Low	Low	High	Medium	High	Not applicable	Low
Traditional	Improved biomass cookstoves	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium
Modern	LPG	High	High	Medium	Medium	Medium	High	High	High
	Natural gas	High	High	Medium	Medium	Medium	High	Low	High
	Electric cooking	High	High	Medium	Medium	Medium	High	Medium	High
	Biogas	High	High	High	Low	High	Medium	Low	High
	Ethanol	High	High	High	Medium	High	High	High	High
		High performance	Medium performance	Low performance	Not applicable				

Figure 4: Cooking Stove Assessment of Performance Against the usual Key Metrics (IEA, 2023, p. 21)

4.2. The Role of Biomass in Modern Cooking Transitions

A significant portion of the global population relies on biomass, which is often unsustainably sourced, as their primary cooking energy source. While traditional biomass stoves are not sustainable for achieving SDG7 and net zero targets by 2050, higher-tier biomass stoves can be part of a multi-fuel strategy for a just energy transition.

Improved cookstoves (ICS) have emerged over the last two decades but have not kept pace with population growth. They are seen as transitional solutions within a broader strategy, enabling a shift to modern fuels like LPG, natural gas, bioLPG, ethanol, electricity, and green hydrogen. Biomass gasification stoves, a new entrant, offer significant potential by

using solid biomass to create syngas for cooking. Critics argue that ICS have not delivered the expected health and climate benefits. However, in low-density rural areas, ICS may still play a role in a NZE world, especially where renewable biomass resources are available. ICS can be locally made, creating jobs and reducing dependence on imports, thus supporting the local economy and minimizing exposure to global price trends – however the adoption of these stoves is likely to continue as a one-off sale rather than a service provision of specialized fuel.

In higher-density rural areas, pellet and briquette provision can support the use of higher-performing Tier 3 stoves. Policymakers should promote only Tier 3

and 4 ICS or gasifier pellet stoves to achieve the cleanest possible cooking stack, in addition to the local job creation and reduction in foreign exchange dependence benefits. However, barriers to implementation, adoption, and sustained use remain significant due to upfront costs, high customer

acquisition costs, dependence on new fuel value chains, and cultural cooking practices. Upfront costs can be mitigated by results-based financing or carbon finance, although issues of overclaiming in carbon projects need to be addressed.

4.3. Beyond Biomass: Fuel Specific Pathways to 2030 and Beyond

Liquid Petroleum Gas (LPG) - The widespread adoption of LPG in Africa requires significant investment in infrastructure, including refilling networks, distribution systems, road networks, import terminals, and refining capacity. The price

volatility of LPG, often linked to crude oil prices, poses a challenge for its large-scale deployment which may expose African economies to economic instability as shown in Figure 5.

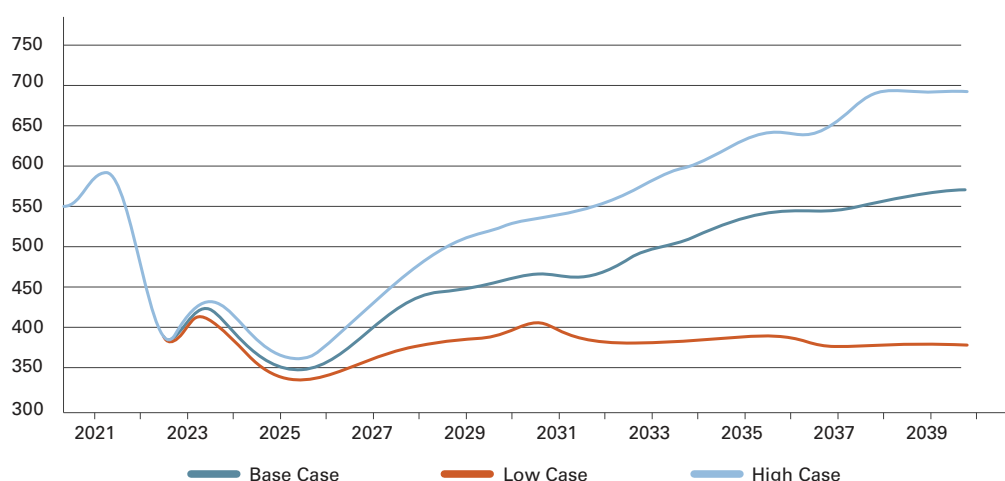


Figure 5: US LPG (MB) Price Forecast Sensitivity Analysis (Nominal), US\$/t (FGE, 2024)

Natural Gas - Both Liquefied Natural Gas (LNG) and LPG are essential for achieving NZE by 2050 and are part of Africa's just transition strategy. However, the increasing affordability of renewable energy generation is slowing the growth of natural gas markets. Natural gas can serve as a viable interim solution while longer-term renewable solutions are developed.

Circular Economy BioLPG - Turning waste into energy is a crucial component of urbanization, potentially reducing landfill methane emissions and contributing to climate change mitigation. Processes like COOL LPG and IH2 can produce propane directly usable in existing LPG infrastructure. While bio-LPG holds promise for long-term clean cooking solutions, its medium-term impact is likely limited.

Hydrogen - Hydrogen is unlikely to provide a

scalable clean cooking solution before 2030 due to the extensive infrastructure investments required. While blending natural gas with hydrogen could be tested, the method's effectiveness in reducing climate emissions is debated. Green hydrogen's potential lies in the long term, supported by programs like ESMAP's Green Hydrogen Support Program, making it a possible solution for 2050 NZE goals.

Bioethanol - Bioethanol is projected to provide clean cooking access to 6% of Africa's population by 2030. Its growth relies on targeted policies, investment frameworks, supply-demand incentives, fiscal regimes, and enhancing opportunities for carbon finance.

Electricity - Electricity as a clean cooking solution involves both national grid networks and off-grid

solutions like mini-grids and stand-alone systems. The advent of cost-effective energy storage at the household level can mitigate weak grid issues, encouraging eCooking. National grids are improving, with strong political commitments to universal access. Electricity is expected to constitute 12% of the clean cooking fuel mix by 2030, increasingly relying on renewable sources.

Biogas - Biogas production through anaerobic digestion of waste products offers a clean cooking fuel and organic fertilizer. Technological advancements in low-cost, IoT monitoring can address issues like fault detection and end-user financing. Biogas has potential at household,

institutional, and industrial scales, supporting smallholder farmers and rural populations. Inclusive Energy's Smart Biogas Meter exemplifies cost-effective monitoring solutions that can unlock carbon revenues.

Gasifier Stoves (Tier 4+) - Gasifier pellet stoves, achieving Tier 4 and targeting Tier 5 emissions standards, can use sustainable biomass and agri-residues. Despite cultural barriers, gasifier stoves have started to gain traction in Africa, with companies like Biomasters in Rwanda and Supamoto in Zambia. However, technical costs are comparable to eCooking and LPG appliances, making widespread adoption challenging without metered verification for carbon finance.

4.4. Key Takeaways from a Multi-Fuel Analysis

Multi-Fuel Strategy: The overall goal is to provide a cleaner cooking stack through a multi-fuel strategy, prioritizing Tier 3+ ICS and incorporating various fuels and technologies to cater to different regional needs.

Investment in Infrastructure: Significant investments are required for LPG and natural gas infrastructure to support their adoption. BioLPG and bioethanol also need targeted policies and investment frameworks to thrive.

Renewable Energy: The transition to renewable energy sources is crucial for sustainable clean cooking solutions. Electricity and biogas offer promising pathways, supported by technological advancements and political commitments.

Long-Term Solutions: While some technologies like hydrogen hold long-term potential, their immediate impact on clean cooking is limited. Long-term planning must consider these future technologies alongside more immediate solutions.

Community Engagement and Cultural Sensitivity: Overcoming socio-cultural barriers and ensuring community engagement are essential for the successful adoption of clean cooking solutions.

Carbon Finance and Economic Stability: Leveraging carbon finance and ensuring economic stability through diversified energy sources are vital for sustainable clean cooking transitions.

4.5. Multi-Fuel Transitions through the Health, Environment, and Economic Lens

Clean cooking strategies must be assessed through three lenses: health, environment, and economy. Each fuel has advantages and disadvantages depending on the criteria applied. Historically, clean cooking has been addressed primarily through health and local environmental perspectives, focusing on household emissions and deforestation. Higher tier fuels are desirable because they emit minimal particulates, reduce non-renewable biomass consumption, and have less impact on health. However, Tier 3 stoves still significantly affect

health despite being included in global statistics as fulfilling SDG7.

SDG7 calls for improved electricity access, increased use of renewable energy, better energy efficiency, and increased investment in clean energy. These improvements should be considered when determining the strategic fuel mix to leverage gains across the full SDG7 energy aspiration and support self-determined economic growth. While oil and gas are less favourable than renewable energy, they are still better for the

climate than non-renewable biomass emissions. In some contexts, using renewable biomass in higher tier stoves can be more climate-friendly than using coal to generate electricity without carbon recapture.

These three lenses—health, environment, and economy—change the criteria and priorities across the fuel mix, meaning no single basket of fuels will work for all situations. Governments need to create enabling environments that align mechanisms to improve health, the environment, and the economy. The private sector and development finance institutions can also assess fuels through these lenses to determine the best long-term returns in social benefits, climate mitigation, and economic growth. This approach should consider food and agricultural systems, industrialization, security, and self-determination.

Each fuel type presents unique health, environmental, and economic impacts. Some fuels require importation, making countries vulnerable to global prices and affecting their foreign exchange balance - reliance on crude oil prices for gas or electricity production may limit the growth of African economies but could benefit countries with oil and gas resources. Higher-tier stoves, such as those using LPG or electricity, are more desirable for their low particulate emissions and minimal health impacts. On the other hand, renewable biomass, such as ethanol or pellets, can be locally produced, supporting economic growth and job creation but may still have health and environmental drawbacks if not managed sustainably. Figure 6 presents the data in Figure 4 through this Infrastructure, Transition, and Service Lens.

	Type of stove	Minimal Infrastructure dependency	Job creation, manufacturing	Global price dependency	Disruption networks	FX dependency
Basic	Gathered biomass	High performance	High performance	High performance	High performance	High performance
	Charcoal and fuelwood	High performance	High performance	High performance	High performance	High performance
	Coal	Medium performance	Medium performance	Medium performance	Medium performance	Medium performance
	Kerosene	Medium performance	Medium performance	Medium performance	Medium performance	Medium performance
Traditional	Improved biomass cookstoves Tier 3	High performance	High performance	High performance	High performance	High performance
	Improved biomass cookstoves (Pellets / briquettes) Tier 4	Medium performance	Medium performance	High performance	High performance	Medium performance
Modern	LPG	Low performance	Low performance	Medium performance	Medium performance	Low performance
	Natural gas	Low performance	Low performance	Medium performance	Medium performance	Low performance
	grid Minigridd eCooking	Low performance	Medium performance	Medium performance	High performance	High performance
	Off-grid Minigridd eCooking	Medium performance	High performance	High performance	High performance	High performance
	Stand alone eCooking	High performance	High performance	High performance	High performance	High performance
	Biogas	High performance	High performance	High performance	High performance	High performance
	Ethanol	Medium performance	Medium performance	High performance	High performance	Medium performance
	bioLPG	Low performance	Medium performance	High performance	High performance	High performance

High performance
Medium performance
Low performance
Not applicable

Figure 6: - Basic, Transitional, and Modern Fuels through the Infrastructure, Transition, and Service Lens

Assessing clean cooking strategies through the lenses of health, environment, and economy reveals the complexity of choosing the right fuel mix and the importance of finding the correct balance between lenses. Governments and private sectors must align

their approaches to maximize social benefits, climate mitigation, and economic growth. By considering the diverse impacts of different fuels, they can develop integrated strategies that support sustainable development and energy access for all.



Smart house with hotplate using renewable energy

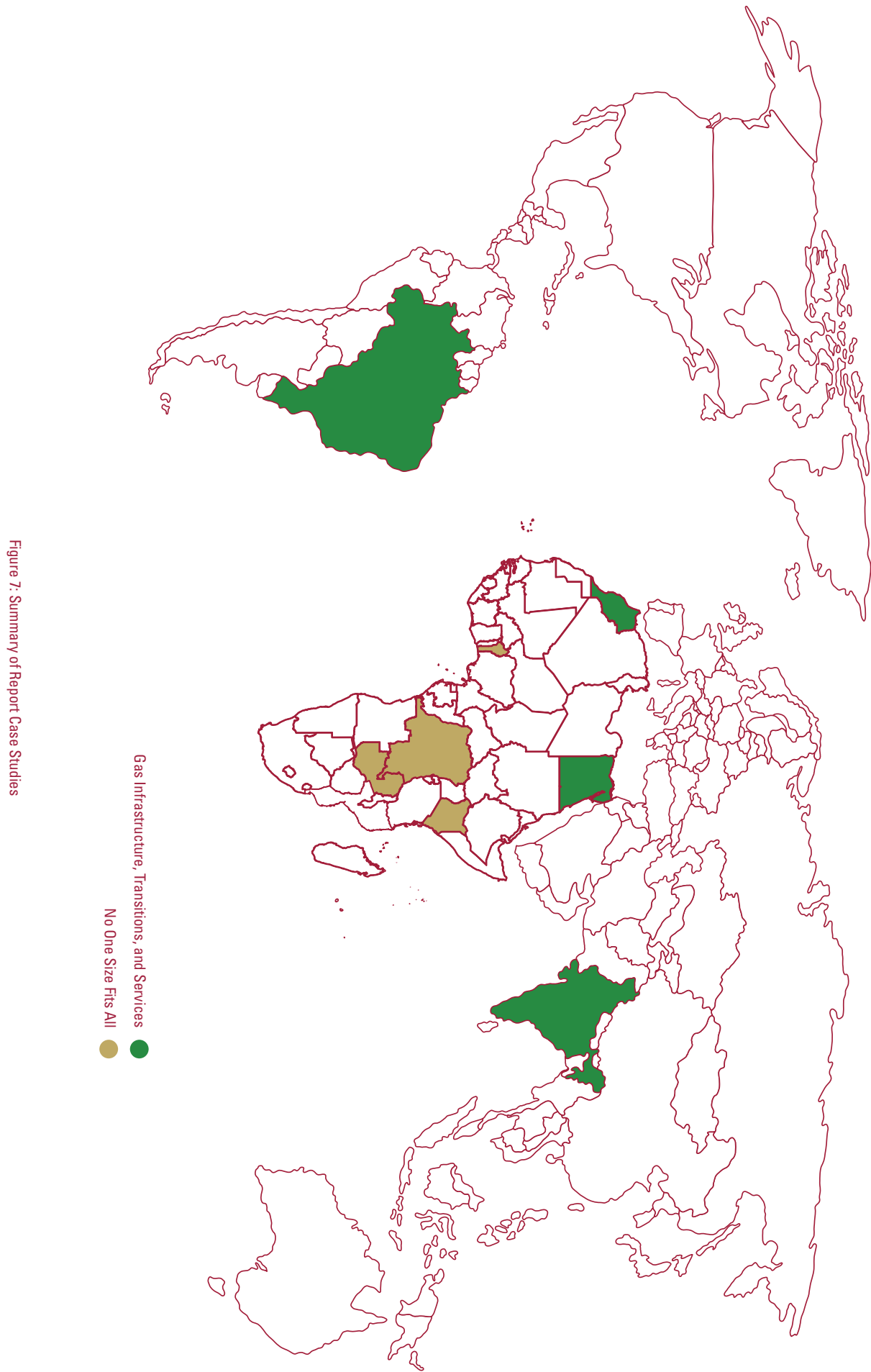


Figure 7: Summary of Report Case Studies

CHAPTER FIVE

COUNTRY-LEVEL ANALYSIS: INDICATORS TO TRACK PROGRESS ON THE CLEAN COOKING CHALLENGE



CHAPTER FIVE

COUNTRY-LEVEL ANALYSIS: INDICATORS TO TRACK PROGRESS ON THE CLEAN COOKING CHALLENGE

Previous chapters established the scale of the clean cooking challenge, outlined high level strategies for addressing those challenges, dived into the modelling of best-case clean cooking strategies, and identified the key fuels which can provide access to a basket of cleaner and modern clean cooking systems and services. As discussed, there is no “one-size-fits-all” approach to securing clean cooking pathways to 2030 and achieving NZE cooking by 2050 due to the complexity of national cooking cultures, existing resource endowments, levels of

energy infrastructure development (including available fuel types), governance capacity and accompanying (or lack of) policy and regulatory environments. In this chapter, the main report details 8 case studies to illustrate the economic lens as this is an under-leveraged dimension of clean cooking transitions. Not only are there health, environmental, and climate benefits to a sustainable transition to modern cooking fuels and appliances but there is also a clear economic case.

5.1. Case Study: Kenya's Leadership in Clean Cooking

We cannot hope to do justice to the detail of the country cases detailed in Chapter 6 of the report. Here we illustrate one particular case, Kenya. Kenya stands out as a global leader in the clean cooking sector, attracting significant international investment and showcasing robust policy frameworks and market diversity and demonstrating how a multi-fuel strategy can be articulated and enacted. The Clean Cooking Alliance (CCA) industry snapshot for 2022 highlights that Kenya received 72% of global investment in clean cooking in 2020, driven by its strong policy environment and economic growth. This leadership is evident in the wide range of clean cooking solutions available, providing more options for consumers than in many other markets.

Kenya has made notable strides in both clean cooking and electricity access. While around three-quarters of the population is now connected to the main electricity grid, the adoption of electricity as a primary cooking fuel remains low (<1%). However, innovations in appliance efficiency, consumer financing, and smart-metering are driving growth in the eCooking sector. A baseline study for the forthcoming Kenya National eCooking Strategy indicates that 24% of the population owns an eCooking appliance, though these are often used

alongside other fuels. Kenya has also become the first African country to scale bioethanol as a cooking fuel, with private sector-led initiatives like Koko Network reaching over 1 million customers.

Currently, 31.49% of Kenyan households use clean cooking fuels and technologies as their primary cooking solution, with LPG being the most common at 31%. The government has supported LPG through fiscal incentives and initiatives like the Mwananchi Gas project, which distributes cylinders to low-income households. Innovations such as PayGo metering also facilitate LPG access for low-income households.

Kenya's policy on clean cooking reflects its commitments to energy access and decarbonization, as seen in the Energy Transition and Investment Plan (ETIP) and the Kenya National Cooking Transition Strategy (KNCTS). These policies aim to achieve universal access to clean cooking by 2028 while contributing to the Paris Agreement targets. The KNCTS harmonizes various fuel-specific strategies, creating a cohesive environment for clean cooking solutions to thrive. It emphasizes truly clean cooking solutions, aligning with WHO guidelines on household air pollution, and includes LPG, bioethanol, sustainable biomass, biogas, and electricity.

Kenya's transition strategies include several scenarios to model different pathways towards universal clean cooking access. These scenarios consider various factors such as energy demand, greenhouse gas (GHG) emissions, and capital expenditures. The scenarios include:

- Business as Usual (BAU-S)
- Implemented Policies (IP-S)
- Gas-Focused (GF-S)
- Net Zero (NZ-S)
- Composite Policy (CP-S)

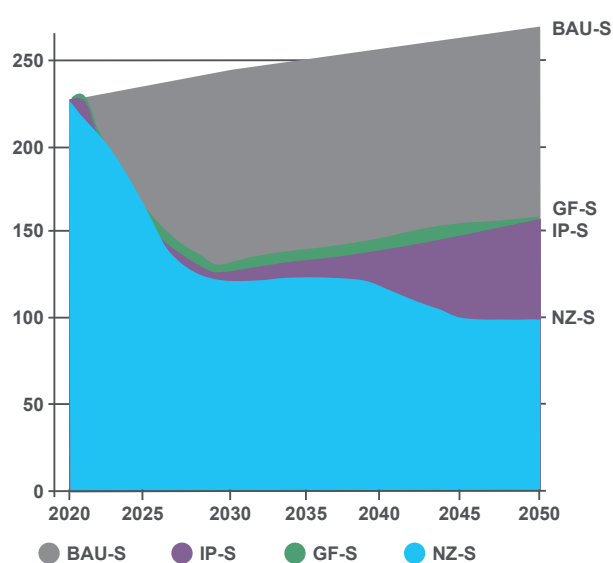


Figure 8: Energy Demand Across All Scenarios (in PJ) (MOEP 2024)

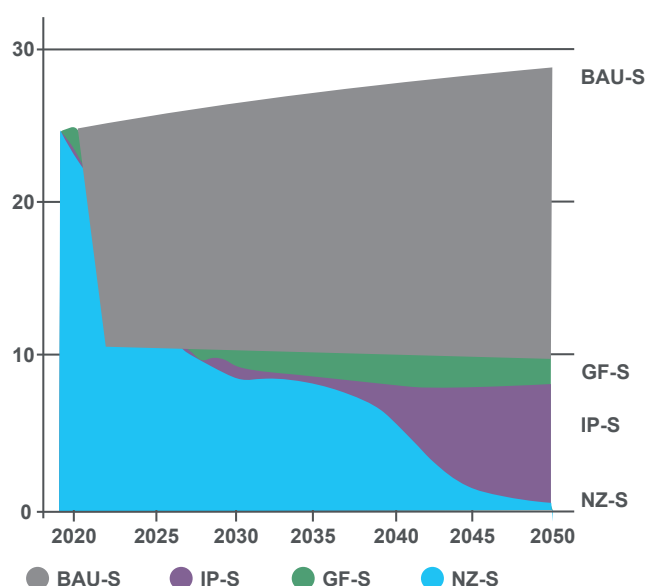


Figure 9: GHG Emissions Across All Scenarios (in MtCO_{2e}) (MOEP 2024)

Figure 7 and Figure 8 outlined the energy demand across all scenarios. The GF-S scenario focuses on LPG as a transition fuel, aiming for 50% of users to rely on LPG by 2030. The NZ-S scenario emphasizes renewable fuels like eCooking, biogas, and bioethanol. All scenarios aim to halve energy consumption by 2030 and achieve net-zero emissions by 2050. The NZ-S scenario is the most cost-competitive when considering the costs related to premature deaths caused by air pollution.

The multi-fuel approach of the CP-S scenario aims to balance the advantages and disadvantages of each fuel, offering greater resilience against supply chain disruptions and global price trends. While LPG emits less GHG than biomass, it introduces economic challenges due to global price instabilities and the need for subsidies. Kenya's high public debt-to-GDP ratio limits the government's capacity to subsidize social programs like clean cooking. Consequently, the KNCTS proposes minimizing direct subsidies and leveraging private-sector monetization of co-benefits like carbon credits and time savings.

The KNCTS modelling suggests significant social and private benefits from implementing clean cooking technologies. The total net social and private benefits include time savings, reductions in unsustainable wood fuel harvest, GHG emissions reductions, and decreased burden of disease. The government will need to enable the private sector to monetize these co-benefits to raise the necessary funds for fuel and stove subsidies.

Kenya's clean cooking transition demonstrates the benefits of collaboration between the private sector and government. The KNCTS outlines key actions for the government to bridge supply and affordability gaps, promote local manufacturing, raise awareness, and ensure accountability. By enabling multiple clean cooking transition pathways, the KNCTS offers an accelerated pathway towards universal access, leveraging the strengths of each fuel and technology. This comprehensive approach supports Kenya's journey towards sustainable and inclusive energy access.

5.2. Case Study Overview

Region	Country	Overview
Africa	Kenya	Kenya is a global leader in advancing the clean cooking cause, with a stable economy and a diverse market for clean cooking solutions. The recent CCA industry snapshot (CCA, 2022) states that a significant portion of global Clean Cooking finance has been attracted to Kenya over the last decade (72% of total global investment in 2020), due in part to its high policy readiness (RISE) scores and its growing economy. This is reflected in strong leadership on the issue from successive governments and innovation in the rapidly evolving private sector unlocking much greater choice to the everyday cook than in other markets.
	Zambia	electricity access has grown in Zambia, high levels of deforestation driven through increased use of charcoal undermines progress, hence the fragmentation between electricity access and clean cooking approaches has led to slow overall progress on clean cooking. Strategic use of integrated energy planning and efficiency measures which promote technologies such as eCooking can more effectively utilise existing resources and build on the electricity access gains of the last two decades. However, disparity between demand and supply means that, Zambia's government owned electricity utility has chosen to prioritise the mining sector over the domestic sector.
	Benin	Benin is an example of another country which to date also has a disconnect between energy planning for electrification and clean cooking – as illustrated in the recent eCooking Market Assessment (MECS et al.) With high aspirations for electrification, the clean cooking focus is on decreasing biomass use through improved cookstoves. Benin is aware that LPG offers potential as a transition fuel, however due to significant central government debt there needs to be an alternative to fossil fuel imports.
	Morocco	Morocco is an example of an economy that has already transitioned from traditional biomass use to LPG. Household subsidy levels for LPG are more than 50%, with the national bill at around \$2.1 billion in 2023. Aspiring to reduce the economy wide GHG, there have been discussions about transitioning to eCooking, but the prevailing ideas to maintain economic growth involve a transition to Natural Gas.
	DRC	The Democratic Republic of Congo (DRC) is an example of a particularly challenging economic context - in particular the stalemate of the war in the East for more than two decades. Infrastructure investment has been patchy, and there has been limited transition from traditional cooking methods. With significant forestry resources, there may be significant promise in generating carbon financing to fund DRC's transition to both clean and modern fuels and appliances.
	Egypt	Egypt's energy sector is powered by Natural Gas. This case study illustrates the need to diversify away from one fuel type, due to significant global price fluctuations and national demand growth, in order to create a basket of clean cooking solutions with distributed access amongst rural and urban populations.
Rest of the World	Brazil	The example of Brazil shows how transitions can take decades and how policies have to change and evolve to keep pace with the economic realities of domestic and global change otherwise countries may be faced with policies that consolidate an un-just energy transition.
	India	The example of India is included as it reinforces the challenges faced by different consumers in differing markets. Despite offering strong subsidies to shift to LPG use, the outcome has shown that refill rates among low-income households are low. The example draws attention to the affordability of the solutions and the need for leveraging all aspects of the economy to deliver an integrated energy system.

Table 1: Summary of Report Case Studies

5.3. Discussion & Analysis of Case Studies

The variety of case studies presented in the full report highlights that there is no single path to achieving clean cooking or modern energy cooking across Africa or globally. Evaluating transitions through health, gender, and environmental lenses shows that higher-tier stoves offer broadly equal benefits. Cleaner fuels like LPG, Ethanol, Biogas, and Electricity reduce non-renewable biomass use, household air pollution, forest loss, and promote gender equity by improving safety and saving time. However, different solutions have varying economic impacts, heavily influenced by infrastructural contexts.

Gas Infrastructure, Transitions, and Services:

- **Morocco and Egypt:** Transitioning to LPG improved household lives but at significant subsidy costs (\$2.1 billion annually for Morocco). Morocco, with 100% electricity access, is exploring transitions to Natural Gas for economic growth, despite potential for renewable energy.
- **India and Brazil:** Both countries illustrate long-term adaptation of LPG, showcasing the need for varied social policies and regulatory environments. India's high electricity affordability suggests a pivot to eCooking, whereas Brazil's renewable energy policies were funded by oil reserves.

One-Size-Does-Not-Fit-All:

- **Kenya:** Demonstrates a multi-fuel mix strategy to avoid dependence on any single fuel or technology. The country's integrated energy plan considers varied markets, from urban to rural areas, recognizing limitations like lack of all-weather roads affecting LPG supply.
- **Benin:** Exhibits a fragmented approach with high aspirations for electrification and a focus on improved biomass cookstoves to combat forest loss but faces challenges with high government debt and low LPG use.
- **Zambia:** Faces challenges with deforestation due to increased charcoal use, despite gains in electricity access. Prioritizing the mining sector over domestic energy needs complicates clean cooking transitions.
- **Democratic Republic of Congo (DRC):** With limited infrastructure and services, the DRC

shows intent to address clean cooking in its NDCs, leveraging significant forestry resources for potential carbon financing.

Case studies provide a comprehensive overview of country-level clean cooking landscapes but often overlook certain dimensions:

Institutional Scale: Includes schools, health facilities, and public institutions, often lacking structured approaches in energy access policies. Initiatives like the World Food Programme's pilots in various countries illustrate efforts to bring structure to institutional meal preparation.

Enterprise Scale: Encompasses restaurants, hotels, and agricultural processing. This scale offers significant job and empowerment opportunities but requires different policy frameworks. Standards for larger stoves are developing to regulate this market.

Displacement Settings: Humanitarian energy needs in displacement settings receive little policy support despite significant clean cooking challenges. The Global Platform for Action on Sustainable Energy in Displacement Settings aims to create a coordinated sector to address these needs.



Cooking with Gas Stove (using LPG cylinder) - Image by: Centre for Research in Energy and Energy Conservation (CREEC), Uganda, 2022.

5.4. No "One-Size-Fits-All" – Key Learnings

These case studies underscore the necessity of context-specific strategies for clean cooking transitions. The varied approaches reveal the importance of considering health, environmental, and economic impacts, and the need for integrated energy planning. By learning from diverse examples, countries can develop tailored strategies that promote sustainable, equitable, and economically viable clean cooking solutions. The key learnings were:

Economic Development. Viewing clean cooking through an economic lens refreshes policy approaches, highlighting vulnerabilities like dependence on imported fuels and government subsidies, and the lack of local job creation.

Market differentiation. Acknowledges that different settings (urban, rural, nomadic) require different

solutions. Offering a basket of choices allows for diverse consumer needs and economic vulnerabilities to be addressed.

Energy Access for all through Inclusive Energy Planning Processes. Ensuring that institutional, enterprise, and displacement clean cooking sub-sectors are integrated into energy planning processes prevents them from being left behind.

Future projections. Africa's vulnerability to climate change necessitates positioning its economy for resilience. Clean cooking, while seemingly unrelated, significantly impacts emissions and requires strategic planning to align with climate goals.



Renewable energy solutions for African villages

CHAPTER SIX

MOVING FORWARD: PLANNING FOR SCALABLE SUSTAINABILITY

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For clean cooking transitions to be successful in Africa, leadership and coordination must come from within the continent. At the national level, the design and implementation of integrated energy plans require intra-governmental coordination to align ministries, agencies, and utilities within the national energy system. This coordination must be led by governmental teams responsible for strategy delivery.

On the international stage, the global clean cooking sector has traditionally been driven by interests outside Africa. To unlock the next generation of clean cooking strategies, policies, and projects, the sector must be driven by and for Africans. African leadership is crucial to achieving the 2030 and 2050 targets, with the African Union (AU) playing a major role in coordinating these efforts.

This report supports the design of the African Union's African Clean Cooking Programme, as called for by African Ministers responsible for Transport and Energy during the 4th Ordinary Session of the Specialized Technical Committee on Transport, Transcontinental and Inter-regional Infrastructure,

and Energy in September 2023. The intent is to establish a baseline, track progress on clean cooking across Africa, disseminate information on the current status, and support the development of a targeted continental clean cooking strategy.

The establishment of an AU-led Africa Clean Cooking Facility (ACCF) is envisioned to provide technical and financial support to AU Member States in their nationally determined transition efforts.

Throughout this report, multiple dimensions of sustainable scaling pathways for universal access to modern cooking fuels and appliances have been highlighted. These pathways aim to address the clean cooking challenge across Africa's 55 countries. The goal is to enable more effective planning, coordination, and implementation of strategies, policies, and programs that drive the transition to modern cooking fuels and appliances. This transition must make national economic sense and align with contextual clean cooking needs. The ACCF can play an invaluable role in supporting national strategy development processes.



Microwave, EPC, and Hot Plate used in a Ugandan Kitchen. - Image by: Centre for Research in Energy and Energy Conservation (CREEC), Uganda, 2022

Recommendations for Effective National Clean Cooking Strategy Development Across Africa

1

Recommendation 1 – Clean cooking transition programmes in Africa should not only consider health, gender and environmental benefits but should also be focused on realising the significant potential for clean cooking to contribute towards economic development.

Improving the state of clean cooking will release economic benefits based on the health, gender and environmental benefits to be gained. All of the estimated costs of the maintenance of the status quo may be underestimates, whilst the potential economic gains are also generally underestimated.

Action:- The AfCCP to support African governments in calculating the economic gains to be realised from the adoption of clean cooking transition strategies and to support, amongst other related activities, the adoption, utilization and improvement of the modelling techniques 4.

2

Recommendation 2 – Build national baskets of fuels based on available resources, existing and potential value chains and infrastructure for a just clean cooking transition that supports socioeconomic growth.

Taking decisive action to tackle clean cooking deficits rapidly could translate into substantial economic benefits or it could create longer term economic vulnerability. In thinking through this challenge, substantial lessons can be derived from the longer-term experiences of India, Brazil, and Morocco. In support of a complementary multi-fuel strategy, Africa's richness in renewable energy resources will also be a crucial consideration.

Action:- (a) Clean Cooking Programmes to support the wider development of all fuel options and relevant energy infrastructures including natural gas and LPG on the continent ensuring affordability without introducing undue financing burden (b) The AfCCP to support African governments in considering the longer-term financial viability of their Clean Cooking Programmes, via technical assistance in assessing the implications of decarbonisation, global infrastructural funding trends and predicted price movements for all fuel without introducing undue financing burden.

3

Recommendation 3 – African Governments should integrate clean cooking transitions as part of overall national energy and economic planning.

Clean cooking needs to be seen as a strategic part of comprehensive energy and economic planning not as a siloed stand-alone delivery programme. Significant funding is required both to close data gaps and to establish a meaningful data baseline that can be used for effective integrated energy and economic planning.

Action:- The AfCCP to (a) support African Countries to develop and implement integrated national clean cooking plans and (b) work with national and international partners to enhance relevant data collection for monitoring and evaluation

4

Recommendation 4 – Clean cooking transitions to leverage infrastructural and technological innovation to drive contextually aligned solutions

Gains have been made recently on infrastructure delivery across Africa, not just electrical networks but also all-weather roads, digital communication systems and financial services - all of which can support a transition to modern energy cooking. For example, there are significant opportunities to leverage the gains in electricity infrastructure; while many urban households are connected, most continue to use polluting fuels for their cooking. However, this is only sustainable if there is full cost recovery in the electricity tariff. Similarly, the ubiquitousness of digital services now enables new approaches to clean cooking. This can again lead to leveraging the gains in digital infrastructure, improving average revenue per user and improving the returns on investment particularly in rural areas.

Action:- Clean Cooking transition programmes leverage existing infrastructure and technologies to drive cross-sectoral win-win alignments

5

Recommendation 5 – Leverage carbon finance to support Clean Cooking Programmes

Africa as a part of the global economy has barely contributed to the problem of climate change and yet will by all estimates be one of the worst affected continents. This is disturbing, but also presents an opportunity. To date the voluntary carbon market has been able to address some issues with clean energy and forestation. The carbon market is formalizing through Article 6, and this presents significant future opportunities for carbon flows. Energy sector decarbonisation will increasingly provide substantial opportunities for financial flows.

Action:- The AfCCP to support member states efforts in accessing carbon finance for clean cooking transitions through among others capacity building.

6

Recommendation 6 - Leverage multiple financing opportunities for clean cooking transitions.

Considering clean cooking as an underlying enabler for a strong economy means that finance for transitions could come from multiple budget lines. There are considerable budgets associated with modern energy infrastructure development and public health. While the first response is to address the health impact on the people, a wider economic view could see health budgets used to mitigate the source of the HAP directed to clean cooking. Similarly, youth employment budgets, could target the increase in jobs associated with a clean cooking transition strategy.

With Africa spending approximately \$24 billion each year on electricity infrastructure and connection, and increase in funding expected in the coming years, pivoting even a portion of users to utilise eCooking as part of a clean stack can be a minute cost compared to such sums and represents an opportunity to deliver scaled clean cooking delivery without any direct infrastructural development

costs for fuel system development. Across African states, one of the strongest sources for financing the uptake of modern energy cooking will be transitioning the existing purchasing power of the consumer.

Globally, we have acknowledged that Africa will be strongly affected by Climate Change, yet the region is a net negative contributor. Green Climate funds are a source of finance that can be leveraged to transition from traditional biomass to modern energy, mitigating GHG emissions in the process.

Action:- The AU to launch an African Clean Cooking Facility under the AfCCP as a vehicle to raise funds for African clean cooking transitions, distributing those resources amongst AU member states alongside support for other innovative fund-raising activity.

7

Recommendation 7 - Turn the increased international interest in Clean Cooking into Domestic political will.

Several international organizations and financial institutions have recently made commitments to support transition to clean cooking. To leverage on the existing goodwill, clean cooking must be seen by policy makers as a linchpin of national economic growth and energy planning and hence a key strategic objective to be supported via national budgets and political prioritization.

Action:- The AU to enhance advocacy on clean cooking at the highest political level for AU Member States to prioritize clean cooking at a national level.

8

Recommendation 8 – Consider local contexts in Clean Cooking transition planning and develop strategies that include cultural preferences, prioritise women, protect vulnerable groups and respond to socioeconomic trends to ensure inclusive clean cooking for all.

Clean cooking transitions are not always fair, just, and equitable. Despite women playing a critical role in the clean cooking system and being a central component of successful modern energy cooking projects they are often not specifically addressed in the policy landscape. Special attention is needed to understand the importance of clean cooking access inequality within countries and the need for interventions to be targeted. This targeting will likely be through increasing social safety nets, social expenditure, and targeted subsidies. Often the unincluded sub-sectors, such as people living in displacement settings, require different approaches and delivery models to ensure that they are not left behind in the race to 2030. In addition, evolving habits and behaviours have important implications for the clean cooking sector. The increasing urbanization of Africa is connected to an evolving socio-economic culture and a shift in their consumption patterns. Habits such as purchasing energy (as opposed to collecting fuelwood), purchasing processed food (pre-cooked beans, street food among others), joint decision-making between men and women and smaller household sizes will all create market differentiation.

Action:- The AfCCP to work with AU Member states to (a) ensure inclusivity and a just transition to clean cooking that leaves no one behind, (b) advocate for gender-inclusive policies to address gender disparities and promote the integration of gender considerations into national clean cooking programmes and (c) to map broader socio-economic changes that might affect food consumption and cooking preferences.

9

Recommendation 9 – Promote development of clean cooking value chains across the African continent

By moving manufacturing value chains to Africa, and linking to the African free trade area, the local production of modern cooking appliances, such as electric pressure cookers, LPG stoves, forced air gasifier cookstoves and biogas digesters, can have a positive impact on job creation and local economic development. Promoting partnerships between international manufacturers and local agents or distributors can facilitate the availability and affordability of high-quality appliances.

Action:- a) The AfCCP to support AU member states to map supply chains for the basket of clean cooking options, and to highlight the impact on job creation and added value to the food system, b) AU member states in partnership with private sector to establish local supply chains for the basket of clean cooking options.

10

Recommendation 10 – Clean cooking transition strategies should emphasize quality and standards and focus on consumer outreach but also be sensitive to the likely need for continued promotion of improved cookstoves (especially Tier 3 and Tier 4) in isolated rural areas.

For multi-fuel strategies, educational campaigns will be indispensable for informing consumers about the efficiency, safety, and environmental advantages of using cleaner cooking, dispelling misconceptions, and encouraging widespread acceptance. In addition, implementing and enforcing testing standards for indoor and outdoor emissions, thermal efficiency, quality of construction, fitness for purpose and safety are necessary to ensure the quality and performance of cooking appliances and instil confidence in customers. If the uptake of Tier 3 and Tier 4 ICS is to have a role within national multi-fuel strategies, then there will need to be an intentional plan to help communities understand their benefits.

Action: - The ACCP to emphasize that all national strategies should promote public awareness campaigns (with a strong focus on demonstrations and peer to peer learning for Tier 3 and 4 biomass stove promotion) and the adoption of effective national standards for each stove type

11

Recommendation 11: Africa's Cooking Transition must be led by African governments and institutions.

In the international context, the global clean cooking sector has historically been driven by interests from outside of the African continent. To unlock the next generation of clean cooking strategies, policies, and projects, the clean cooking sector must be driven by and for Africans. African leadership is critical to the achievement of 2030 and 2050 targets.

Action: - The AUC to establish an AU-led African Clean Cooking Programme (AfCCP) to provide technical and financial support to AU Member States in the delivery of nationally determined cooking transition efforts



Market using bioethanol energy

This report has been developed to support the design of the African Union's African Clean Cooking programme called for by the African Ministers. We envisage an AU-led Africa Clean Cooking Facility, which addresses each of the above recommendations as outlined above. The establishment of this facility (and its resulting programme of work centred around the economic opportunities embodied within the meeting of the clean cooking challenge) will ensure that Africa will break free from the siloed clean cooking response of the last 30 years via its high priority inclusion in integrated energy planning and wider economic planning.



AFREC

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