REPUBLIC OF KENYA

MINISTRY OF ENERGY AND PETROLEUM

POWERING FREEDOM

KENYA NATIONAL COOKING TRANSITION STRATEGY

2024 – 2028

eed ADVISORY 10 YEARS

UK PACT

UKaid

MECS Modern Energy Cooking Services

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

GREEN CLIMATE FUND

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Acronyms

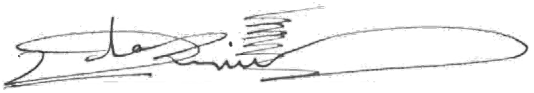
CCA	Clean Cooking Alliance
CCAK	Clean Cooking Association of Kenya
CCT	Controlled Cooking Test
CDM	Clean Development Mechanism
CET	Common External Tariff
COPD	Chronic Obstructive Pulmonary Diseases
CRA	Comparative Risk Assessment
DALYs	Disability-Adjusted Life Years
DANIDA	Danish International Development Agency
EnDev	Energising Development
ESMAP	Energy Sector Management Assistance Program
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HAP	Household Air Pollution
ICS	Improved Cookstove
IER	Integrated Exposure Response
IHD	Ischemic Heart Disease
ISO	International Organization for Standardization
IWA	International Workshop Agreement
KES	Kenya Shillings
KIRDI	Kenya Industrial Research and Development Institute
kMT	Thousand (Kilo) Metric Tonnes
KNBS	Kenya National Bureau of Statistics
KOSAP	Kenya Off-Grid Solar Access Project
KWFT	Kenya Women Microfinance Bank
LPG	Liquefied Petroleum Gas
MFI	Micro Finance Institutions
MTF	Multi-Tier Framework
NGO	Non-governmental Organization
PAYG	Pay-as-you-go
PSUs	Primary Sampling Units
SACCO	Savings and Credit Cooperatives
SCODE	Sustainable Community Development Services
SDG	Sustainable Development Goals
SEforALL	Sustainable Energy for All
SMEs	Small and Medium-sized Enterprises
SEZ	Special Economic Zones
SNV	Netherlands Development Organization
SPSS	Statistical Package for Social Sciences
TOR	Terms of Reference
TSOF	Three Stone Open Fire
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollar
WBT	Water Boiling Test
WHO	World Health Organization

Foreword

Cooking touches every home across the country. Today, the use of polluting fuels such as firewood, charcoal and kerosene has dramatic consequences for public heath, the local and global environment, as well as the opportunities for women and girls. As a result, the Government of Kenya set an ambitious goal of universal access to clean cooking by 2028.

The aspiration for universal access was informed by the broader commitments we have made as a nation through the Sustainable Development Goals (SGDs) and our Nationally Determined Contribution (NDC) goal of lowering emissions by 43MtCO_2 equivalent by 2030. Kenya's Vision 2030 and the Bottom-Up Economic Transformation Agenda underlines Kenya's commitment to improving the livelihoods and welfare of its citizens. This strategy lays out a pathway for achieving universal access that will not only improve quality of life for those who cook, but will also create new jobs across the value chain by prioritising the local production of both cooking devices and the fuels that power them. In doing so, Kenya will be able to cement its role as a regional hub for clean cooking solutions.

Through a participatory approach that brought together key stakeholders from Kenya's rapidly growing clean cooking sector and deepened the evidence-base on critical sub-sectors, this strategy has been able to harmonise across the many different approaches to tackling the clean cooking challenge. It charts a pathway towards universal access that leverages Kenya's unique position as a regional innovation hub, with an array of clean cooking technologies already deployed at scale in the market. By building upon the firm foundation laid by the existing fuel-specific strategies and the actions of the private sector, this strategy aims to create the enabling environment in which all clean cooking solutions can thrive.



Davis Chirchir, EGH
Cabinet Secretary
Ministry of Energy and Petroleum

Preface

Kenya is a global leader in the clean cooking space. We are fortunate to have a vibrant clean cooking sector, with many different sub-sectors offering consumers a diverse array of solutions. Until now, there has been limited coordination between these sub-sectors. As a result, the Cooking Transition Strategy was commissioned to harmonise across this diverse set of actors and provide coherence to Kenya's clean cooking sector. The strategy joins the dots between the existing fuel-specific strategies, such as the Bioenergy Strategy, the Bioethanol Masterplan, the LPG Growth Strategy, and the Electric Cooking Strategy, to create a cohesive enabling environment under which all solutions, both transitional and truly clean, can thrive.

The strategy focuses on clean cooking solutions (at point of use) that have a critical role to play in transitioning large segments of the population away from unsustainably harvested and inefficiently burned biomass. These include LPG, bioethanol, low emission/clean burning sustainable biomass e.g., briquettes and pellets, biogas, and electric cooking, which offer long-term sustainable pathways that leverage Kenya's abundant renewable energy resources.

The Kenya National Cooking Transition Strategy (KNCTS) articulates the next steps that households across Kenya can take in the journey towards universal access to clean cooking. It outlines five key actions that the government will take to facilitate this journey: bridging the supply gap for clean cooking solutions; bridging the affordability gap for the demand side; promoting local manufacturing and fuel production for local use and export; reframing and raising awareness on the role of clean cooking; and instituting accountability, planning, and continuous tracking of progress

Alex K Wachira, CBS
Principal Secretary
State Department for Energy

Acknowledgements

The Ministry of Energy and Petroleum (MoEP) is honored to present the Kenya National Cooking Transition Strategy (KNCTS), a collaborative effort between the MoEP through the Directorate of Renewable Energy and a consortium of development partners comprising Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Agence Française de Développement (AfD), UK Partnering for Accelerated Climate Transitions (PACT), Climate Compatible Growth (CCG), and the Modern Energy Cooking Services Programme (MECS).

We would also like to acknowledge the invaluable support accorded by the coordination committee, comprised of representatives from various government ministries, non-governmental organizations, national institutions, the private sector, academia, sectoral associations, development partners, and EED Advisory (lead consultants). This committee played a pivotal role in overseeing the development of the KNCTS. The committee was co-chaired by the Ministry of Energy and Petroleum (MoEP) and the Modern Energy Cooking Services Programme (MECS).

For a full list of institutions that have contributed to the development of this strategy through the coordination committee, the contributing studies/strategies commissioned by the coordination committee members, the sectoral roundtables, and key informant interviews, please see Annex 4 .

Executive Summary

Introduction

The Government of Kenya aims to achieve universal access to clean cooking by 2028. This target is motivated by the urgent need to accelerate the transition to cleaner cooking solutions to mitigate the negative impacts associated with the use of traditional fuels. It is also related to global commitments outlined in Kenya's Nationally Determined Contribution (NDC) under the UNFCCC Paris Agreement, the Sustainable Development Goals (SDGs), and the Sustainable Energy for All (SEforALL) agenda. This commitment is consistent with Kenya's Vision 2030, a strategic framework aimed at elevating the country to the status of a newly industrializing, middle-income country by 2030, with improved quality of life for all residents.

The Ministry of Energy and Petroleum commissioned the development of the Kenya National Cooking Transition Strategy (KNCTS) in September 2022 as a transparent, data-driven, and inclusive effort to articulate Kenya's national cooking sector priorities and aspirations. The strategy aims to transform the cooking sector in Kenya into a sustainable and profitable sector in line with the target of attaining universal access by 2028. KNCTS defines clean cooking as cooking with fuels and stove combinations that meet the standards defined by the World Health Organization (WHO) guidelines for indoor air quality. These include cooking solutions that attain Tier 5 on carbon monoxide emissions (≤ 3.0 g/MJ) and Tier 4 on PM2.5 (≤ 62 mg/MJ) emissions. However, the strategy aims to ensure that all households are using clean cooking solutions as part of their fuel stack and to encourage as many households as possible to use clean fuels as their primary source.

The current state of cooking in Kenya

The 2022 KNBS Demographic and Health Survey (DHS) reveals a high dependence on traditional cooking fuels. In total, 68.5% of the population, or 9.1 million households (1.7 million in urban areas and 7.4 million in rural areas), rely on traditional cooking fuel options as their primary source. Firewood remains the predominant cooking fuel.

9.1 million households in Kenya (1.7 million in urban areas and 7.4 million in rural areas), rely on **traditional cooking fuel** options as their **primary source**.

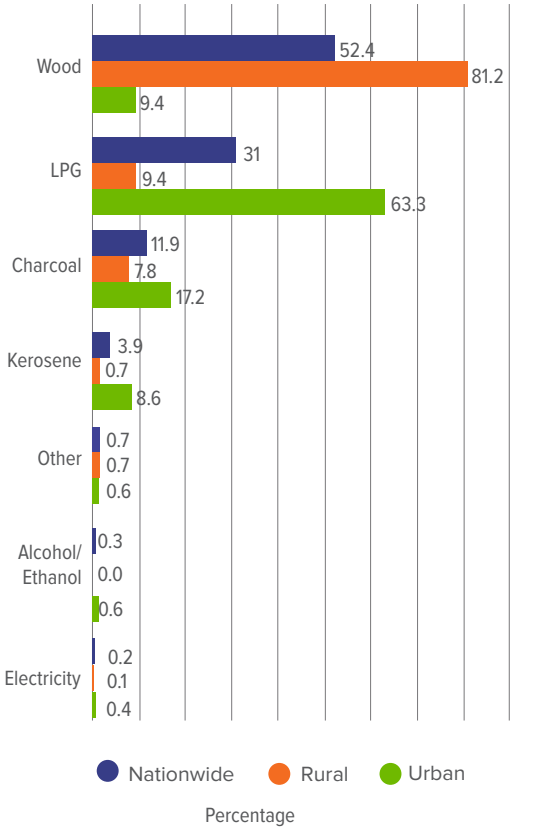


Figure ES 1: Main Cooking Fuel at the Household Level (compiled with data from KNBS & ICF, 2022)

At the county level, the prevalence (proportion of households without access) and the deficit (absolute number of households without access) vary across counties as shown in the figure below. While counties listed as underserved under the Kenya Off-grid Solar Project (KOSAP) have the highest prevalence of households without access to clean cooking solutions, Nakuru, Kakamega, Meru, Bungoma, and Nairobi counties have the highest deficit. These five counties account for 1.83 million households, or 21% of the national deficit, which is comparable to the estimated 1.69 million households not using clean cooking solutions in the fourteen KOSAP counties. The top five counties with the highest prevalence account for 0.58 million households, or 6%, of the total.

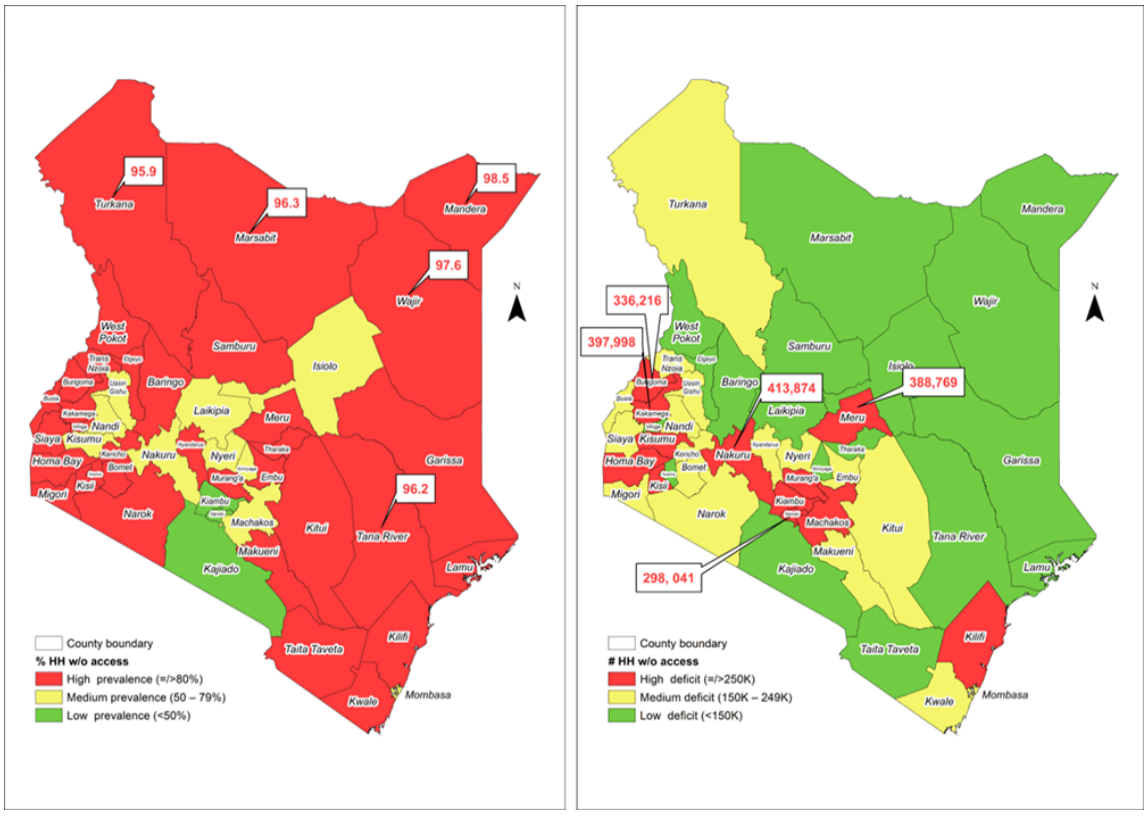


Figure ES 2: Household without Access to Clean Cooking – Prevalence versus Deficit (compiled with data from KNBS & ICF, 2022)

Nakuru, Kakamega, Meru, Bungoma, and **Nairobi** counties have the highest deficit of clean cooking solutions accounting for **1.83 million households**, or **21% of the national deficit.**

Characterisation of households without access to clean cooking solutions yields four market segments, as shown below. All households without supply fall into four quadrants: Q1(non-commercial markets with adequate supply chains) – Urban households that cannot afford clean cooking solutions, Q2 (commercial markets) – Urban households that can afford clean cooking solutions, Q3 (non-commercial markets) – Rural households that cannot afford clean cooking solutions, and Q4 (commercial markets with inadequate supply chains) – Rural households that can afford clean cooking solutions.

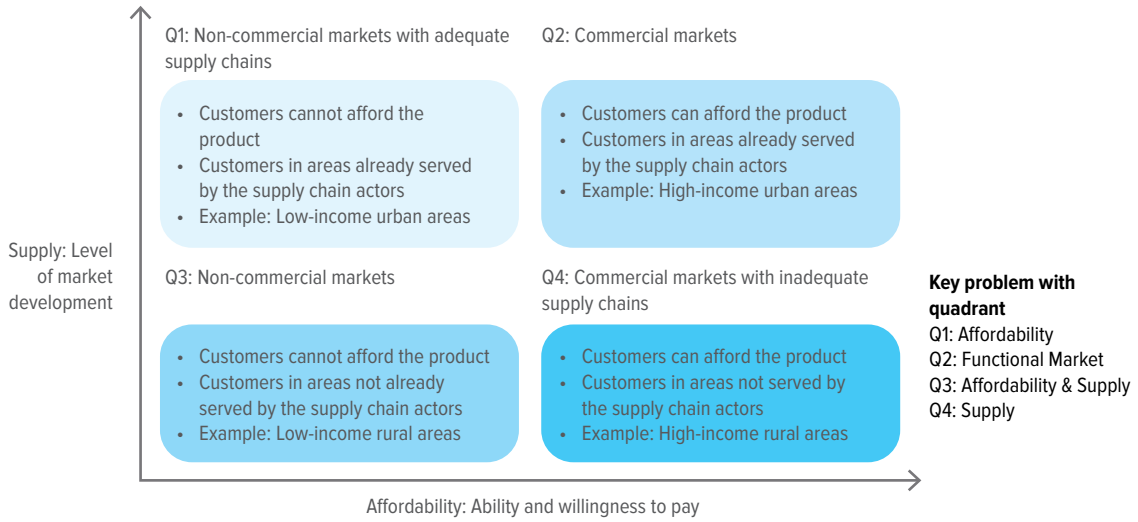


Figure ES 3: Market Segmentation

Further analysis to estimate the Total Addressable Market (TAM) and Total Serviceable Market (TSM) for clean cooking stoves and appliances indicates that out of 9.1 million households, only 0.6 million fall under the total serviceable market, as shown in the figure below.

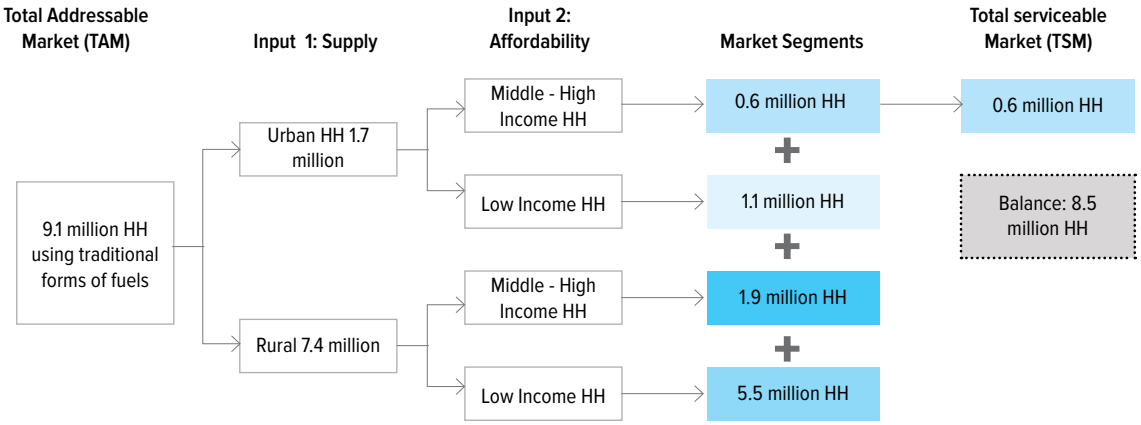


Figure ES 4: Estimates of the Number of Households per Market Segment

Policy and institutional infrastructure

The cooking sector in Kenya is influenced by policies, regulations, legislations, and standards operating at the global, regional, national, and sub-national levels. The Ministry of Energy and Petroleum is tasked with promoting access to clean cooking, ensuring a favourable policy environment, and attracting investments into the cooking sector. However, several public sector entities work closely with MoEP to achieve this goal. These include the core ministries of energy and petroleum, health and environment, and climate change. The coordination of efforts among these ministries needs improvement, and the Ministry of Energy and Petroleum specifically requires increased support to achieve this objective.

Barrier analysis

The process of developing the KNCTS strategy sought to go beyond the conventional menu of challenges to identify the most binding of these constraints by employing the growth diagnostic framework (Hausmann et al., 2008). The process of analysing barriers identifies the three most binding constraints, which are (i) supply gap (limited or no supply chains); (ii) affordability (relatively lower income or high incidence of poverty); and (iii) availability of low-cost or no-cost alternatives as shown below. While certain counties may face contextual challenges, the majority are impeded by these three critical constraints.

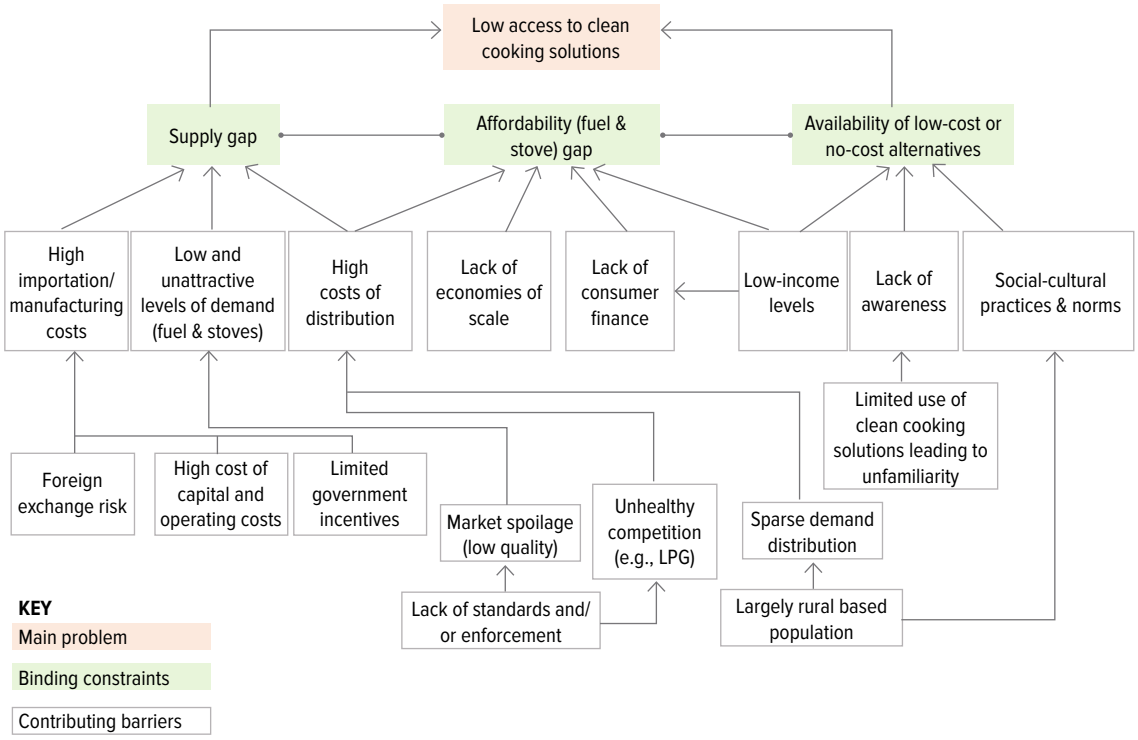


Figure ES 5: Problem Tree – Identifying the Binding Constraints (EED Advisory, 2023)

The five-point agenda

This strategy aims to guide and orient the country toward the goal of universal access through five interconnected action agendas (see the figure below). Additionally, the five-point agenda will guide the sector to realise the targets under the composite policy scenario (CP-S), which aims to have at least 50% (LPG stoves), 30% (bioethanol) 10% (electricity) 3% (biogas technology), 7% (low emission/clean burning sustainable biomass e.g., briquettes and pellets), of households in Kenya, using the designated clean cooking solution. The overarching action agenda five (5) will ensure that this strategy is instituted, implemented, and supported while also ensuring that plans are built on this framework.

The implementation budget is estimated to be KES 65 billion (US$435 million) spread over five years. This includes private sector investments, carbon finance and other climate finance options, public finance, philanthropic contributions, and development agency assistance. Additionally, the strategy recommends the creation of a fund dedicated to clean cooking. It proposes that the government publicly announce its financial commitment in the inaugural financing round to demonstrate the efficacy of the fund's framework.

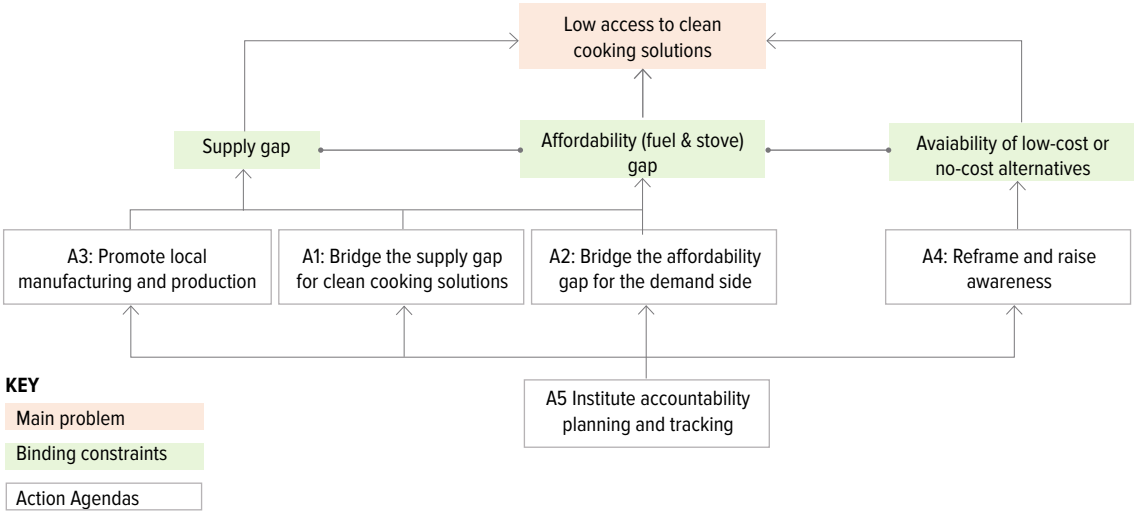


Figure ES 6: Targeting the Action Agenda

Costs and benefits of implementing the strategy

Implementing the strategy considering 100% utilisation of clean cooking solutions necessitates an annual government cost of US$210,711,189, along with private costs (borne by households) amounting to US$71,568,309. Whereas the fuel (US$178 million) and stove (US$10.3 million) subsidy costs are allocated to the government, they will be primarily financed through trading of clean cooking co-benefits (e.g., carbon credits, averted disability-adjusted life years, and time savings) generated from the sustained use of clean fuels and technologies.

The government's spending covers stove subsidies and bioethanol subsidies, which the main supplier of the solution currently provides. Consequently, the overall social and private benefits would reach US$240,106,966. It's important to note that the actual benefits could be even greater, as the current assessment does not factor in elements such as job creation and government revenues from taxes. Implementation of the strategy (at 100% utilisation of the cooking solutions) is projected to prevent approximately 26,589 deaths related to household air pollution, save 789.7 hours per household per year spent on firewood collection, and avoid the emission of 16 MtCO2e annually. While the strategy initially focuses on ensuring households are using clean cooking solutions as part of their fuel stack, the results of the modelling exercise emphasise the advantages that support a compelling case for pushing towards 100% use of clean cooking solutions for all cooking needs. This approach aims to maximise the benefits derived from such transitions.

The avoided unsustainable wood harvest is equivalent to **466,543ha** (≈11% of Kenya's forest cover of **4.2 million hectares**) based on an average wood production of **3.2 tonnes** per hectare.

Note to the Reader

This strategy is presented in four chapters.

Chapter 1

Baseline which describes the current state of play.

Chapter 2

Barriers, Challenges, and Opportunities which explains the historical context and the causes of the current state of play while outlining the opportunities.

Chapter 3

Target Setting which offers a vision for the cooking industry in 2028.

Chapter 4

Logic of Intervention which explains the actions needed to propel the sector toward universal access to clean cooking by 2028.

This document should be read together with the associated modules that provide more details on the aspects discussed here. The modules shown in the table below can be accessed here.

#	Report	Title
1	Module 1	Assessment of the Demand and Supply of Cooking Solutions in Kenya
2	Module 2	Policy and Institutional Framework in Kenya
3	Module 3	Financing Options for the Kenya Cooking Sector
4	Module 4	Barriers and Opportunities in the Cooking Sector in Kenya
5	Module 5	Case Studies: Lesson Learnt From Promoting Clean Cooking Solutions

This strategy seeks to bring about a profound transformation in the cooking sector, going beyond the goal of simply increasing stove sales. It aims to make the sector sustainable and profitable, capitalising on various opportunities such as becoming a significant source of foreign exchange, reducing Kenya's reliance on fossil fuel imports, generating employment throughout the stoves and fuels value chain, offering substantial potential for greenhouse gas reduction, creating opportunities for carbon projects, contributing revenue to the electricity utility, and serving as a viable source of government taxes, among other benefits.

This strategy establishes a baseline by detailing the status of access to fuels and cooking appliances. It also provides insights into the reasons behind the existing situation. The objective is to shift the sector from this baseline to a desired outcome within a specified timeframe, using a clearly defined five-point action agenda. This agenda targets market entry barriers, including policy and institutional gaps, inadequate market information, limited access to finance, supply gaps, and low awareness among the critical actors in the sector. The goal is to bring about lasting changes in the cooking sector in Kenya, attracting private sector investment and creating a self-sustaining industry independent of donor funds in the long term. Four strategies have been simultaneously formulated alongside the overarching strategy: (i) the Kenya National Electric Cooking Strategy, (ii) the Liquefied Petroleum Gas (LPG) Strategy, (iii) the National Knowledge Management Strategy for the Cooking Sub-Sector in Kenya, and (iv) Behaviour Change Communication (BCC) Strategy.

These strategies delve into specific measures aimed at encouraging the use of electric appliances for cooking, promoting LPG solutions, forming a baseline for reframing and raising awareness of the role of clean cooking, and promoting accountability, planning, and continuous tracking of progress in the sector.

Additionally, Endev has commissioned a study on resource mobilisation to fund the strategies. This study will detail the various funding opportunities for the cooking sector in Kenya.

According to Sustainable Energy for All (SEforAll), the indicator for universal access to affordable, reliable, and modern energy services target is the **proportion of the population with primary reliance on clean fuels and technology**[1]. Considering the local realities, where 68.5% of the population, equivalent to 9.1 million households (1.7 million in urban areas and 7.4 million in rural areas), primarily depend on traditional cooking fuels, this strategy does not envision a scenario in which all households in Kenya will adopt clean cooking solutions by 2028 as primary cooking solutions, particularly considering that many of these households use non-commercial fuels.

The strategy does not anticipate government subsidies for recurrent expenditure, such as cooking fuel costs. As of June 2022, the public debt had reached KES 8.59 trillion, and it is expected to surpass the KES 10 trillion debt ceiling by June 2024[2], driven by the significant devaluation of the Kenya Shilling against major foreign currencies, with 51.1% of external debt denominated in foreign currency, leading to increased repayment expenses[3].

Given this context, the strategy aims to ensure that all households use a clean cooking solution as part of their fuel stack, with the objective of encouraging as many households as possible to use clean cooking solutions as their primary source. It is important to note that the proposed action agendas are designed to establish essential elements in fuel supply and adoption, laying the groundwork for a cross-subsidy program post-2028.

The following general definitions are adopted and used throughout this document.

- **Cooking solution:** Any combination of technology and fuel used for cooking.
- **Traditional cooking solutions:** Cooking technologies that do not advance thermal efficiency or a reduction in emissions. These include the three-stone fires, metallic charcoal stoves, kerosene wick stoves, and unvented coal stoves.
- **Improved cooking solutions:** Refers to cooking solutions that improve, however minimally, the adverse health, environmental, or economic outcomes from cooking with traditional solid fuel technologies.

1 Department of Economic and Social Affairs. (n.d.). Sustainable Development Goals. United Nations. Retrieved August 19, 2023, from https://sdgs.un.org/goals/goal

2 Parliament of Kenya. n.d. Public Debt Stock Projected to Surpass The Kshs. 10 Trillion Mark by June 2024. http://www.parliament.go.ke/index.php/public-debt-stock-projected-surpass-kshs-10-trillion-mark-june-2024#:~:text=10%20trillion%20debt%20ceiling%20by,Abdi%20Shurie.

3 Deloitte. (2023). Kenya Budget Highlights 2023/24 Navigating headwinds for inclusive growth.

- **Clean cooking solutions:** Refers to cooking solutions with low particulate matter and carbon monoxide emissions levels at the point of use. These include solar, electric, biogas, natural gas, LPG, and alcohol fuels, including ethanol. For other fuels and technologies to be classified as clean, they must achieve tier 5 of ISO standards (that aligns with the 2014 WHO guidelines) for CO emissions and tier 4 or tier 5 for PM2.5 emissions. A stove that achieves Tier 4 or Tier 5 for PM2.5 emissions based on the voluntary performance targets (VPTs) is classified as clean for PM2.5 emissions, and stoves must also be classified as Tier 5 for CO emissions to be considered clean for health[4].

- **Multi-tier framework (MTF) for cooking:** A multi-dimensional, tiered approach to measuring household access to clean cooking solutions across six technical and contextual attributes with detailed indicators and six thresholds of access ranging from Tier 0 (no access) to Tier 5 (full access). The aggregate MTF tier is the lowest tier rating across the six attributes: convenience, (fuel) availability (a proxy for reliability), safety, affordability, efficiency, and exposure (a proxy for health related to exposure to pollutants from cooking activities).

- **Modern energy cooking services:** Refers to a household context that has met the standards of Tier 4 or higher across all six measurement attributes (convenience, availability, affordability, efficiency, and exposure) of the multi-tier framework.

- **Modern cooking solutions:** Includes biogas technology, electric cooking appliances, LPG stoves and bioethanol stoves and their associated fuels.

- **Primary cooking solution -** the cooking solution that is most used (frequency of use).

- **Access rate:** Whilst different documents have adopted different definitions of access, spanning from ownership to primary use, this strategy defines access to clean cooking solutions as the use of a clean cooking fuel/technology as part of a household/enterprise/institution's fuel stack. In this strategy, the access rate is, therefore the same as the use rate.

- In this strategy, the **use rate** is used interchangeably with the access rate.

- **Use rate:** The share (%) of households/enterprises/institutions using a particular cooking fuel/technology as part of their fuel stack.

- **Ownership rate:** The share (%) of households/enterprises/institutions that own (but not necessarily use) a particular cooking fuel/technology as part of their fuel stack.

- **Primary use rate:** The share (%) of households/enterprises/institutions using a particular cooking fuel/technology as their primary cooking solution.

- **Electric cooking devices** refer to appliances capable of preparing a majority of the dishes made by a standard stove

- **Exchange Rate** 1 US$ is 150 KES. Rate as of November 2023.

4 World Health Organisation. (2023). Defining clean fuels and technologies. https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean

CHAPTER ONE

Baseline: Where are we?

1.1 Introduction

There has been a remarkable decline in the global population lacking access to clean cooking from 2.9 billion in 2010 to 2.3 billion in 2021. Despite this decline, achieving universal access at a global scale by 2030 remains elusive at the current rate[5]. Furthermore, six (6) out of every ten (10) of the 1.9 billion people who will lack access by 2030 are expected to be in Sub-Saharan Africa. Over the last 10 years, the proportion of Kenyans primarily using clean cooking solutions has more than doubled, from 15% to 31%[6,7]. This represents one of highest annualised average change in access rates in Sub Saharan Africa. Even so, the country is still among the top 20 countries with the largest access deficits in the world. The Government of Kenya now aims to achieve universal access to clean cooking by 2028.

This target is motivated by the urgent need to accelerate the transition to cleaner cooking solutions in order to mitigate the negative impacts associated with the use of traditional fuels. It is also related to global commitments outlined in Kenya's Nationally Determined Contribution (NDC) under the UNFCCC Paris Agreement, the Sustainable Development Goals (SDGs), and the Sustainable Energy for All (SEforALL) agenda. This commitment is consistent with Kenya's Vision 2030, a strategic framework aimed at elevating the country to the status of a newly industrialising, middle-income country by 2030, with improved quality of life for all residents.

Over the last ten years, the proportion of Kenyans **using clean cooking solutions** has more than doubled, from **15%** to **31%** representing one of highest annualised average change in access rates in Sub Saharan Africa.

The Kenya National Cooking Transition Strategy (KNCTS), was commissioned by the Ministry of Energy and Petroleum in September 2022 as a transparent, data-driven, and inclusive effort to articulate Kenya's national cooking sector priorities and aspirations. This process was unveiled at the Clean Cooking Week in November 2022. Its primary objective is to develop an overarching strategy that guides and drives a rapid transition towards clean cooking. This will be achieved by transforming the cooking sector in Kenya into a sustainable and profitable sector in line with the target of attaining universal access by 2028.

KNCTS defines clean cooking as cooking with fuels and stove combinations that meet the standards defined by the World Health Organization (WHO) guidelines for indoor air quality. These include cooking solutions that attain Tier 5 on carbon monoxide emissions (≤ 3.0 g/MJ) and Tier 4 on PM2.5 (≤ 62 mg/MJ) emissions. See examples of clean cooking solutions in Table 1. However, this strategy aims for universal access (using a clean cooking solution as part of their cooking fuel stack) rather than primary use by 2028. This rationale is explained in chapter 3. The development process has been guided by the following five considerations

- **Building on past and on-going experiences:** Several past and recent initiatives have contributed to the current state of the cooking sector. This strategy reflects on past experiences and builds on the lessons that other similar or related interventions have provided.

5 IEA, IRENA, UNSD, World Bank, WHO. (2023). *Tracking SDG 7: The Energy Progress Report*. World Bank, Washington DC.

6 ibid

7 KNBS & ICF (2022). Kenya Demographic and Health Survey. Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya.

The National Bioenergy Strategy 2020-2027, Clean Cooking Association of Kenya Strategy 2018-2022, National Climate Change Action Plan 2023-2027 (NCCAP), The Climate Change (Amendment) Act, no. 9 of 2023, the Kenya Nationally Determined Contribution (NDC), SEforALL Kenya Action Agenda and Investment Prospectus (2016), Kenya Ethanol Fuel Master Plan, The Kenya Clean Cooking Energy Compact, among others, outline aims focused on improving the cooking sector. This strategy has been developed in parallel but in close collaboration with the Kenya LPG Strategy and the Kenya eCooking Strategy..

- **Cultivating national ownership:** Anchoring the process within the Ministry of Energy and Petroleum and associated institutional structures from the onset has been key to ensuring government ownership and leadership. This has been an iterative process with the government and other stakeholders such as MECS, SNV, AFD, MoH, involved throughout. Other stakeholders, such as supply chain actors, development agencies, research institutions, and sub-national governments, have been integrated into the process to ensure sector-wide national support. A KNCTS coordination committee was established to provide oversight and guidance to the process.

- **Ensuring transparency, inclusion, and wide representation:** The process has sought to unify national objectives associated with creating an enabling environment and supportive policy frameworks. However, deciding which solutions or business models to prioritise can be divisive as sector players, especially supply chain actors, are often competitors. Despite this, perspectives of all the supply chain actors including SMEs, last-mile distributors (LMDs) and end-users have been considered. Realising that such processes are vulnerable to the outsized influence of the larger or influential sector actors, individual actors but also sector associations including the Kenya Renewable Energy Association (KEREA), Clean Cooking Association of Kenya (CCAK), Association of Biogas Contractors of Kenya (ABC-K), Petroleum Institute of East Africa, Energy Dealers Association (EDA), United Briquettes Producers Association (UBPA), have been engaged.

- **Balancing national priorities with international obligations:** The widespread use of traditional forms of cooking has negative impacts on health, the climate, and the environment. Transition to cleaner and modern cooking solutions is therefore a national priority. Kenya submitted its first Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in July 2015 and an updated version in December 2020 which set a target of abating greenhouse gas emissions by 32% by 2030. In addition to the NDC, Kenya has ambitious plans to attain low emission status through its policy and legal frameworks including the Constitution of Kenya (2010), Climate Change Act (2016), Kenya Energy Transition and Investment Plan, Climate Finance Policy (2016), and National Climate Change Action Plan (2023-2027). Transition to clean and modern cooking solutions presents the potential for GHG abatement. For instance, The Kenya National Climate Change Action Plan (2018 to 2022)[8] notes that promoting use of LPG in urban areas and efficient biomass cookstoves will contribute to an annual reduction of 7.1 MtCO2e[9]. This process has sought to balance international obligations with the local realities, constraints, and opportunities.

- **Mainstreaming simplicity, flexibility, and agility:** This strategy aims to outline specific, measurable, achievable, relevant, and time-bound objectives with in-built updating mechanisms that allow for flexible reorientation of priorities which consider prevailing circumstances. Changes in technology options, global geo-political dynamics, pandemics, and other prevailing circumstances require that such processes maintain recalibration measures to ensure they remain relevant and agile. Although this is a technical process, the need to communicate effectively to a wider audience requires the outcomes to be presented in simple and easy-to-understand formats for non-technical audiences including policymakers.

8 The updated Action Plan is yet to be finalized as per the writing of this strategy.

9 Government of the Republic of Kenya (2018). National Climate Change Action Plan 2018-2022. Ministry of Environment and Forestry, Nairobi

The specific objectives of KNCTS process include the following:

1. Establish the baseline scenario of Kenya's clean cooking sector including the following themes current cooking energy mix, barriers to uptake of clean cooking solutions, enabling environment, and opportunities for clean cooking.).
2. Assess gender dimensions in Kenya's clean cooking sector and make appropriate recommendations.
3. Determine the most appropriate cooking energy mix to meet the 2028 goal of universal access to clean cooking.
4. Develop a roadmap for achieving universal access to clean cooking by 2028.

This process is led by the Ministry of Energy and Petroleum (MoEP), through the Directorate of Renewable Energy, in collaboration with a consortium of development partners, including the United Kingdom Partnering for Accelerated Climate Transitions (UK PACT), Modern Energy for Cooking Services (MECS), *Agence Française de Développement* (AFD), GIZ Energising Development (EnDev) Programme, and Climate Compatible Growth (CCG), and supported by the Clean Cooking Association of Kenya (CCAK).

Table 1: Categorization of Cookstoves and Fuels

Cooking Solutions	**Traditional Biomass Stoves**		**Improved Biomass Stoves**			**Modern[10] - Liquid, Gas & Electric Stoves**			**Renewable Fuel Stoves**		
Stove Category	Open fire	Legacy stoves	Basic ICS	Intermediate ICS	Advanced ICS[11]	Kerosene stoves	LPG stoves	Electric[12]	Biogas	Biofuel stoves	Solar & Retained heat
Emissions (PM 2.5)	Tier 0	Tier 0 -1	Tier 1	Tier 1 -2	Tier 3	Tier 3 -4	Tier 4	Tier 4-5	Tier 4 - 5	Tier 4 - 5	Tier 5
Cookstoves & their description	1. Three stone	2. Metallic, biomass (+wood), stoves, no chimney	4. Built in or portable biomass (+wood) stoves, insulated, with chimney,	6. Built in, biomass (+wood), stoves incl. rocket[13] stoves	9. Natural draft, TLUD[14], gasifier stoves	12. Kerosene wick stoves	14. Single burner stoves incl. LPG *mekos*	16. Electric coil stoves, 17. EPCs, 18. Mixed LPG-Electric stoves 19. Electric induction stove	21. Biogas stoves	22. Liquid biofuel stoves	25. Solar cookers
		3. Metallic charcoal stoves, no insulation	5. Charcoal, ceramic stoves, basic & artisanal	7. Portable, biomass (+wood), stoves incl. rocket stoves	10. Natural draft, TCHAR[15], gasifier stoves	13. Kerosene pressurized stoves	15. Multiple burner stoves incl. tabletops & cookers	20. Other task specific eCooking appliances (Microwave ovens, Air fryer, electric oven, rice cookers, halogen oven)		23. Gel biofuel stoves	26. Retained heat cookers
				8. Improved charcoal stoves incl. rocket stoves	11. Forced/ Fan draft gasifier stoves					24. Solid biofuel stoves[16]	

Fuel Category	Solid biomass - Traditional or Renewable[17]		Fossil – fuels		Electricity	Renewable fuels		
Fuels	i) Firewood; ii) Charcoal; iii) Uncarbonized briquettes; iv) Carbonized briquettes; v) Pellets		vi) Kerosene	vii) LPG	viii) Electricity	ix) Biogas feedstock	x) Liquid xi) Gel xii) Pellets	
CATEGORIES	*Traditional*	*Improved*			*Clean*			

10 Modern refers to non-biomass stoves relying on Liquid/gas fossil fuels or electricity – Kammila, S., Kappen, J., Rysankova, D., Hyseni B., Putti, V. (2014) *Clean and improved cooking in Sub-Saharan Africa* (English). Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/879201468188354386/Clean-and-improved-cooking-in-Sub-Saharan-Africa

11 If advanced ICS are used with fuels like pellets and briquettes, they can be clean cooking solutions.

12 Electric can also be renewable. For instance, an isolated solar mini-grid with battery storage in place of a backup genset.

13 Rocket stove: has an L shaped combustion chamber or other design features that promote thermal efficiency.

14 TLUD: Top loading updraft gasifier cookstove

15 TCHAR: Combination TLUD / charcoal cookstove, produce biochar as a by-product, which can be used for fertilizer or for charcoal cooking.

16 The Mimi Moto pellet gasifier is the biomass stove identified in this assignment to reach the highest Efficiency and Emissions rating (ISO/IWA Tier 4).

17 Renewable biomass refers to wood, charcoal and agro-waste obtained from sustainable management practices of source land, crops, and forests.

1.2 Current State of Cooking

The 2022 KNBS Demographic and Health Survey (DHS) reveals a high dependence on traditional fuels for cooking. In total, 68.5% of the population, or 9.1 million households (1.7 million in urban areas and 7.4 million in rural areas), rely on traditional cooking fuel options as their primary source[18]. Firewood remains the predominant cooking fuel. While the proportion of households cooking with firewood has decreased from 76% to 52% over the last two decades, the total number of households depending on this traditional form of cooking fuel has increased by 2 million, from 4.7 million to 6.7 million. Of these, 6.4 million households or 96% of the total, reside in rural areas. 1.5 million households rely on charcoal as their primary cooking fuel. More than 635,000 people earn a living as producers, transporters, wholesalers, and retailers along the charcoal value chain[19].

These include part-time and opportunistic actors. Thus, charcoal plays a dual role as a source of livelihood and an important energy source. Liquefied Petroleum Gas (LPG) is the most widely used clean cooking option. Due to substantial investments from the private sector and favourable policies and regulations, such as the Petroleum (Liquefied Petroleum Gas) Regulations,[20] the yearly demand for LPG increased by over threefold between 2013 (90 kMT) to 2019 (300 kMT) most of which was used for cooking applications[21].

In 2021, demand for LPG exceeded 374 kMT but then declined to 338 kMT in 2022[22]. These three fuel sources – firewood, charcoal, and LPG, are used as the primary source of cooking by 95% of Kenyan households as shown in Figure 1 below. Kerosene and ethanol are the primary cooking fuels among 0.5 million and 38,566 households, respectively[23].

Firewood usage has decreased from **76%** to **52%** over the last two decades, Whilst use of **cooking fuel** has increased by **2 million**, from **4.7 million** to **6.7 million.**

18 KNBS & ICF (2022). *Kenya Demographic and Health Survey*. Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya.

19 Ministry of Environment and Forestry (2018). *Taskforce Report on Forest Resources Management and Logging Activities in Kenya*; Ministry of Environment and Forestry: Nairobi, Kenya

20 Kenya Subsidiary Legislation (2019). *The Petroleum (Liquefied Petroleum Gas) Regulations.* LN100 of 2019, Government of Kenya.

21 EPRA (2022). *Energy and Petroleum Statistics Report. For the Financial Year ended June 2022*. Energy and Petroleum Regulatory Authority (EPRA) Nairobi.

22 KNBS (2023). *Economic Survey, 2023.* Kenya National Bureau of Statistics, Government of Kenya.

23 KNBS & ICF (2022). *Kenya Demographic and Health Survey*. Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya.

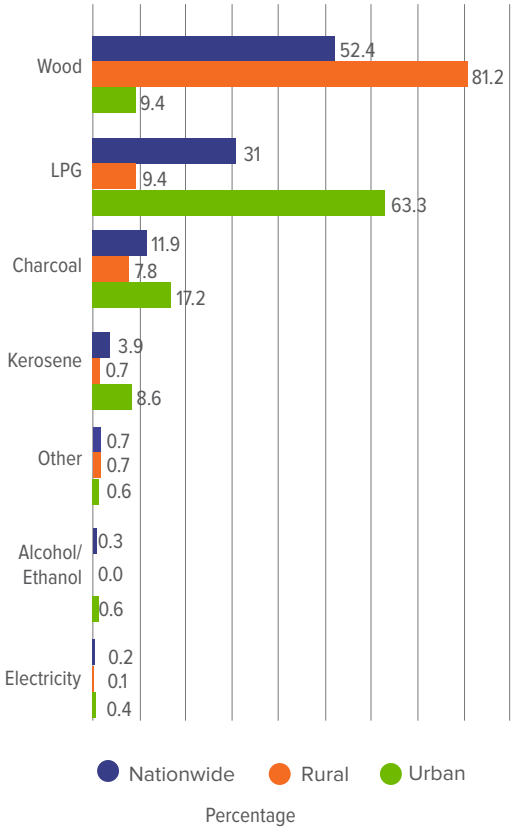


Figure 1: Main Cooking Fuel at the Household Level (compiled with data from KNBS & ICF, 2022

Based on the 2022 demographic and health survey (DHS) data[24],firewood is the predominant cooking solution in rural settings, constituting 82.7% of usage, followed by LPG at 9.36% and charcoal at 7.84%, Conversely, in urban areas, LPG is the primary cooking solution, accounting for 63.26% of usage. This showcases an increase from the 2019 reported[25] figure of 54%. Charcoal stands as the second most utilised cooking solution in urban regions, amounting to 17.19%, while kerosene follows at 8.59%. However, according to the latest data by DHS, the number of people using kerosene has significantly decreased to 2.4%, with 6.5% of the users being urban compared to 0.3% in rural areas[26].

An analysis of the data at the county level[27],indicates that more than 70% of the households in twenty-nine (29) of the forty-seven (47) counties use firewood. The top five counties with the highest proportion of firewood usage are Wajir (89.5%), Bomet (84%), West Pokot (87.9%), Elgeyo Marakwet (87.1%), and Mandera (86%). Kerosene is notably prevalent in Mombasa (32.1%), Nairobi (26.5%), Machakos (11.1%), and Kajiado (12.7%). Charcoal is more commonly used in Tana River (31%), Lamu (27.0%), Nakuru (23.9%), and Isiolo (23.9%). LPG has a high usage rate in Nairobi (67.2%), Kiambu (58.1%), Kajiado (47.2%), and Mombasa (37.5%). Wajir and Mandera have a low LPG usage rate, with less than 1% of households using the solution.

In 2012, the per capita consumption of LPG stood at 2.3kg in 2012, experiencing a notable increase to 7.5kg in 2022[28]. Conversely, urban households, on average consumes approximately 199 liters (163kg) of kerosene annually, whereas rural household consumes 95 litres (78kg) per year, leading to a national average annual residential consumption of 205 kton/yr in urban areas and 38 kton/yr in rural areas[29].

Educational, health, and correctional institutions in Kenya commonly rely on traditional cooking fuels. For an average primary school, the annual consumption is estimated to be between 64 tonnes and 164 tonnes when utilising improved and traditional stoves, respectively[30,31], leading to an annual consumption ranging from 2.8m and 6.9 million tonnes by 43,076 primary and secondary schools in Kenya. Key aspects along the value chain of the big three – firewood, charcoal, and LPG, are summarised in Figure 2 below. The entire LPG value chain is a fully formal framework. Thus, LPG is subject to continuous and methodical oversight by EPRA and the Ministry of Energy and Petroleum.

24 KNBS, & ICF. (2023). Kenya demographic and health survey 2022. https://www.knbs.or.ke/kenya-demographic-and-health-survey-kdhs-2022/

25 Ministry of Energy. (2019). *Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level*. Ministry of Energy, Government of Kenya.

26 KNBS. (2022). Demographic and health survey 2020, volume 1. Retrieved from, *https://dhsprogram.com/pubs/pdf/FR380/FR380bis.pdf*

27 KNBS. (2021). The Kenya poverty report: Based on the 2021 Kenya Continuous Household Survey. https://www.knbs.or.ke/download/the-kenya-poverty-report-2021/

28 Energy and Petroleum Regulatory Authority. (2022). Energy and petroleum statistics report for the financial year ended 30th June 2022. https://www.epra.go.ke/downloads/

29 Ministry of Energy. (2019). Kenya Cooking Sector Study. Assessment of the Supply and Demand of Cooking Solutions at the Household Level. Available at: https://eedadvisory.com/wp-content/uploads/2020/09/MoE-2019-Kenya-Cooking-Sector-Study-compressed.pdf

30 SNV & CCAK (2018). *Study on the use of biomass cookstoves and fuels in institutions in Kenya*. SNV and the Clean Cooking Association of Kenya, Nairobi.

31 UNDP GEF (2008) *Energy Saving Institutional Stoves in the Mt Kenya Region, Kenya*. Small Grants Programme (SGP), Global Environment Facility. Renewable Energy Technology Assistance Programme (RETAP.

According to the EPRA energy and petroleum statistics report for the financial year 2021-2022, licensed entities involved in the LPG value chain consist of i) 56 bulk importers and wholesalers, ii) 101 bulk road transporters, iii) 91 storage and cylinder filling plants, iv) 266 transporters.

The midstream segment of the LPG value chain has experienced significant growth, with the number of bulk LPG storage facilities increasing from 8 in 2012 to 120 in 2022, distributed across 25 counties, with a combined storage capacity of 34,000 metric tonnes[32]. Plans are underway to enhance upstream capacity by various actors as presented in Table 2 below[33].

Table 2: Planned bulk LPG storage facilities[34].

#	Company	Capacity (tons)	Location
1	Kenya Pipeline Company	30,000	Changamwe
2	Taifa Gas	30,000	Dongo Kundu
3	Eleven Energy	22,000	Mombasa
4	FSL	6,000	Changamwe
5	KenPetroGas Limited	10,000	Kibuyuni, Kwale

Like the regulation of other petroleum products, the supply chain for kerosene is overseen by the EPRA. The EPRA is responsible for issuing different types of licenses, such as those for import, export, wholesale, and the bulk transportation of kerosene. It is estimated that there are at least 1,500 kerosene dispensing units in Nairobi alone, making the kerosene distribution networks one of the most extensive and elaborate networks since consumers travel short distances to purchase fuel compared to the other fuels[35]. Approximately 70% of users in urban and rural areas buy kerosene at small retail stores[36].

On the contrary, parts of the charcoal value chain are semi-formal due to inadequate enforcement of regulations related to upstream production and transportation, as well as the absence of taxation on downstream sales. The Forest (Charcoal) Rules of 2009, revised in 2012 by EPRA regulates the sustainable production, transportation, and marketing of charcoal. The rules require that charcoal producers and transporters be licensed by the Kenya Forest Service (KFS). Commercial charcoal producers are required to organise themselves into Charcoal Producers Association and are tasked with promoting sustainable charcoal production across supply chains. The 2015 draft charcoal regulations require individuals to have a charcoal movement permit, a certificate of origin of the charcoal, and a receipt from a trader to transport charcoal in Kenya. It also outlines 3 bags per month as the maximum for a person to produce charcoal without a licence.

The supply chain for firewood is not as elaborate as other cooking fuels, as most people collect firewood from their farms or surrounding forests rather than purchase it. In cases where users purchase firewood, they source it from timber yards, retailers like kiosks, and other wood collectors.Stove and fuel stacking (the use of multiple stoves and fuels) is common in Kenya, with more than half of the population (51%) owning more than one cooking solution[37]. The remaining 49% of households use only one stove, and most of these (70%) use the three stone open fire. The process of stoves and fuel selection, stacking, and switching is extremely complex. Preferences for stoves and fuels vary according to sociocultural practices and norms, income level, type of meal prepared, meal size, cooking area layout, and even time of day.

Aside from the three-stone fire, the inability of any other single cooking solution to satisfy all the cooking applications and needs of a household is one of the fundamental factors anchoring this practice.

32 Energy and Petroleum Regulatory Authority. (2022). Energy and petroleum statistics report for the financial year ended 30th June 2022. https://www.epra.go.ke/downloads/

33 Anyango, M. (2023). Cooking gas prices to drop to Sh500 by June 2023—Ruto. The Star. https://www.the-star.co.ke/news/realtime/2023-03-02-cooking-gas-prices-to-drop-to-sh500-by-june-2023-ruto/

34 Odhiambo, A. (2023). Inside the race for Kenya's cooking gas bright spot. Nation, Business. https://nation.africa/kenya/business/inside-the-race-for-kenya-s-cooking-gas-bright-spot-4250896

35 Ministry of Energy (2019): Kenya Household cooking sector study Assessment of the Supply and Demand of Cooking Solutions at the Household Level. Available online: *https://eedadvisory.com/wp-content/uploads/2020/09/MoE-2019-Kenya-CookingSector-Study-compressed.pdf*

36 Ibid

37 MoE. (2019). *Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level*. Ministry of Energy, Government of Kenya.

The selection process is influenced by several interrelated factors including the cost of stove, cost of fuel, divisibility of the fuel, availability of the fuel, type of cooking area, size of household, commonly cooked meals, and ease of use. It is debatable whether stove and fuel stacking is a temporary or permanent practice. It is debatable whether stove and fuel stacking is a temporary or permanent practice[38], but interventions promoting the use and adoption of clean cooking solutions should take this practice into account. Even effective interventions promoting clean cooking solutions do not immediately facilitate a complete transition away from traditional fuels, according to a World Bank study[39]. Additionally, the study reveals that while several interventions, particularly those promoted by non-governmental organizations (NGOs), achieved success in terms of cooking solution distribution, they were unable to endure beyond the pilot or program phase unless they utilised market-based strategies.

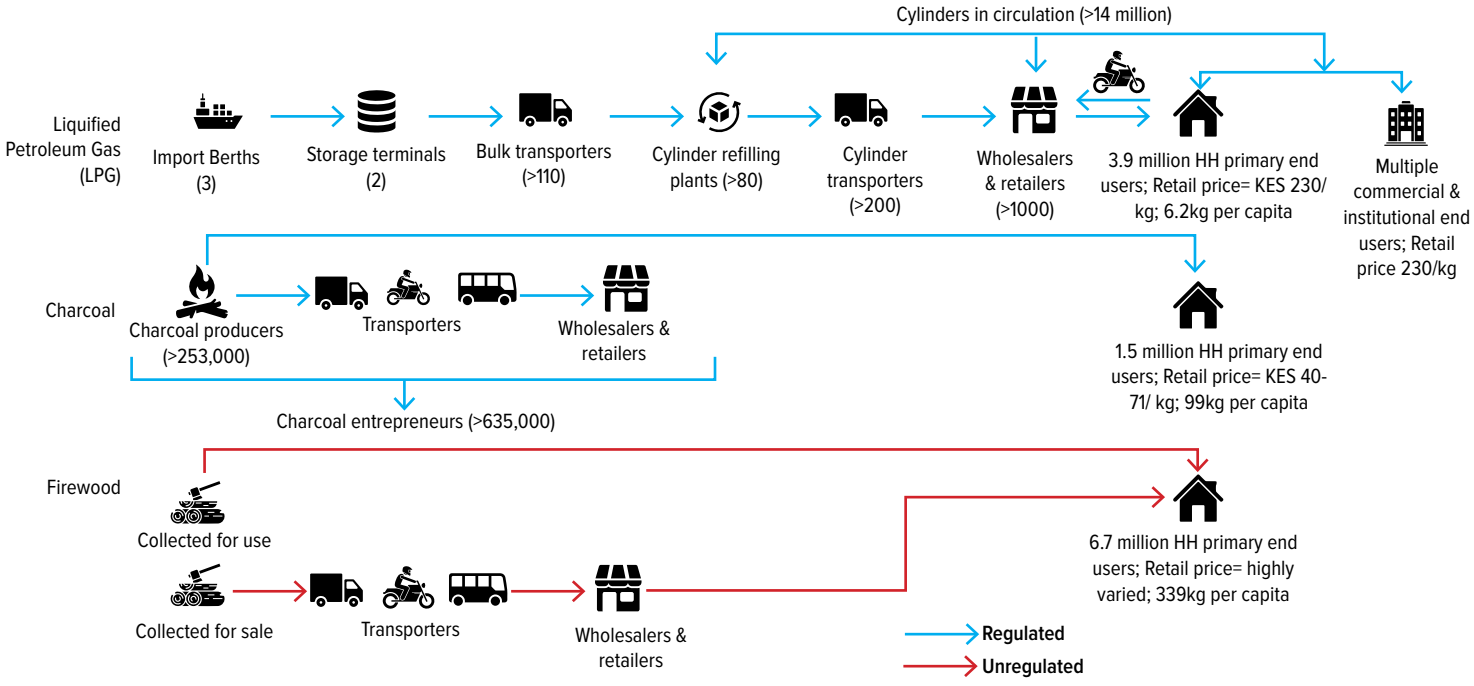


Figure 2: Summary of the big-three value chains[40]

38 Yadav, P., Davies, P. J., & Asumadu-Sarkodie, S. (2021). Fuel choice and tradition: Why fuel stacking and the energy ladder are out of step? *Solar Energy, 214*, 491-501. https://doi.org/10.1016/j.solener.2020.11.077

39 ESMAP. (2021). *What Drives the Transition to Modern Energy Cooking Services? A Systematic Review of the Evidence*. Technical Report 015/21. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO

40 Sources of data: MoE. (2019). Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level. Ministry of Energy, Government of Kenya; KNBS & ICF (2022). Kenya Demographic and Health Survey. Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya; KNBS (2023) Economic Survey, 2023. Kenya National Bureau of Statistics, Government of Kenya; EPRA (2022). Energy and Petroleum Statistics Report. For the Financial Year ended June 2022. Energy and Petroleum Regulatory Authority (EPRA) Nairobi; Hystra (2023), Strategic recommendations to accelerate LPG development in Kenya – Intermediary Report, Hystra and AFD.

Income disparities and other contributing factors influence access and use of clean cooking solutions between female and male-headed households. In Kenya, 17% of male-headed households are in the lowest income quintile compared to 19% among female-headed households demonstrating a variance in income levels[41]. A smaller proportion of female-headed households use clean cooking solutions as their main fuel compared to male-headed households while a larger proportion depend on traditional fuels (see Figure 3).

There is strong evidence that women are disproportionately affected by the negative impacts of cooking with traditional fuels[42,43,44]. This includes impacts on their health and the burden of collecting and preparing the fuels, especially solid biomass-based fuels. Interventions to support the uptake of clean cooking solutions must address this imbalance in access levels which is directly influenced by the level of disposable income, ability to pay, and willingness to pay for appliances. In line with MoEP's *Gender Policy in Energy*, the gender, equality, and social inclusion (GESI) dimension has been mainstreamed into all aspects of this process.

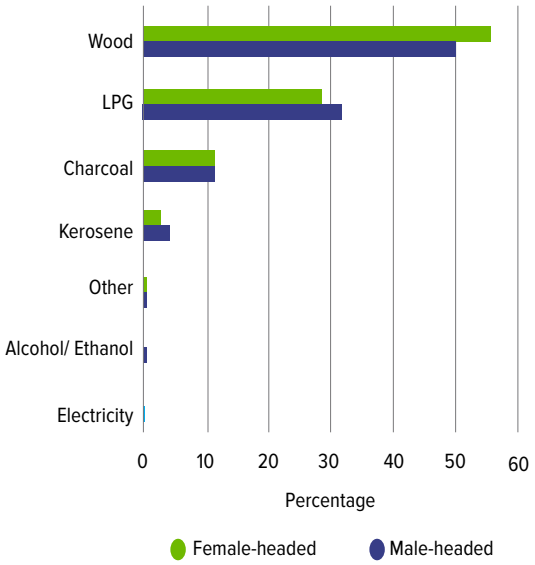
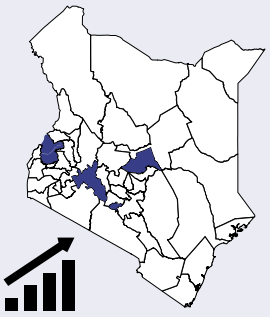


Figure 3: Main Cooking Fuel - Gender Disaggregated by HH Head (compiled with data from KNBS & ICF, 2022)

The prevalence (proportion of households without access) and the deficit (absolute number of households without access) varies across counties as shown in Table 3 and Figure 4 below. While counties listed as underserved under the Kenya Off-grid Solar Project (KOSAP)[45] have the highest prevalence of households without access to clean cooking solutions, Nakuru, Kakamega, Meru, Bungoma, and Nairobi counties have the highest deficit. These five counties account for 1.83 million households, or 21% of the national deficit, which is comparable to the estimated 1.69 million households not using clean cooking solutions in the 14 KOSAP counties. The top five counties with the highest prevalence account for 0.58 million households, or 6%, of the total.

Nakuru, Kakamega, Meru, Bungoma, and **Nairobi** counties have the **highest deficit of clean cooking solutions** accounting for **21% of** the national deficit comparable to the estimated **1.69 million households** not using clean cooking solutions in the fourteen KOSAP counties.



41 KNBS & ICF (2022). *Kenya Demographic and Health Survey.* Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya.

42 Dida, G.O., Lutta, P.O., Abuom, P.O. *et al.* (2022). Factors predisposing women and children to indoor air pollution in rural villages, Western Kenya. *Arch Public Health* 80, 46 https://doi.org/10.1186/s13690-022-00791-9

43 Njenga, M., Gitau, J., & Mendum, R. (2021). Women's work is never done: Lifting the gendered burden of firewood collection and household energy use in Kenya. *Energy Research & Social Science*, 77, 102071. https://doi.org/10.1016/j.erss.2021.102071

44 James, B. S., Shetty, R. S., Kamath, A., & Shetty, A. (2020). Household cooking fuel use and its health effects among rural women in southern India—A cross-sectional study. *PLOS ONE*, 15(4), e0231757. https://doi.org/10.1371/journal.pone.0231757

45 Garissa, Isiolo, Kilifi, Kwale, Lamu, Mandera, Marsabit, Narok, Samburu, Taita Taveta, Tana River, Turkana, Wajir, and West Pokot.

Table 3: Top 5 Counties – Prevalence versus Deficit (compiled with data from KNBS & ICF, 2022)

Prevalence (% HH w/o access)				Deficit (# of HH w/o access)			
Rank	County	%	#	Rank	County	#	%
1	Mandera	98.5	130,358	1	Nakuru	413,874	64.8
2	Wajir	97.6	132,173	2	Kakamega	397,998	86.2
3	Marsabit	96.3	78,842	3	Meru	388,769	85.9
4	Tana River	96.2	68,750	4	Bungoma	336,216	88.1
5	Turkana	95.9	166,481	5	Nairobi	298,041	18.7
	Total		**576,604**		**Total**	**1,834,898**	

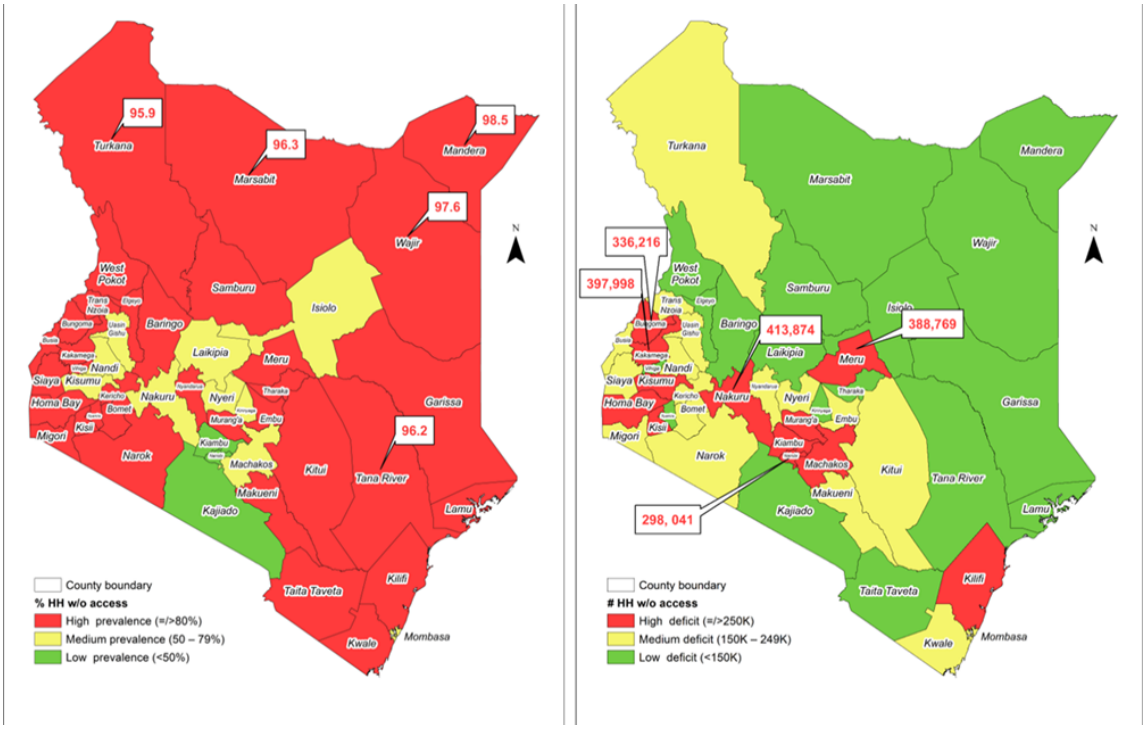


Figure 4: Household without Access to Clean Cooking – Prevalence versus Deficit (compiled with data from KNBS & ICF, 2022)

1.3 Transitions in the Cooking Sector

A transition to cleaner, less polluting energy sources has the potential to reduce anthropogenic climate change while also providing social, economic, commercial, health, and environmental benefits. Cooking using traditional forms of biomass, especially fuelwood and charcoal, is now the leading source of greenhouse gas emissions in Sub Saharan Africa and a significant driver of premature death attributable to household air pollution[46,47]. Transitions, such as the one proposed by the KNCTS, occur when prevalent practices in society are displaced progressively or immediately by external or endogenous changes driven by policy, business models, technological advancement, natural processes, or a combination of these[48].

46 Bensch, G., Jeuland, M., & Peters, J. (2021). Efficient biomass cooking in Africa for climate change mitigation and development. *One Earth*, 4(6), 879–890. https://doi.org/10.1016/j.oneear.2021.05.015

47 Household air pollution refers to pollution within homes caused specifically by the use of traditional cooking stoves. Indoor air pollution encompasses all pollution sources within the household, not limited to traditional stove usage.

48 Huh, T., Yoon, K.-Y., & Chung, I. R. (2019). Drivers and Ideal Types towards Energy Transition: Anticipating the Futures Scenarios of OECD Countries. *International Journal of Environmental Research and Public Health*, 16(8), 1441. PubMed. https://doi.org/10.3390/ijerph16081441

Although there is no universally accepted definition of energy transition, it has been conceptualised as "a change in an energy system, usually to a particular fuel source, technology, or prime mover (A device that transforms energy into practical applications)"[49] .Such transitions can manifest at micro and/or macro levels, occur rapidly or gradually, and materialise intentionally or unintentionally.

The Benefits of Action to reduce Household Air Pollution (BAR-HAP) model identifies three broad types of fuel or technology – traditional, cleaner, and clean, with 16 possible transition pathways as illustrated in Figure 5 below. The process of developing this strategy adopts this characterisation of transitions in the cooking sector.

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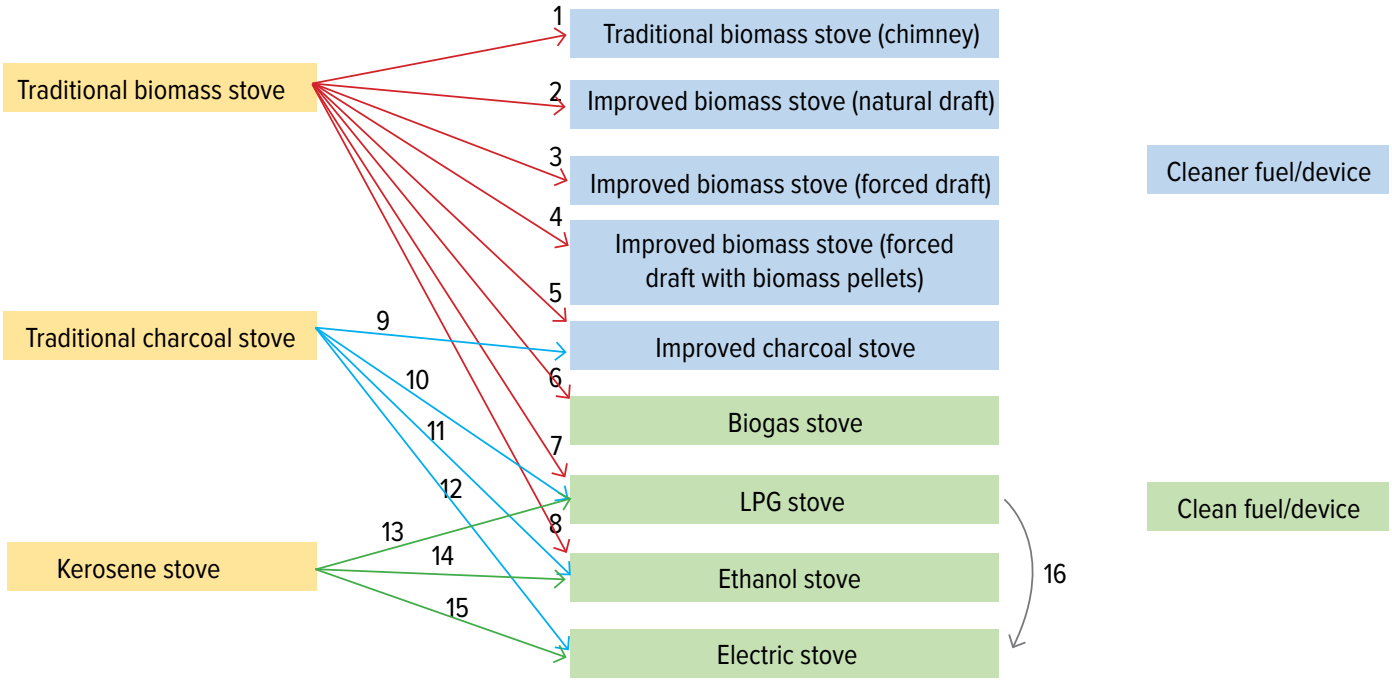


Figure 5: Transition Pathways[50,51]

49 Sovacool, B. K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science*, 13, 202–215. https://doi.org/10.1016/j.erss.2015.12.020

50 Das I, Lewis JJ, Ludolph R, Bertram M, Adair-Rohani H, Jeuland M (2021) The benefits of action to reduce household air pollution (BARHAP) model: A new decision support tool. PLoS ONE 16(1): e0245729. https://doi.org/10.1371/ journal.pone.0245729

51 Traditional biomass stove as depicted in the figure 5 above refers to traditional firewood stoves i.e., the three stones fireplace.

Transitions from dependency on traditional to clean cooking require time and deliberate effort. Access rates for Kenya, Indonesia, Tanzania, and Uganda were all below 20% as of the year 2000 (see Figure 6). Although Indonesia has achieved an access rate of over 80% by 2020 through a range of interventions, the remaining three countries continue to have rates below 30%, with Tanzania and Uganda remaining below 10%. The direction of government policy and investment has a significant impact on a country's commitment to achieving universal access to clean cooking. Significant private sector investment and innovation are also required. For example, because of such action, Kenya's access to grid-connected electricity has increased from 15% to more than 70% in the same period (2000-2020). This demonstrates that, even within the same national context, one aspect of the energy sector can undergo transformational change while another remains stagnant.

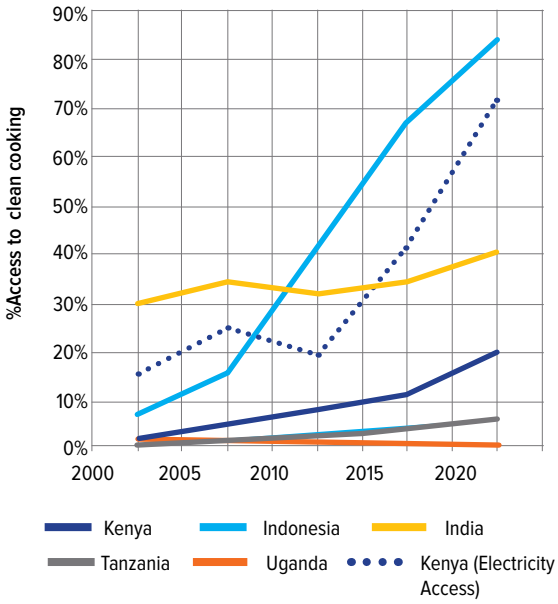


Figure 6: Pace of transition in Kenya, Uganda, Tanzania, India, and Indonesia.

Experience in several contexts demonstrates that transitioning to cleaner cooking solutions does not translate into a total abandonment of traditional fuels. An assessment conducted in 2017 on a programme in Chiapas, Mexico, that provided LPG stoves in one thousand rural homes in 2011 found that all the households continued to rely on firewood for part of their cooking[52]. Similarly, a large-scale programme in Himachal Pradesh, India, to promote electric cooking over LPG did not result in a complete shift away from traditional wood stove.[53]

In Indonesia, where over 50 million households gained access to LPG for cooking in 5 years, households still use kerosene and firewood alongside these clean cooking solutions[54]. In Kenya, households that use LPG as their primary fuel and use either firewood, charcoal, or kerosene as their secondary fuel consume, on average, 144 ±51kg, 48 ±9kg, and 14 ±3kg, respectively of these traditional fuels per month[55].

This practice is confirmed by a 2023[56] study of Nairobi that shows that 55% of all households have a secondary cooking solution, with charcoal being the most popular secondary option (see Figure 7 and Figure 8). Additionally, the same study reveals that some households retain their former cooking solution even if they no longer use them, despite switching to alternative solutions. Figure 9 below shows that 34%, 20%, and 16% (depicted by the curve) of households that own a woodstove, charcoal stove, and a kerosene stove, respectively do not use them at all. These rates are significantly lower among clean cooking solutions – 6%, 3%, and 2% among those that own an electric appliance, bioethanol stove, and LPG stove respectively. Transitions can therefore be partial, complete, or take on a recessionary pattern from clean to traditional and back.

52 Troncoso, K., Segurado, P., Aguilar, M., & Soares da Silva, A. (2019). Adoption of LPG for cooking in two rural communities of Chiapas, Mexico. *Energy Policy, 133*, 110925. https://doi.org/10.1016/j.enpol.2019.110925

53 Banerjee, M., Prasad, R., Rehman, I. H., & Gill, B. (2015). Induction stoves as an option for clean cooking in rural India. Energy Policy, 88, 159-167. https://doi.org/10.1016/j.enpol.2015.10.021

54 Thoday, K., Benjamin, P., Gan, M., & Puzzolo, E. (2018). The Mega Conversion Program from kerosene to LPG in Indonesia: Lessons learned and recommendations for future clean cooking energy expansion. *Energy for Sustainable Development*, 46, 71-81. https://doi.org/10.1016/j.esd.2018.05.011

55 MoE. (2019). *Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level*. Ministry of Energy, Government of Kenya

56 EED Advisory (2023). *Alternative Fuels Assessment: Nairobi Survey*. Report commissioned by the Modern Energy Cooking Services (MECS) with support from the UK Partnership for Accelerated Climate Transitions (UK PACT).

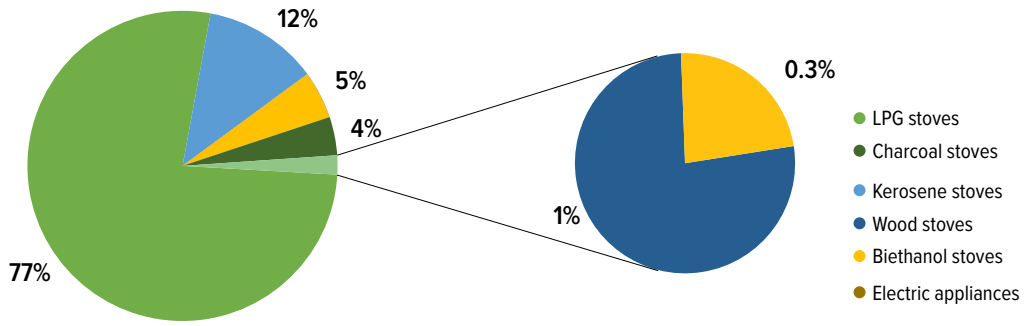


Figure 7: Primary Cooking Solutions in Nairobi (%)

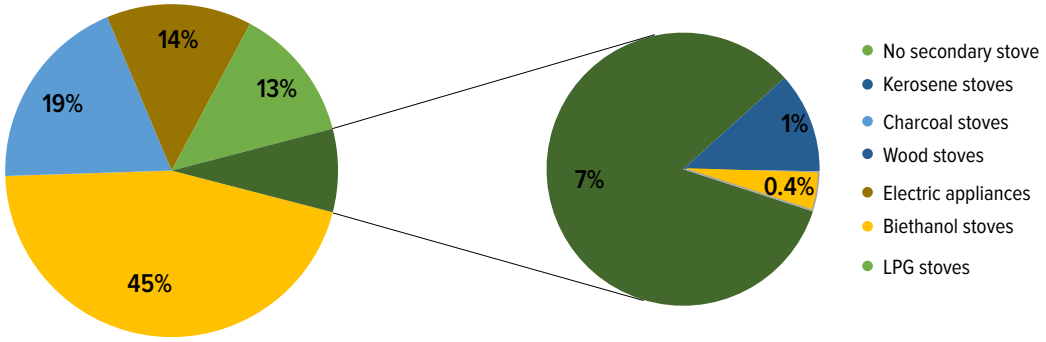


Figure 8: Secondary Cooking Solutions in Nairobi (%)

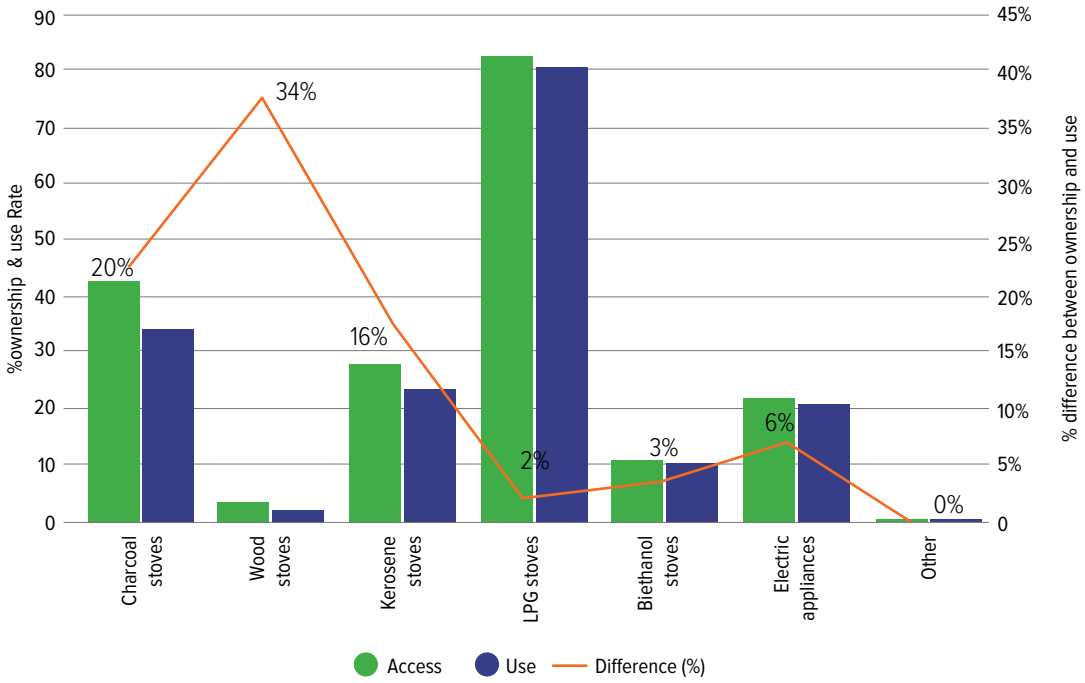


Figure 9: Difference between access and use rate in Nairobi[57]

57 EED Advisory. (2023). Alternative fuels assessment.

Transitions also lead to unintended and in some cases, negative outcomes. These may include loss or reduction in business opportunities, loss, or reduction in the number of jobs, over-reliance on new resources or sector actors, and new sources of waste and pollutants, among others. The charcoal sector in Kenya provides a source of income for more than 635,000 people[58]. This figure exceeds the number of individuals employed in the education sector estimated to be 609,211 in 2022[59]. The adoption of clean cooking solutions will invariably impact the number of actors and income-generating opportunities throughout the charcoal value chain. Fabricators and assemblers of improved charcoal stoves will also be negatively affected.

Many formal and informal business actors are involved in supplying educational, health and correctional institutions. A shift to clean cooking solutions will diminish or effectively eliminate their contribution. Interventions to support a transition to clean cooking solutions should consider these anticipated changes. UNDP and the Alliance for a Just Energy Transformation recommend that such transitions should be fair and inclusive, leaving no one behind.

Just transitions should be guided by science; be fair and uphold the rights of the majority; be sustainable and ambitious; be comprehensive and transparent; ensure meaningful stakeholder engagement and dialogue; be centred on climate justice; recognise energy access as an essential contributor to social well-being; and ensure access to justice and information[60].

1.4 Market Size, Attributes, and Potential

1.4.1 Total Addressable Market and Total Serviceable Market

This process estimates the Total Addressable Market (TAM) and Total Serviceable Market (TSM) for clean cooking stoves and appliances using data and assumptions from multiple sources as shown in Table 4 below. The Total Addressable Market (TAM) which is the estimated value of the entire revenue opportunity in KES/US$ for a product or service that exists in a market, is first estimated *(Total # of potential customers X US$ value of product/service per customer)*. The Total Serviceable Market which is the part of the market that can be immediately and realistically served (*[Total # of potential customers X US$ value of product/service per customer] X percentage of ready and reachable customers*) is then determined from this. TAM is the value (KES/US$) of the total number of stoves and appliances needed in the market, while the TSM is the values (KES/US$) of the total number of stoves and appliances that can be purchased immediately considering the challenges of supply (last mile distribution) and affordability.

Table 4: List of Assumptions and Data

#	Item	Assumption	Data source
1	Households without supply	Households using kerosene, coal, lignite, charcoal, wood, straw/shrubs/grass, agricultural residue, gasoline/diesel, processed biomass, garbage/plastic, sawdust as the primary fuel	KDHS 2022
2	Households with supply	Households that do not use kerosene, coal, lignite, charcoal, wood, straw/shrubs/grass, agricultural residue, gasoline/diesel, processed biomass, garbage/plastic, sawdust as the primary fuel	KDHS 2022
3	Number of households in 2022 and 2028	• Number of households in 2022 = 12,855,470 • Number of households in 2028 = 15,154,985 • Number of urban and rural households in 2022 is 4,978,362 and 7,877,108, respectively.	• KNBS 2019 census extrapolated using the 2.2% intercensal growth rate. • KNBS 2019 Summary Report on Kenya's Population Projections for number of HHs in 2028
4	Ability to pay	The fraction of households that cannot pay are those in the lowest (poorest), second (poor) and middle quintiles.	• KDHS 2022 (Table 2.6 -wealth quintiles) • KNBS 2021 The Poverty Report

58 Ministry of Environment and Forestry (2018). *Taskforce Report on Forest Resources Management and Logging Activities in Kenya*; Ministry of Environment and Forestry: Nairobi, Kenya.

59 KNBS. (2022). *Statistical Abstract, 2022*. Kenya National Bureau of Statistics, Nairobi.

60 UNDP & The Alliance for a Just Energy Transformation (2023). *The 8 core principles of a Just Energy Transformation*. KPMG, UNDP, and the Alliance for a Just Energy Transformation.

"The uptake of cleaner fuels remains slow in rural Africa, in large part due to issues of affordability and supply" observes the SDG & Tracking Report[61]. Other studies also identify these two attributes as significant obstacles to universal access[62,63,64]. This process divides the unreached market (households not using a clean cooking fuel as their primary fuel) into four quadrants based on supply (level of market development which answers the question *"to what degree can potential users easily obtain the product?"*) and affordability (ability and willingness to pay which answers the question *"to what degree can potential users afford and are willing to pay for the product?"*). As a proxy indicator for supply, the geographic location of the households without supply, which differentiates those in urban and rural areas is applied while affordability is estimated using the income classes in the KDHS 2022[65] as shown in Figure 10 below.

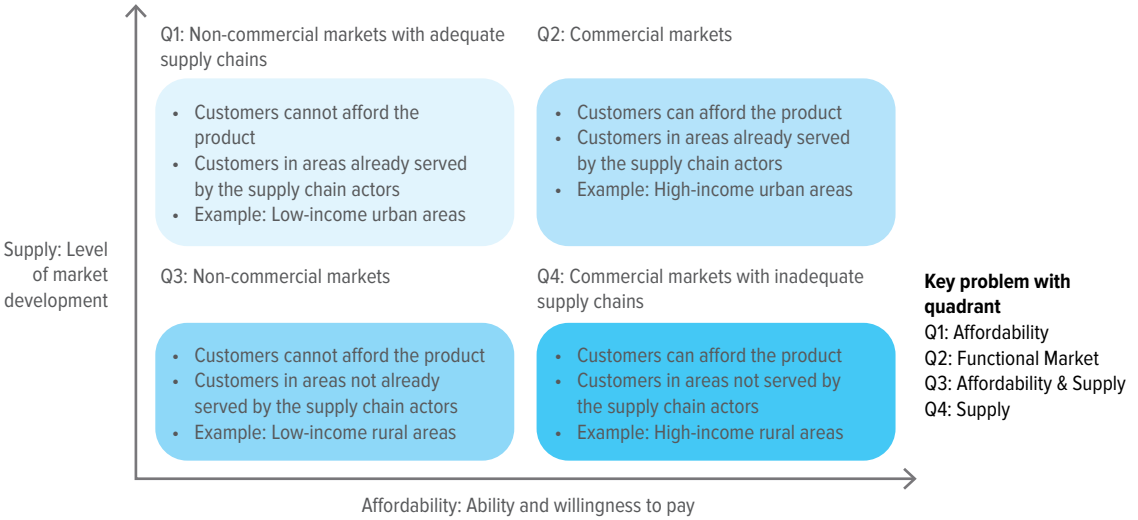


Figure 10: Market Segmentation

The following steps are applied to calculate the Total Addressable Market (TAM) and the Total Serviceable Market (TSM) at the national level and county level.

1. Using the 2019 population and housing census data, the 2.2% intercensal growth rate is applied to estimate the total urban and rural number of households per county. This computation yields 12,855,470 households nationally in 2022, with urban households 4,978,362 and 7,877,108 rural households.
2. The KDHS 2022 data is used to determine the number of households with supply and those without.
3. The KDHS 2022 data is then used to classify the rural and urban without supply into the respective socioeconomic status (SES) grouped into quintiles – poorest, poorer, middle, richer, and richest. These quintiles together with data from the KNBS 2021 Poverty Report[66] which estimates the incidence of poverty per county, are used as proxy indicators to classify households into groups that can afford and those that cannot afford a clean cooking solution.
4. Households without supply are classified into rural households and urban households based on the KDHS 2022 data. This process assumes that households in urban areas have easier access to clean cooking relative to those in rural areas. The distribution cost of clean cooking solutions is typically higher due to the population density and inadequate transport infrastructure.

61 IEA, IRENA, UNSD, World Bank, WHO. (2021). Tracking SDG 7: *The Energy Progress Report. World Bank*, Washington DC.

62 Khavari, B., Ramirez, C., Jeuland, M., & Fuso Nerini, F. (2023). A geospatial approach to understanding clean cooking challenges in sub-Saharan Africa. *Nature Sustainability*, *6*(4), 447-457. https://doi.org/10.1038/s41893-022-01039-8

63 Gill-Wiehl, A., Ray, I., & Kammen, D. (2021). Is clean cooking affordable? A review. *Renewable and Sustainable Energy Reviews*, *151*, 111537. https://doi.org/10.1016/j.rser.2021.111537

64 Zhang, Y. (2022). Accelerating Access to Clean Cooking Will Require a Heart-Head-and-Hands Approach. *Development* 65, 59–62. https://doi.org/10.1057/s41301-021-00297-x

65 KNBS & ICF (2022). *Kenya Demographic and Health Survey*. Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya.

66 KNBS. (2021). *The Kenya Poverty Report: Based on the 2021 Kenya Continuous Household Survey.* https://www.knbs.or.ke/download/the-kenya-poverty-report-2021/

5. All households without supply will then fall into four quadrants: Q1 – Urban households that cannot afford clean cooking solutions, Q2 – Urban households that can afford clean cooking solutions, Q3 – Rural households that cannot afford clean cooking solutions, and Q4 – Rural households that can afford clean cooking solutions. These steps are summarised in Figure 11 below.

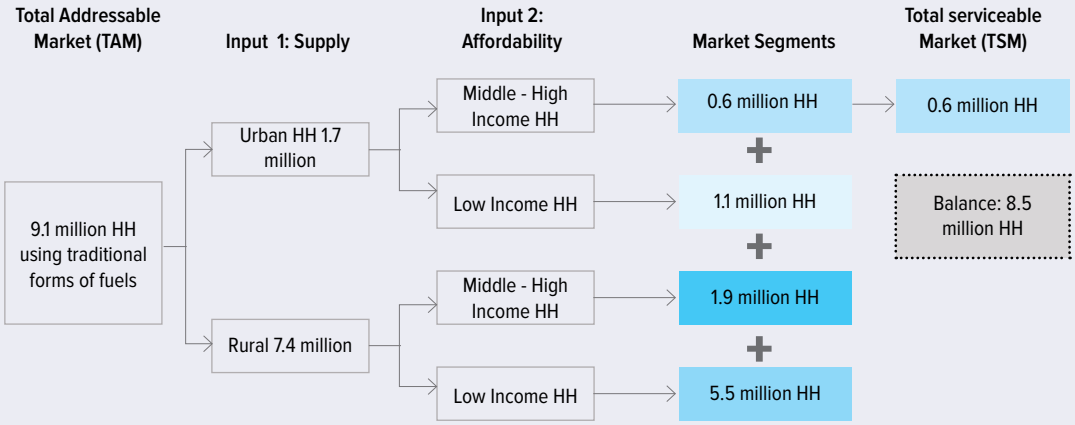
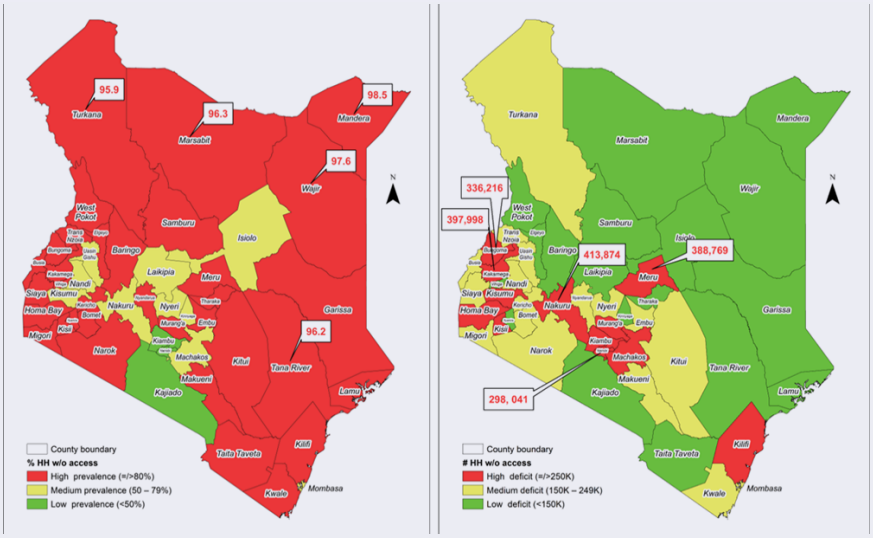


Figure 11: Estimates of the Number of Households per Market Segment

6. The TAM (total KES/US$ value of stoves and appliances needed) and TSM (total value KES/US$ of stoves and appliances that can be immediately purchased) will depend on the type of solution adopted by each household. This in turn depends on the size of the family, cooking preferences, proximity to clean cooking fuel associated with the solution, income levels, among others. The total value will also be determined by the prices of a clean cooking solution which ranges from KES 1,550 (US$ 11) for a KOKO Networks two-burner bioethanol stove to KES 20,995 (US$ 145) for a high-end electric pressure cooker (EPC)[67]. Based on these low and high price stove ranges, the TAM is between KES 14 billion (US$ 99.9 million) and KES 190 billion (US$ 1.3 billion), while the TSM is between KES 939 million (US$ 6.7 million) and KES 12.7 billion (US$ 87.9 million) depending on the stove and appliance selected to address the lack of supply.

7. The absolute number of households in each quadrant is then estimated across each county. Counties are classified depending on the prevalence (proportion of households without access) and the level of deficit (absolute number of households without access) as show in Figure 4 above in section 1.2 above. These four categories are also shown in the Figure 12.



67 EED Advisory (2023). Alternative Fuels Assessment: Nairobi Survey. Report commissioned by the Modern Energy Cooking Services (MECS) with support from the UK Partnership for Accelerated Climate Transitions (UK PACT).

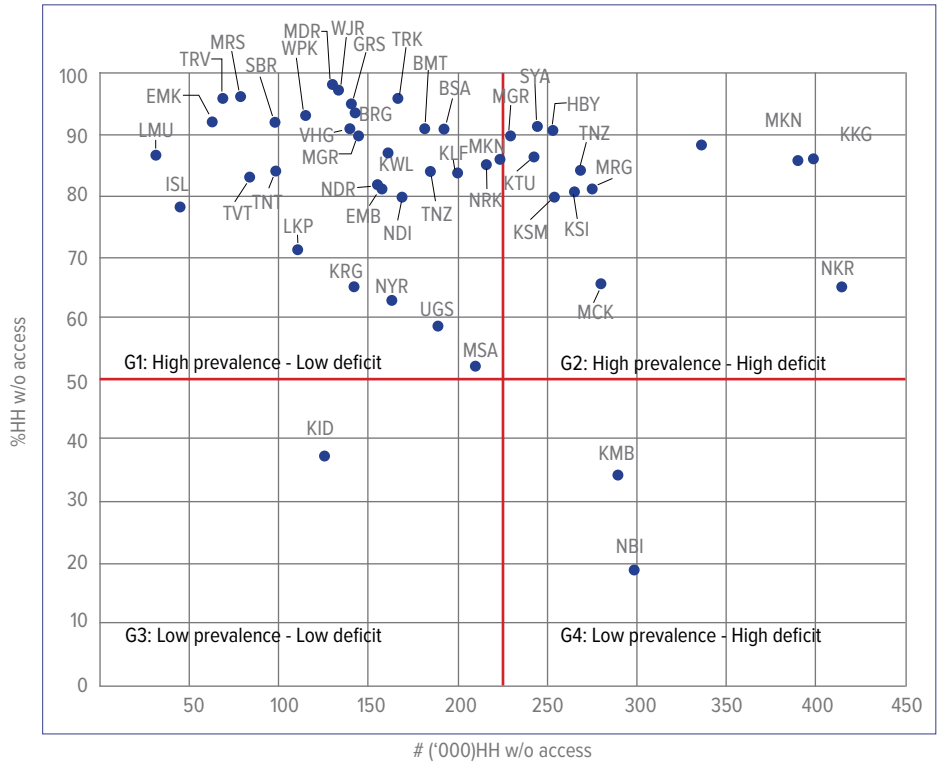


Figure 12: Counties According to Prevalence and Level of Deficit

1.4.2 Group 1: High Prevalence – Low Deficit

Households in counties with high prevalence and low deficit are listed in Table 5 below and categorised into the four quadrants: Q1 – Non-commercial markets with adequate supply chains, Q2: Commercial markets, Q3: Non-commercial markets, and Q4: Commercial markets with inadequate supply chains.

Table 5: Group 1 Counties by Market Segments (Quadrants), KDHS 2022

#	Group 1	Q1	Q2	Q3	Q4	# HH w/o access
1	Narok	20,790	80,520	91,760	22,982	216,052
2	Mombasa	111,879	97,879	-	-	209,758
3	Trans Nzoia	27,756	52,116	76,710	43,318	199,900
4	Busia	19,805	31,293	109,276	31,843	192,218
5	Uasin Gishu	35,656	12,718	65,030	75,562	188,965
6	Kericho	9,524	80,632	55,279	39,152	184,587
7	Bomet	4,446	40,166	118,883	18,238	181,734
8	Nandi	8,007	36,010	98,196	27,038	169,252
9	Turkana	26,723	21,793	103,976	13,989	166,481
10	Nyeri	2,320	50,135	30,215	81,330	164,000
11	Kwale	23,388	21,036	92,458	24,114	160,996
12	Embu	8,083	50,541	48,540	50,668	157,832
13	Nyandarua	6,788	40,865	57,304	50,437	155,394
14	Nyamira	6,374	50,525	63,334	24,515	144,748

#	Group 1	Q1	Q2	Q3	Q4	# HH w/o access
15	Baringo	15,990	31,926	70,467	23,600	141,983
16	Kirinyaga	4,792	40,267	31,198	65,320	141,577
17	Garissa	22,153	28,633	53,376	36,513	140,675
18	Vihiga	7,563	50,225	105,030	21,309	139,127
19	Wajir	26,023	21,943	68,904	15,303	132,173
20	Mandera	38,628	22,952	65,825	2,953	130,358
21	West Pokot	6,739	10,340	85,877	12,063	115,019
22	Laikipia	13,586	36,208	40,415	20,834	111,044
23	Tharaka Nithi	4,893	30,320	41,445	21,682	98,339
24	Elgeyo Marakwet	3,549	30,372	46,653	16,852	97,426
25	Taita Taveta	14,574	18,002	33,472	17,741	83,789
26	Marsabit	16,609	1,275	52,672	8,285	78,842
27	Tana River	17,014	20,637	25,227	5,872	68,750
28	Samburu	10,056	10,843	34,224	7,927	63,050
29	Isiolo	15,012	8,118	11,256	10,038	44,423
30	Lamu	6,156	5,896	12,418	7,259	31,728

1.4.3 Group 2: High Prevalence – High Deficit

Households in counties with high prevalence and high deficit are listed in Table 6 below and categorised into the four quadrants: Q1 – Non-commercial markets with adequate supply chains, Q2: Commercial markets, Q3: Non-commercial markets, and Q4: Commercial markets with inadequate supply chains.

Table 6: Group 2 Counties by Market Segments (Quadrants) KDHS 2022

#	Group 2	Q1	Q2	Q3	Q4	# HH w/o access
1	Nakuru	111,043	81,533	105,900	125,397	413,874
2	Kakamega	43,337	61,263	229,379	64,018	397,998
3	Meru	21,354	72,811	204,915	89,690	388,769
4	Bungoma	30,287	9,191	245,465	51,273	336,216
5	Machakos	32,100	73,265	82,657	91,660	279,683
6	Murang'a	31,980	20,789	116,056	105,831	274,657
7	Kilifi	76,416	24,036	132,230	34,899	267,580
8	Kisii	10,772	20,296	184,868	48,581	264,518
9	Kisumu	61,701	49,625	79,032	62,886	253,244
10	Homa Bay	17,947	20,622	180,480	33,572	252,621
11	Siaya	15,110	50,735	147,614	30,186	243,645
12	Kitui	10,862	50,262	158,400	22,783	242,306
13	Migori	25,251	51,707	120,846	30,694	228,499
14	Makueni	10,267	51,759	117,208	44,560	223,795

1.4.4 Group 3: Low Prevalence – Low Deficit

Households in counties with low prevalence and low deficit are listed Table 7 below and categorised into the four quadrants: Q1 – Non-commercial markets with adequate supply chains, Q2: Commercial markets, Q3: Non-commercial markets, and Q4: Commercial markets with inadequate supply chains.

Group 3 Counties by Market Segment (Quadrants), KDHS 2022

#	Group 3	Q1	Q2	Q3	Q4	# HH w/o access
1	Kajiado	26,376	21,379	34,692	43,134	125,581

1.4.5 Group 4: Low prevalence - High deficit

Households in counties with high prevalence and high deficit are listed in Table 8 below and categorised into the four quadrants: Q1 – Non-commercial markets with adequate supply chains, Q2: Commercial markets, Q3: Non-commercial markets, and Q4: Commercial markets with inadequate supply chains.

Table 8: Group 4 Counties by Market Segments (Quadrants), KDHS 2022

#	Group 4	Q1	Q2	Q3	Q4	# HH w/o access
1	Nairobi	128,879	169,163	-	-	298,041
2	Kiambu	85,783	57,060	48,100	98,400	289,343

This analysis aims to provide a comprehensive examination of the present condition of both commercial and non-commercial markets. The objective is to gain a more profound understanding of the challenges existing in the sector, with the ultimate purpose of informing the strategy for the proposed action agenda. For instance, it is evident that only a limited number of households are included in the functional market, and the primary obstacles pertain to the availability and affordability of cooking solutions. These hindrances are elaborated upon in the barrier section, where specific action agendas are formulated to tackle these particular issues.

1.5 Policy, Players, and Institutional Frameworks

From a policy and institutional standpoint, Kenya's energy sector is disproportionately focused on electricity generation, transmission, and distribution, despite accounting for only 21% of Total Energy Supply (TES)[68]. Non-electric biomass energy, primarily used for cooking and heating, accounts for 56% of total TES. Petroleum and other sources account for the balance (~23%). The cooking sector in Kenya is influenced by policies, regulations, legislations, and standards operating at the global, regional, national, and sub-national levels. These are summarised in Table 9 below.

Table 9: Summary of Policy Instruments

#	Instrument				Frameworks	Policies	Laws	Regulations
	Global	Regional	National	Sub-National				
1	Kyoto Protocol (1997)						X	
2	Paris Agreement (2015)					X		
3	Sustainable Development Goals				X			
4	Sustainable Energy for All				X			
5	ESMAP Multi-Tier Framework				X			
6	WHO/ISO Standards for HAP				X			

68 IEA (2023). Energy Profile – Kenya, International Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Africa/Kenya_Africa_RE_SP.pdf

#	Instrument				Frameworks	Policies	Laws	Regulations
	Global	Regional	National	Sub-National				
7	COMESA Framework				X		X	
8	EAC Customs Union				X		X	
9	East African Centre for Renewable Energy and Efficiency (EACREE)				X			
10	Constitution of Kenya (2010)						X	
11	Kenya Vision 2030					X		
12	Energy Act (2019)						X	
13	Energy Policy (2018)					X		
14	The Petroleum (Liquefied Petroleum Gas) Regulations, 2019'(LN 100 of 2019)							X
15	Draft Improved Biomass Cookstoves Regulations (2013)							X
16	Bioenergy Strategy (2018)					X		
17	Gender Policy for Energy (2019)					X		
18	Bioethanol Fuel Masterplan (2020)					X		
19	National Energy Efficiency & Conservation Strategy (2020)					X		
20	Behavior Change & Communication Strategy (2022)					X		
21	Finance Act						X	
22	Climate Change Act (2023)						X	
23	National Climate Change Action Plan					X		
24	Forest (Charcoal) Rules (2009)							X
25	Environmental Management & Coordination Act (1999)						X	
26	Forest Conservation and Management Act (2016)						X	
27	Kenya Health Sector Strategic Plan					X		
28	Least cost power development plan (LCPDP) 2021-2030					X		
29	Kenya National Electrification Strategy (2018)					X		
30	Kenya National eCooking Strategy (Draft)					X		
31	The Energy (Electricity Tariffs) Regulations 2022 (Draft)							X
32	County Integrated Development Plans					X		
33	County Energy Plans					X		

Kenya also has at least 32 standards that influence bioethanol production, stoves and fuels, biogas technology, electric cooking appliances, gas ovens, LPG product specifications and operations (plant layout, storage and filling, bulk and cylinder transportation, etc), solid biofuels, biomass stoves, and ethanol production.

The different actors play a variety of roles including (i) advocacy and lobbying for clean cooking, (ii) creation of awareness on impacts of using polluting cooking solutions, (iii) financing initiatives promoting the uptake of clean cooking, (iv) formulating policies, acts, and regulations governing the sector, and (v) conducting research and development.

Table 10: Highlights of roles played by some actors.

No.	Entity	Role Related to the Cooking Sector
1	Ministry of Energy and Petroleum.	• Formulates energy policies, acts, and regulations. • Promotes development of Renewable Energy Technologies. • Provides information on the energy sector. • Coordinates stakeholder engagement • Track progress on the implementation of the strategy
2	Ministry of Environment Climate Change and Forestry.	• Safeguards and manages the environment for long-term development and expansion of forest and tree cover to improve social and economic advantages. • Sets policy that will influence carbon finance, which directly impacts the promotion of cooking solutions.
3	Ministry of Health.	• Creates measures to reduce the health burden associated with polluting fuels. • Tracks impacts of indoor air pollution from cooking fuels. • Integrate clean cooking data gathering into the household reporting framework by community health volunteers. • Equips the community health volunteers with knowledge of indoor air pollution for effective dissemination.
4	National Treasury.	• Budgetary allocation to different departments. • Act as Designated National Authority (DNA) for GCF matters.
5	Ministry of Agriculture, Livestock, Fisheries and Co-operatives	• Formulates, implements, and monitors laws, regulations, and policies guiding the use of agricultural waste for fuel production of bioethanol, pellets, and briquettes.
6	Ministry of Education	• Provides a platform for promoting the use of science and technology to design and produce stoves, cooking appliances, fuels, and locally fabricated machines for local production of fuels. • Implementation of the policy on adoption of clean cooking solutions by education institutions
7	Ministry of Investments, Trade, and Industry	• Facilitates domestic and foreign investments. • Promotes value addition and agricultural processing. • Promotes and oversees the development of special economic zones and industrial parks
8	Special Economic Zones Authority	• Designation of quotas within the SEZ to promote local manufacturing of stoves and appliances and locally grown renewable and sustainable energy crops such as bioethanol
9	Ministry of of Labour and Social Protection	• Identification of the beneficiaries for the cross-subsidy program.
10	Ministry of Devolution and ASAL (MoDA)	
11	Rural Electrification and Renewable Energy Corporation (REREC)	• Develops renewable energy technologies, including biomass for cooking.
12	The Inter-Ministerial Committee on Clean Cooking (IMCCC).	• Provides an inter-ministerial platform to better coordinate clean cooking activities across the Ministries. • This Committee includes the Ministries of Energy and Petroleum; Health; Environment, Climate Change and Forestry; Agriculture, Livestock, Fisheries and Co-operatives; the Kenya Bureau of Standards; the Kenya Industrial Development and Research Institute; and the Energy and Petroleum Regulatory Authority.

No.	Entity	Role Related to the Cooking Sector
13	Council of Governors (CoG).	• Coordinates and harmonizes the development policies and programs of the county governments. • Resource mobilization to support clean cooking initiatives, e.g., partnering with development agencies to mobilize resources for clean cooking programs. • Capacity building through training programs and workshops to build awareness on clean cooking.
14	Energy and Petroleum Regulatory Authority (EPRA).	• Responsible for economic and technical regulation of the energy and petroleum sectors. • Regulating the importation, exportation, transportation, refining, marketing, distribution, and sale of petroleum products.
15	Kenya Revenue Authority (KRA).	• Implements taxation policies enacted by parliament and the executive.
16	Kenya Bureau of Standards (KEBS)	• Designs and maintains quality standards for locally manufactured and imported stoves. • Develops testing methods and protocols for biomass and biogas cookstoves.
17	Kenya Industrial Research and Development Institute (KIRDI).	• Undertakes Research and Development on clean cooking solutions. • Provides testing services for clean cooking solutions – both laboratory and field-based.
18	Kenya Power and Lighting Company (KPLC).	• Plays a key role in electricity for cooking through the distribution of electricity. • Collaborating with CCAK and MECs to promote electricity for cooking by supporting the government in developing an eCooking strategy, establishing regional demonstration hubs, and operationalization of mobile eCooking demonstrations.
19	Kenya Forest Research Institute (KEFRI).	• Leads research on wood fuel characterization (e.g., charcoal, fuelwood) and biomass gasification. • Facilitates measures to promote the cultivation of biomass feedstock, including agroforestry, energy crops, and short-rotation crops.
20	Kenya Medical Research Institute (KEMRI).	• Undertakes research on clean cooking technology that would reduce indoor air pollution and diseases associated with it.
21	Sustainable Energy Technical Assistance (SETA).	• Provides technical support primarily to the Ministry of Energy and Petroleum, County Governments, private sector (including sector associations), and civil society organizations working in the energy sector.
22	Financing Institutions	• Provides finance and financial services for the acquisition of clean cookstoves. • Accelerates the transition to clean cooking by investing in clean cooking companies that manufacture and distribute clean cookstoves and fuels.
23	Associations (The Clean Cooking Association of Kenya, The Kenya Renewable Energy Association, Electricity Sector Association of Kenya).	• Setting opportunities for intersectoral knowledge exchange and collaboration by bringing together actors in the cooking sector to engage on cooking issues. • Facilitates business capacity development and advocacy for the formulation of clean cooking policies. • Raises public awareness including behavioural change for clean cooking practices. • Advocates on behalf of the sector for removing tariff barriers in clean cooking solutions.

No.	Entity	Role Related to the Cooking Sector
24	Development agencies (GIZ, MECS, SNV, Practical Action).	• Promotes clean cooking solutions by focusing on market development, policy and advocacy, research and development, and capacity building. • Collaborates with local partners to facilitate creating and developing markets for clean cooking technologies and fuels. • Offers funding, research, and logistical support. • Facilitates training and information dissemination.
25	Non-Governmental organisations (UNHCR).	• Promote clean cooking access in displacement settings
26	Research institutes (Jomo Kenyatta University of Agriculture and Technology, Kenya Industrial Research Institute, Strathmore Energy Research Centre)	• Lead innovation in the sector and generate new knowledge. • Facilitate the testing and piloting of new technologies within the local context. • Facilitate the customization of various technologies to increase their useability
27	Value chain actors (manufacturers, distributors of cooking solutions).	• Design, manufacture and distribute clean and efficient cookstoves. • Grow, cultivate, promote various energy crops and energy fuels. • Create market awareness campaigns on clean cooking.
28	Consumers (households, enterprises, and institutions).	• They are the end-users of various stove technologies.

The Ministry of Energy and Petroleum is tasked with promoting access to clean cooking, ensuring a favourable policy environment, and attracting investments into the cooking sector. However, several public sector entities work closely with MoEP towards this goal. These include the core ministries of energy and petroleum, health, and environment and climate change as shown in Figure 13 below. The coordination of efforts among these ministries needs improvement, and the Ministry of Energy and Petroleum specifically requires increased support or to achieve this objective.

Regarding raising awareness among households in Kenya, the Ministry of Energy and Petroleum developed a behavioural change and communication strategy[69] to educate at least 60% of households about improved cookstoves (ICS) Regarding raising awareness among households in Kenya, the Ministry of Energy and Petroleum developed a behavioural change and communication strategy to educate at least 60% of households about improved cookstoves (ICS) and encourage the same percentage of targeted households to adopt them. BCC boosts clean cooking markets by raising awareness and encouraging the adoption of clean cooking solutions, ultimately minimising polluting fuels' health and environmental effects. When households grasp the value of using clean cooking solutions, they would be willing to pay for the fuels and technologies thereby enabling transitions from polluting fuels. A decrease in willingness to pay for clean cooking solutions is influenced by factors such as limited awareness of health, economic, and time-saving benefits, as well as restricted access to finance. Thus, the BCC strategy forms a key foundation that should be enhanced and improved (to include all the other clean cooking solutions) to facilitate the implementation of the Kenya National Cooking Transitions Strategy.

69 Ministry of Energy and Petroleum. (2022). Behavior Change & Communication Strategy. Government of Kenya

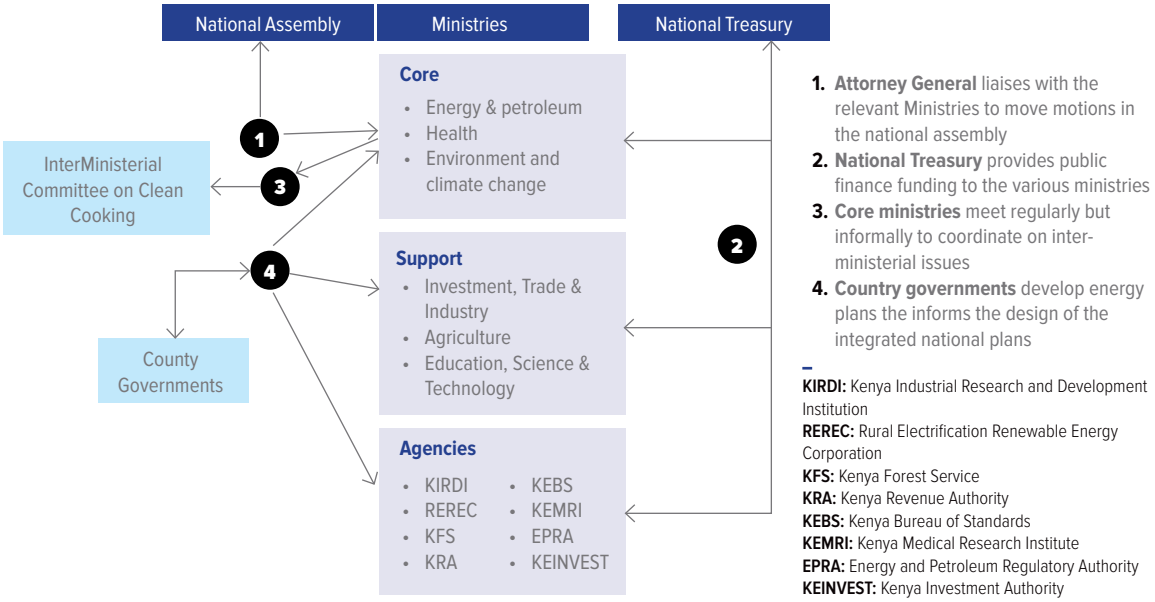


Figure 13: Public Sector Institutions Influencing the Cooking Sector in Kenya

CHAPTER TWO

Barriers, Challenges and Opportunities: Why are we here?

2.1 Evolution of the Sector

Kenya has served as a test bed for cutting-edge technological, policy, and financial innovations that have advanced energy access in the region and provided valuable lessons that can be applied in other parts of the world. The pay-as-you-go (PAYGO) model, which is based on various mobile payment platforms, has transformed access to energy technologies, services, and appliances including the cooking sector. In Kenya, early adopters who have leveraged carbon finance to bridge the affordability gap limiting access to clean cooking have achieved remarkable success. It is estimated that 16.7 million tCO2e in form of carbon credits had been generated across various projects, and that the promotion of clean cooking solutions could generate US$700-800 million in carbon revenue between 2023 and 2030[70].

The country has a vibrant cooking sector. According to the Clean Cooking Alliance, firms based in Kenya received an estimated 72% of the total investments allocated to cooking enterprises in Africa in 2020[71]. Large cooking sector enterprises such as BURN Manufacturing, KOKO Networks, Bboxx Kenya, SISTEMA.bio run major operations in Kenya alongside influential indigenous companies such as SCODE, Nyalore Impact, Wisdom Innovation, among others. Oil marketing companies (OMC) and LPG marketing companies such as Total Energies, Vivo Energy, Rubis, Hashi, Proto, Hass, among others, play a major role in promoting the widespread use of LPG and have contributed greatly to the rise in the number of households with access to clean cooking. Kenya Power, the national electricity utility, has also demonstrated its commitment to advancing electric cooking as one of the transition options.

The sector's long-term support from development partners including GIZ, SNV, EU, the World Bank, the UN Foundation Clean Cooking Alliance, and Practical Action, among others, has been a key contributor to this current state. This, combined with a policy environment that is flexible and responsive, has established a business environment that is conducive and enabling, under the direction of the Ministry of Energy and Petroleum. Structured as a top-down centralised planning framework, the energy sector in Kenya has also undergone fundamental changes in its architecture since the adoption of the new Constitution in 2010. This change established 47 counties as sub-national administrative units, each led by a governor and deputy governor elected in a free and fair election held every five years. Several functions have now been devolved to the county level, including some in the energy sector. These functions are outlined in Chapter 11 and Schedule 4 of the Constitution of Kenya, 2010.

Subsequently, the Energy Act (2019) operationalised the provisions of the Constitution and provided details of this new structure under sections 5, 193, 194, 196, 199, 222, and the fifth schedule. Section 5, subsection 3 states that "each County Government shall develop and submit to the Cabinet Secretary a country energy plan in respect of its energy requirements". As a result, at least 12 counties, as shown in Table 11 below, explicitly mention cooking activities in their Country Integrated Development Plans (CIDP). At least 6 counties have published a County Energy Plan (CEP) and several have these under development, with support from the EU under the Sustainable Energy Technical Assistance (SETA) project. This sub-national energy planning should feed into the national energy planning through the Integrated National Planning Process (INEP). The Energy Act (2019) requires the Cabinet Secretary who is the executive leader in the sector, to coordinate the development of a national Integrated National Energy Plan (INEP) and ensure a continuous and iterative review of the plan every three years.

70 CCA (2023). Kenya Carbon Markets Regulations, A Clean Cooking Perspective. Washington DC.

71 CCA (2022). Clean Cooking Industry Snapshot. Clean Cooking Alliance of the United Nations Foundation, Washington DC.

Table 11: Examples of CIDPs that mention Cooking.

	County	Target /strategies
1	Kitui CIDP 2023-2027	Conduct 200 trainings on briquette production; Establish 25 woodlots of fast maturing trees for wood fuel; 1000 households with installed clean cook stoves; Establish 25 Biogas plants; Established 5 efficient energy saving technologies; Develop policies to streamline and harmonize alternative livelihood activities within the county
2	Nyeri CIDP 2023-2027	Energy savings *jikos* installed in institutions; Energy savings cooking stoves distributed to households; Biogas plants installed; Renewable energy projects promoted.
3	Kisumu CIDP 2023-2027	Installation of clean energy for lighting, heating, cooking, and laundry; 55% of households using ICS; 3% of households using briquettes; 3% of households using biogas; 3% of households using ethanol/ gel stoves; 4% of households using electric cooking; 36% of households using LPG; 10 clean cooking/ sensitization forums organized
4	Machakos CIDP 2023-2027	46% of households having access to renewable energy by year 5; Distribute 800 clean cooking stoves every year
5	Baringo CIDP 2023-2027	10,000 households using energy efficient equipment (cook stoves etc.); 8 Efficient charcoal production technologies promoted (Kilns, briquettes etc.); 5 pilot projects on green energy technologies promoted (Biogas, Biofuels, solar, Wind etc.)
6	Marsabit CIDP 2023-2027	50 energy saving stoves and accessories supplied/ installed in early childhood development centres; 536 community units conducting participatory cooking/ food demonstrations.
7	Bungoma (Draft) CIDP 2023-2027	60% of households using biogas; 45% of households using Energy saving jikos; Facilitate quantum investment in renewable energy, solar and biogas.
8	Mombasa CIDP 2023-2027	10 community forums conducted for capacity development on sustainable energy options; 50,000 energy-saving cooking jikos distributed
9	Mandera CIDP 2023-2027	Support establishment of 30 community biogas centres (6 annually); Establish 5 biogas plants in leaning institutions; 2500 households using energy saving cooking technologies; Support 25 community groups to produce and distribute clean cook stoves and fuels
10	Kakamega CIDP 2023-2027	40 public institutions installed with clean energy (not explicit if this includes energy on clean cooking); 1,480 households supplied with clean energy; 780 households using clean /affordable cooking technologies; 3 kitchens upgraded to clean energy in HFs
11	Kisii CIDP 2023-2027	22,500 households using biogas for cooking; Construct 15 biogas demonstration plants; 100 schools using biomass/biogas; Increase the number of households using LPG; Increase the number of households adopting energy saving *jikos*
12	Lamu CIDP 2023-2027	5 hospitals to use biogas for cooking; Train 100 farmers on biogas production; 50 community groups using clean technologies; 10 schools with clean energy systems; 5 hospitals with clean energy systems

The cooking sector has evolved over the last 40 years. Previously, it was solely dependent on the development assistance, but it is now attracting private sector investment. Planning has traditionally been fully centralised, now sub-national governments contribute to national planning. Additionally, the sector has shifted its focus from simply enhancing the efficiency of solid biomass use through improved jikos to advocating for the use of multiple fuels and solutions. Lastly, it has transitioned from merely focussing on residential energy access to tackling multiple challenges and leveraging numerous opportunities. Several challenges, however, remain.

2.2 Barriers to Access and Use

The barriers to uptake and use are complex and interrelated, and often contextual. These include policy and regulatory concerns, affordability, information asymmetry, social-cultural practices, livelihood practices, technological limitations, weak or non-existent supply chains, and lack of awareness. Framing the barriers to uptake is also complicated by the diversity of cooking technologies and fuels. While some barriers apply across the solutions (e.g., lack of policy and regulatory standards), some are unique to specific solutions (e.g., lack of access to electricity which is a barrier unique to electric cooking solutions). The barriers also have varying significance and influence across the end-user segments. For example, urban versus rural end-users and poorer versus wealthier households face common but also differentiated challenges in accessing modern cooking solutions. A poor household may be unable to use electric cooking solutions due to the high upfront cost while a wealthier household will face the same issue but because of unreliable electricity supply. Some fuel sources, for example charcoal, are important both as a source of affordable urban energy source and key livelihood options for rural populations. Table 12 below provides a summary of the common barriers classified as overarching barriers, demand-side barriers, and supply-side barriers.

Table 12: Summary of Barriers

#	Description	
A	**Overarching Barriers**	
1.	Insufficient capital allocation	Insufficient funding is allocated by governments and development agencies to tackle the obstacles associated with access. In contrast to, say, the electricity sector, cooking is allocated a considerably lesser portion of the budget.
2.	Gaps in inter-ministerial coordination	Despite the inter-ministerial coordination committee's objective of enhancing collaboration, a legally mandated working understanding among ministries is currently absent.
3.	Failures to adequately enforce regulations	Some regulations are not sufficiently enforced e.g., cylinder refilling in the LPG sector and licensing charcoal production and transportation.
4.	Lack of institutionalised monitoring and tracking frameworks	The 2019 national cooking sector study was the first in-depth and dedicated cooking sector study. Continuous and consistent data collection and tracking are required.
5.	Lack of continuous and systematic planning	The electricity sector has several long-term planning frameworks, including the Least Cost Power Development Plan (LCPDP), whereas the cooking sector does not.
6.	Unpredictable fiscal policies	While the government provides incentives to promote the uptake of clean cooking fuels such as LPG, these have been unpredictable.
7.	Lack of standards and guidelines	Even though Kenya has over 32 standards influencing the production, sale, and use of cooking solutions, there are still gaps that affect the quality of some products. There is also a general lack of understanding about these standards.
8.	Misrepresentation of the role of energy for cooking	Energy for cooking is primarily an end user challenge, especially at the household level. However, confining cooking to this diminishes its prominence and potential role in economic development, health, environment, and climate.
9.	Lack of integration of cooking into broader sector planning	Cooking needs to be integrated into broader energy planning at national and county levels to ensure that adequate resources are allocated, and progress tracked. For instance, cooking data should be accurately reflected in the LCPDP, and incorporate eCooking demand stimulation alongside grid extension in the next phase of the LMCP.
10.	Lag in evolution of policy frameworks	The time required for Government to adapting policy frameworks around the needs of emerging private sector initiatives can stifle innovation.

#	Description	
B	**Supply-side Barriers**	
1.	High cost of importation and production	The impact of taxes on the importation of raw materials and fuels coupled with the high costs of doing business, including the cost of electricity, limits the ability of entrepreneurs to scale and diversify.
2.	Limited finance options	Even the limited options for financing expansion, production, and operations require conventional forms of collateral and assurances, which restricts the borrowing capacity of businesses, particularly smaller ones.
3.	Price volatility due to dynamic geopolitical factors	Kenya is reliant on imported fossil fuels, including LPG, which are susceptible to geopolitical volatility beyond the nation's control. This results in price and supply uncertainty.
4.	Foreign exchange risks	In comparison to the U.S. dollar, the Kenya Shilling has lost nearly sixty percent of its value over the past decade. Entrepreneurs who obtain investments or loans denominated in foreign currency and collect revenues in the local currency face a challenge posed by this trend.
5.	High distribution costs	Demand is widely dispersed, particularly in rural areas, raising the distribution costs significantly. Some areas also have inadequate transportation and power supply infrastructure.
6.	Market spoilage	Highly popular products, both stoves and fuels, suffer from cheap counterfeits or copycat options. This is a challenge of enforcement but also awareness among end users.
7.	Insufficient supply of clean cooking fuels	Local production of denatured bioethanol, compliant with KEBS standards, falls short of rising demand. Additionally, pellet production is in its early stages, hindering its promotion as a charcoal alternative.
8.	Lack of a common user storage for imported LPG	The market relies on private importers who provide a significantly higher price than would be under an OTS (open tender system)
C	**Demand-side Barriers**	
1.	High upfront cost of acquisition	The cost of acquisition and use is prohibitively expensive for most households. Clean cooking solutions are significantly more expensive than traditional options, as shown in Table 13 below. A 6kg LPG solution, for example, could cost up to ten times the price of a charcoal stove.
2.	High cost of continuous fuel use	Households who buy clean cooking fuels like LPG, bioethanol, and electricity switch to cheaper but more polluting fuels ifthe cost is too high. Households may also perceive certain fuels as expensive hence are averse to consistently using them to preserve the fuel[72].
3.	Limited financing options and financial services	End users have very limited financing options. Likewise, most of the distributors do not offer financial services that allow customers to stagger payments as discussed in the example provided below (Figure 15). Additionally, the unit cost of cookstoves is low, typically around US$ 30 or 50, financial institutions find it economically challenging to facilitate loans for these products due to high transaction costs.
4.	Availability on low-cost of no-cost alternatives	Traditional forms of cooking, especially solid biomass options like firewood are widely available at no financial cost. This is matched by the three-stone open fire cooking solution, which is also available at no financial cost to the end user.
5.	Demand capture	Many educational, health, and correctional institutions rely on biomass fuel suppliers who are connected with the institution's administration, making it difficult for even more competitive actors to offer their solutions.
6.	Limited access	Last mile distribution channels of some fuels are limited or non-existent in many parts of the country especially in rural and remote regions.
7.	Socio-culture norms and practices	Attitudes attached to traditional cooking fuels, such as “ugali (local popular dish) tastes better when cooked with firewood”, affect transition to and adoption of clean cooking fuels.
8.	Lack of awareness and inaccurate assumptions	While many households are not aware of some of the clean cooking solutions some have negative attitudes towards them. For example, there are general fears associated with the use of LPG.

72 Ochieng, C. A., Zhang, Y., Nyabwa, J. K., Otieno, D. I., & Spillane, C. (2020). Household perspectives on cookstove and fuel stacking: A qualitative study in urban and rural Kenya. Energy for Sustainable Development, 59, 151–159.

#	Barrier	Description
9.	Limited, non-existence, or low-quality supply	In many rural and remote parts of the country, the availability of clean cooking fuel supply networks, such as bioethanol and LPG, is limited or non-existent. This barrier is also evident in the electricity sector, as a considerable number of households in Kenya lack access to it, while those that do encounter frequent and unreliable supply.

The discussion below further explain some of the barriers mentioned above.

Barrier A3[73] (Failure to adequately enforce regulations) is exemplified by the challenges of illegal refilling which creates unhealthy competition, increases the cost of operation for some of the oil marketing companies, and compromises the quality of the final product sold in the market. Illegal refilling hinders the investment in new cylinders and the acquisition of new customers, as all competitors vie for the same customer base, leading to stagnant LPG market growth. This is in part due to the inability of the regulator and other authority organs to fully implement the Petroleum (Liquefied Petroleum Gas) Regulations, Legal Notice No. 100 of 2019 (LN100).

Barrier B6 (Market spoilage) affects popular products and fuels. BURN Manufacturing has sold more than 1.4 million *Jikokoa charcoal stoves since 2014*[74]. This is one of the most popular improved stoves. As a result, there are several counterfeit versions at significantly lower prices. This led to the company launching awareness campaigns to address this problem

Barrier C2 (Limited financing options and financial services) is a challenge even in areas that have relatively higher income levels. In Nairobi country, which has a high cash circulation rate and relatively wide range of financial services providers, only 21.4% of households (Figure 14) are aware of a programme that funds purchase of cooking solutions[75]. The issue of clean cooking is not accorded the level of attention it merits even on a global scale. Traceable public and private investment in clean cooking in 2018 amounted to a mere US$131 million. This figure is significantly lower than the estimated US$6 billion for access to clean cookstoves alone and represents less than 0.1% of the investment needed to attain the most advanced levels of modern energy cooking services[76].

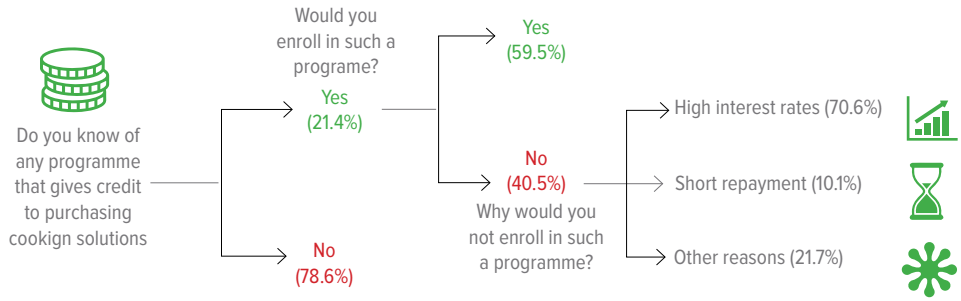


Figure 14: Knowledge and Attitudes towards Credit

Table 13: Prices of Various Cooking Solutions

#	Fuel used	Stove	Cost
1	Electricity[77]	Electric Pressure Cookers	KES 7,995 - 20,995 (US$55-145)
		Electric Hotplates	KES 1,000 - 8,495 (US$7-59)
		Gas burner with hotplate	KES 10,995 - 11,995 (US$76-83)

73 Table 12 has rows labeled. The category of the barrier is labelled as A, B or C. The list of barriers in each category is labelled 1 to 10.

74 BURN Manufacturing (2023). Statistics from official website obtained on 11/11/2023. https://www.burnstoves.com/products/charcoal-stoves/jikokoa-classic/

75 EED Advisory (2023). *Alternative Fuels Assessment: Nairobi Survey*. Report commissioned by the Modern Energy Cooking Services (MECS) with support from the UK Partnership for Accelerated Climate Transitions (UK PACT).

76 Zhang, Y. (2022). Accelerating Access to Clean Cooking Will Require a Heart-Head-and-Hands Approach. *Development 65*, 59–62. https://doi.org/10.1057/s41301-021-00297-x

77 EED Advisory. (2022). EED Internal Appliance Availability Report

#	Fuel used	Stove	Cost
		Induction cooker	KES 8,750 (USD$61)
		Microwaves	KES 9,495 - 23,600 (US$65-163)
		Air fryers	KES 8,995 - 23,000 (US$62-159)
		Rice cookers	KES 4,400 - 12,495 (US$30-86)
		Kettles	KES 1,742 - 4,395 (US$12-30)
		Toaster ovens	KES 7,995 - 27,300 (US$55-188)
		Sandwich makers	KES 1,904 - 6,795 (US$13-47)
2	LPG[78,79]	3-kg LPG grill (with burner, grill, and LPG)	KES 3,000 – 4,000 (US$21-28)
		6-kg LPG grill (with burner, grill, and LPG)	KES 4,000 – 5,000 (US$28-34)
		13-kg LPG cylinder (with a double burner/ tabletop cooker and 4-burner (stand-alone).	KES 8,000 – 50,000 (US$57-357)
		M-gas 13-Kg LPG cooker	No upfront cost
3	Ethanol[80]	Koko ethanol cooker	KES 1,550 (US$11)
4	Charcoal	Kenya Ceramic Jiko	KES 250 – 500 (US$2-4)
5	Biogas[81]	Biodigester	> KES 50,000 (US$345)
6	Firewood[82]	Portable firewood stove	KES 400 – 500 (US$3-4)
		Improved firewood stove	KES 2,800 – 3,600 (US$20-25)

In situations where fuel is readily available and potential users are informed about the clean cooking solution, there is evidence that favourable payment plans that distribute the upfront cost will increase demand. 76% of traditional fuel-using households in Nairobi are willing to purchase an LPG solution if the payments can be spread over a period (see Figure 15). The averseness to pay for an electric pressure cooker (73% are unwilling to purchase an EPC even under a repayment plan) could be associated with the limited understanding of its benefits. Additionally, there seems to be a perception that cooking with electricity is costly, irrespective of the appliance's efficiency.

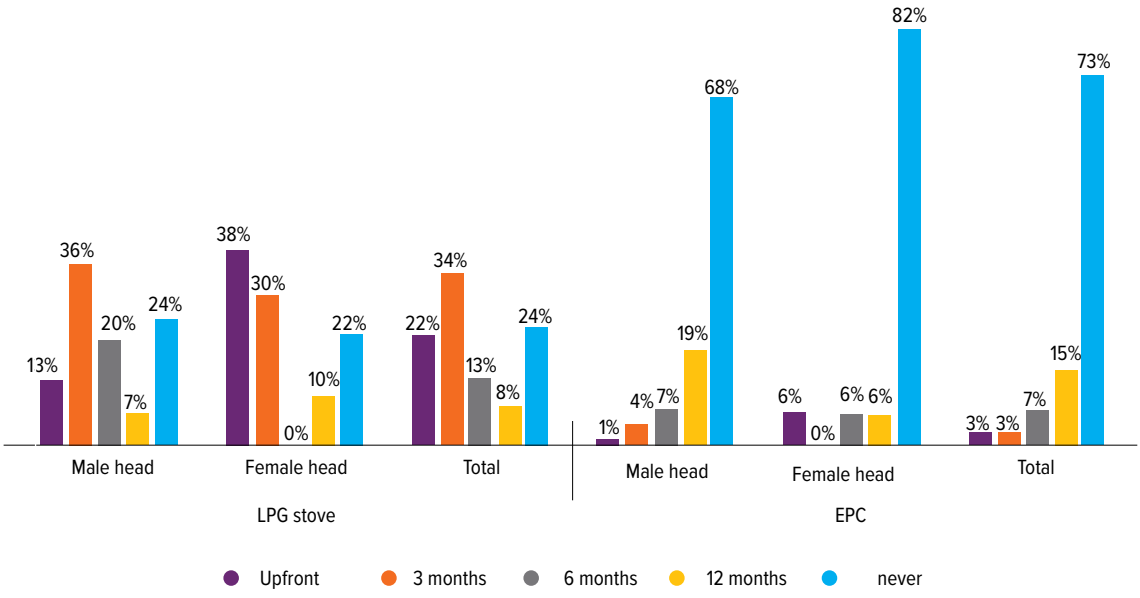


Figure 15: Willingness to Pay for LPG and EPC for Households using Traditional Fuels

78 Total Energies. (2018,). Total Energies Gas prices cylinders & accessories. https://totalenergies.ke/products/totalenergies-gas/totalenergies-gas-prices-cylinders-accessories

79 Circle Gas. (n.d.). M-Gas – *Furahia Upishi Wako*. Mgas. https://mgas.ke/

80 Ibid

81 Circle Gas. (n.d.). M-Gas – *Furahia Upishi Wako*. Mgas. https://mgas.ke/

82 Ibid

2.3 Most Binding Constraints

Barriers to clean cooking have been widely researched and discussed[83,84]. The process of developing the KNCTS strategy sought to go beyond the conventional menu of challenges to identify the most binding of these constraints. By employing the growth diagnostic framework[85]—an approach initially developed to identify impediments to a nation's growth potential—this approach systematically evaluates the clusters of obstacles and identifies the most significant ones. This enables the private sector, policymakers, development agencies, and researchers to concentrate on addressing these barriers. Barriers vary in terms of their attributes, degree of influence, and level of dominance. Certain obstacles serve as contributors, whereas others are direct causes.

For instance, market spoilage is a consequence of inadequate or lack of standards, which subsequently reduces the demand for a stove or fuel. However, the lack of awareness also contributes to low demand. The degree to which market spoilage or lack of awareness impacts demand is then dependent on other factors external to the barrier. The effectiveness of addressing some barriers is contingent on the absence of other barriers, or the existence of a complementary market or policy function. Developing regulations, for example, is a good first step but without enforcement this act alone will have little to no effect on the sector. Additionally, some barriers affect only certain segments of the market or specific technologies. High distribution costs affect rural populations due to low population density more than urban populations and the unreliability of electricity supply affects the potential for electric cooking. As a result of this variation in the characteristics of barriers, potential effect, and level of influence, it is critical to differentiate between them and identify the most significant barriers that, if resolved, will have the greatest impact on accelerating access to clean cooking. While a lack of sufficient resources has been often cited as the leading cause of the current state of the sector, the lack of a unified framework for analysing and formulating strategies which has previously led to fragmented interventions, also plays a key role.

Individual barriers are first listed, and the interconnections, dependencies, influence, and feedback loops are identified as shown in Figure 16 below. The barriers that then ascend to the top of the hierarchy are tested to determine and validate their role in a potential reform strategy that seeks to accelerate the rate of access. For example, a largely rural market (market structure barrier) implies that potential users are sparsely populated (demand-side barrier), which means that distribution costs will be high (supply-side barrier), either making it unattractive for supply chain actors or making products and fuels unavailable in those segments of the market. Subsequently, this manifests as a lack of supply of products or fuels.

The market structure barrier can be categorised as a tertiary level barrier; the demand-side barrier as a secondary level barrier; and the supply-side barrier as a primary level barrier or the main binding constraint. Several studies also point to the lack of supply and affordability as key barriers to universal access to clean cooking solutions[86,87,88,89].

This approach is tested against the observable market dynamics in the country. Nairobi County, which operates largely under the same policy and institutional frameworks as the rest of the country but has attained a near-universal access rate of 82%[90,91], provides important insights into the hierarchy of barriers[92].

83 Vigolo, V., Sallaku, R., & Testa, F. (2018). Drivers and Barriers to Clean Cooking: A Systematic Literature Review from a Consumer Behavior Perspective. *Sustainability, 10*(11), 4322. https://doi.org/10.3390/su10114322

84 Schlag, N., & Zuzarte, F. (2008). Market Barriers to Clean Cooking Fuels in Sub-Saharan Africa: A Review of Literature. Sweden.

85 Hausmann, Ricardo, Dani Rodrik, and Andres Velasco. (2008). "Growth Diagnostics", in Joseph Stiglitz and Narcís Serra, eds., The Washington Consensus Reconsidered: Towards a New Global Governance, Oxford University Press, New York.

86 Khavari, B., Ramirez, C., Jeuland, M., & Fuso Nerima, F. (2023). A geospatial approach to understanding clean cooking challenges in sub-Saharan Africa. *Nature Sustainability, 6*(4), 447-457. https://doi.org/10.1038/s41893-022-01039-8

87 Gill-Wiehl, A., Ray, I., & Kammen, D. (2021). Is clean cooking affordable? A review. *Renewable and Sustainable Energy Reviews, 151,* 111537. https://doi.org/10.1016/j.rser.2021.111537

88 Zhang, Y. (2022). Accelerating Access to Clean Cooking Will Require a Heart-Head-and-Hands Approach. *Development 65*, 59–62. https://doi.org/10.1057/s41301-021-00297-x

89 IEA, IRENA, UNSD, World Bank, WHO. 2023. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC.

90 KNBS & ICF (2022). Kenya Demographic and Health Survey. Kenya National Bureau of Statistics and the Ministry of Health, Government of Kenya.

91 EED Advisory. (2023). Alternative fuels assessment.

92 EED Advisory (2023). Alternative Fuels Assessment: Nairobi Survey. Report commissioned by the Modern Energy Cooking Services (MECS) with support from the UK Partnership for Accelerated Climate Transitions (UK PACT).

Despite gaps in policy and regulatory frameworks, the county has been able to achieve this high rate of access. This implies that, while limitations in policy and institutional framework are significant barriers, they are not one of the main binding constraints. Then, a critical question arises as to which specific barriers, unique to those counties relative to Nairobi County, impede access in all or most of the counties characterised by high deficit levels and high prevalence. While some of these counties may have contextual barriers, most of them are limited by i) supply gap (limited or no supply chains); ii) affordability (relatively lower income or high incidence of poverty); and iii) availability of low-cost or no-cost alternatives. These three are identified as the most binding constraints. Supply and affordability have been commonly discussed in literature[93,94,9596,97]. The availability of low-cost or no-cost alternatives, which makes up the third binding constraint, ascends to the top of the hierarchy as well because this process observes that some households, despite having the financial ability and supply to clean cooking solutions, continue to use traditional fuels. Studies in Nyeri County for example, which has a relatively low incidence of poverty, and which has high population density, demonstrate this practice[98,99]. Some households in this county still use firewood as their main cooking fuel[100].

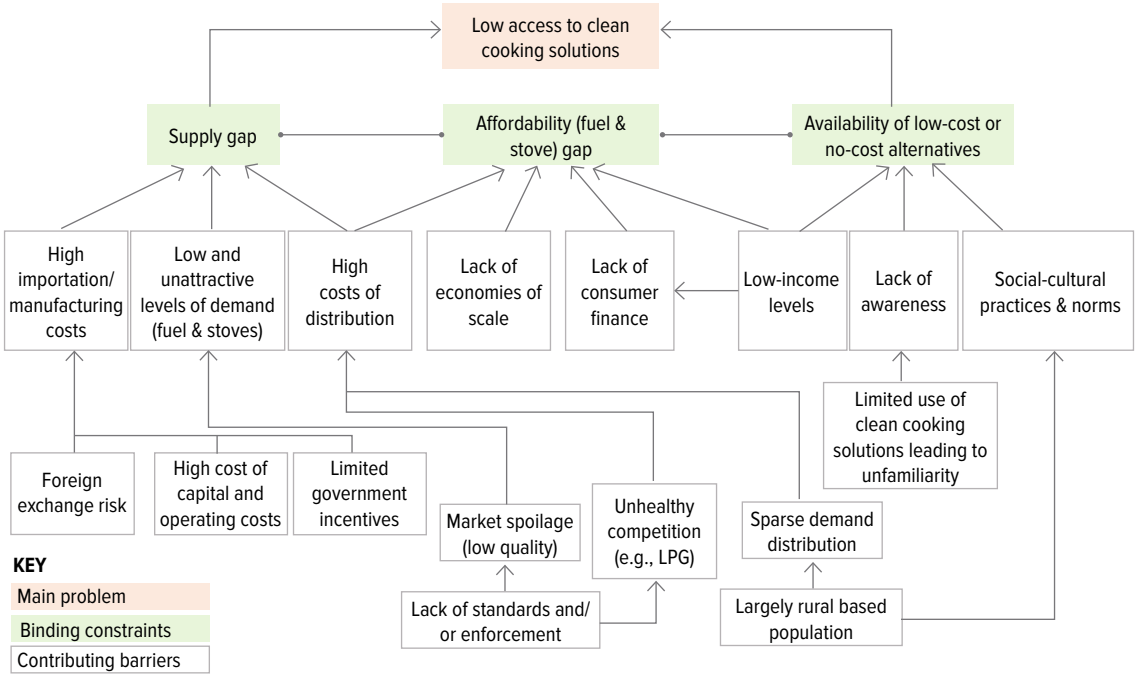


Figure 16: Problem Tree – Identifying the Binding Constraints (EED Advisory, 2023)

93 Ministry of Energy and Petroleum. (2023). Assessment of Alternative Fuels. Nairobi Survey. Report commissioned by the Modern Energy Cooking Services (MECS) with support from the UK Partnership for Accelerated Climate Transitions (UK PACT).

94 Khavari, B., Ramirez, C., Jeuland, M., & Fuso Nerima, F. (2023). A geospatial approach to understanding clean cooking challenges in sub-Saharan Africa. *Nature Sustainability, 6*(4), 447-457. https://doi.org/10.1038/s41893-022-01039-8

95 Gill-Wiehl, A., Ray, I., & Kammen, D. (2021). Is clean cooking affordable? A review. *Renewable and Sustainable Energy Reviews, 151*, 111537. https://doi.org/10.1016/j.rser.2021.111537

96 Zhang, Y. (2022). Accelerating Access to Clean Cooking Will Require a Heart-Head-and-Hands Approach. *Development 65*, 59–62. https://doi.org/10.1057/s41301-021-00297-x

97 IEA, IRENA, UNSD, World Bank, WHO. 2023. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC.

98 Fuso Nerini, F., Ray C., and Boulkaid Y. (2017) The cost of cooking a meal. The case of Nyeri County, Kenya. *Environmental Research Letters* 12 065007

99 Ngetha, H., Sasaki, M., Taheri, M., & Mathenge, S. (2015). Energy Transitions for the Rural Community in Kenya's Central Highlands: Small Scale Solar Powered Systems. *Energy Procedia, 79*, 175-182. https://doi.org/10.1016/j.egypro.2015.11.458

100 Some cold areas such as Nyeri and Nyahururu continuous use of firewood and charcoal may be due to the need for house heating

A holistic and systematic focus on these three constraints has the best chance of translating into transformational change, propelling the momentum toward the goal of universal access to clean cooking by 2028. These must be addressed collectively and simultaneously because they are interconnected and co-dependent. Addressing the supply gap only without addressing affordability will be inadequate just like raising awareness on the negative impacts of low-cost or no-cost traditional fuels alone will not lead to the desired change.

2.4 Emerging Opportunities

2.4.1 Heightened Global Focus on Clean Cooking

The World Bank is one of the largest providers of financing for renewable energy and energy efficiency projects in low- and middle-income countries. From July 2015 to June 2022, the Bank's clean-cooking support totalled US$562 million across 30 access-deficit countries[101]. Although this is significantly lower than the over US$27 billion in Bank financing supported projects with a utility component[102], it is a strong indication of the heightened attention given to cooking issues. Additionally, the funding for the utility component advances the goal of cooking with electricity. The World Bank's Energy Compact presented to the United Nations High-Level Dialogue on Energy in 2021 commits support to providing up to 100 million people with access to clean cooking by 2025. Cooking also featured prominently in the inaugural Africa Climate Summit (ACS) held in Nairobi in September 2023 and is now recognised as a leading source of greenhouse gas emissions in Sub-Saharan Africa. At COP28, the African Development Bank (AfDB), International Energy Agency (IEA), and Clean Cooking Alliance (CCA) unveiled plans to create the Africa Clean Cooking Consortium (ACCC). This initiative aims to ensure universal access to clean cooking by overseeing activities ranging from national planning and setting up Delivery Units to developing country-specific programmes and boosting public and private investments[103].

2.4.2 Expanded Access to Electricity

With more than 9 million customers[104] Kenya Power is one of the largest electric power utilities by number of customers in Africa. This is a significant increase from just 2.3 million customers in 2013[105], and it means that more than three out of every four Kenyans now have access to grid-based electricity. Due to this outcome, majority of Kenyans can now cook with electricity but the primary use for electricity for cooking remains low (≈0.2% nationwide)[106]. The rapid expansion in access addressed the last mile distribution challenge for electric cooking fuel albeit the challenge remains for appliances including supply chain challenges, price fluctuations, high upfront costs, and lack of customised appliances for local cuisines among others[107]. About 87% of electricity delivered through the grid in 2022 was from renewable energy sources making the utility one of the greenest in the world with a very low grid emission factor. This creates a great opportunity to develop greenhouse gas abatement projects that facilitate a transition from traditional forms of cooking to cooking with green electricity.

2.4.3 Digital Innovations

Kenya has witnessed an increase in mobile connectivity, as estimated by the Communication Authority in its sector statistics report for the fiscal year 2022/2023 for the third quarter. Mobile phone penetration stands at 124.5% of the total population and SIM subscriptions top 130.5%. The disparity between mobile phone penetration and SIM subscription is attributed to the registration of multiple SIM cards per user. The uptake of these mobile phone technologies provides an opportunity for innovative customer financing methods,

101 World Bank (2023). *Moving the needle on clean cooking for all.* International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA), Washington DC.

102 World Bank (2023). *Annual Report 2023 – A New Era in Development*. International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA), Washington DC.

103 Clean Cooking Alliance. (2023). AfDB, IEA, and CCA Join Forces To Help African Governments Deliver Clean Cooking for All. News. https://cleancooking.org/news/afdb-iea-and-cca-join-forces-to-help-african-governments-deliver-clean-cooking-for-all/

104 Kenya Power. (2022). Annual Report and Unaudited Financial Statements, Nairobi

105 Okoth, E. (2020). How too much energy generation short-circuited Kenya Power. Nation Africa, https://nation.africa/kenya/business/how-too-much-energy-generation-short-circuited-kenya-power-1925156

106 KNBS, & ICF. (2023). Kenya demographic and health survey 2022. https://www.knbs.or.ke/kenya-demographic-and-health-survey-kdhs-2022/

107 Kenya national ecooking study

including PAYGO, which allow greater access to clean cooking technologies. In addition, it enables new financing models, such as Buy Now Pay Later (BNPL), which allows users to pay for products on hire purchase using their mobile money statement as one of the financing requirements. All these factors contribute to increased access to consumer financing for clean cooking products. Mobile phone technologies also provide opportunities for user data tracking, credit rating, and delivery of public services e.g., subsidies, among other benefits.

2.4.4 Local Manufacturing and Assembly

Several companies (Table 14 below) have increased their capacity to manufacture and/or assemble solutions locally, employing many local employees and generating foreign exchange inflows through exports. The Gearbox Europlacer[108] has started electronics manufacturing of Printed Circuit Board Assemblies (PCBA), also known as motherboards, in Kenya. This has created an opportunity for local assemblers and manufacturers of clean cooking solutions to design and manufacture critical electronic components in-country. Other local manufacturers of clean cooking solutions are listed in Table 14 below.

Table 14: Examples of clean cooking product manufacturing companies in Kenya

#	Company	Clean cooking products
1	Burn Manufacturing Co	• Electric stoves • LPG stoves • Biomass stoves
2	CIST Africa	• Bioethanol
3	Giraffe bioenergy	• Bioethanol
4	Gearbox Europlacer)	• Printed circuit board assemblies
5	Biogas International	• Prefabricated biodigesters
6	Cookswell	• Charcoal ovens • Portable charcoal kilns • Improved charcoal stoves
7	Cylinder Works Limited, East Africa Spectre LTD, Tianlong Cylinders (Kenya) Co.,LTD	• LPG cylinders

2.4.5 Leveraging Demand from Public Institutions

The use of traditional forms of cooking fuels is also prevalent among educational, health, and correctional institutions in Kenya. 1.3 million tonnes of firewood, 46,200 tonnes of charcoal and 55 tonnes of LPG is consumed in these institutions each year[109]. It is difficult to find current and comprehensive data on fuel consumption disaggregated across institutions as educational, health, correctional, or commercial. While the SNV report estimates that 1.3 million tonnes of firewood are consumed each year, a RETAP report[110] estimates that an average school consumes between 64 tonnes (using improved stoves) and 160 tonnes (using traditional stoves) per year. Extrapolating this across the 43,076 primary (32,594) and secondary (10,482) schools in Kenya translates to an annual firewood consumption of between 2.8 million and 6.9 million tonnes. This is based on a survey of 100 schools in Central Kenya. While the precise figures and patterns of consumption among institutions in Kenya remain unknown, it is apparent that a significant amount is involved, with most of this amount coming from transitional fuels. This creates both a challenge and huge opportunity to initiate a transition to clean cooking solutions. The number of educational institutions has risen from 41,971 in 2015 to 45,597 in 2021 (Table 15) with a majority of these being public institutions managed by the Ministry of Education[111]. Through policy the government can create a substantial demand for clean cooking solutions and an opportunity to expand the last mile distribution network across the country. Through policy the government can create a substantial demand for clean cooking solutions and an opportunity to expand the last mile distribution network across the country.

108 Gearbox Europlacer. (2023). Gearbox Europlacer. www.gearbox-Europlacer.com. https://www.gearbox-europlacer.com/

109 SNV & CCAK (2018). *Study on the use of biomass cookstoves and fuels in institutions in Kenya. SNV and the Clean Cooking Association of Kenya,* Nairobi.

110 UNDP GEF (2008) *Energy Saving Institutional Stoves in the Mt Kenya Region, Kenya.* Small Grants Programme (SGP), Global Environment Facility. Renewable Energy Technology Assistance Programme (RETAP).

111 KNBS. (2022). *Statistical Abstract, 2022.* Kenya National Bureau of Statistics, Nairobi.

Table 15: Number of Educational Institutions in Kenya

Type	2015	2016	2017	2018	2019	2020	2021
Primary	31,333	33,202	35,442	37,910	32,344	31,464	32,594
Secondary	9,440	9,942	10,655	11,399	10,463	10,390	10,482
Teachers Training	271	282	414	406	384	122	61
TVET Institutions	874	1,300	1,675	1,769	2,140	2,301	2,396
Universities	53	60	61	63	63	64	64
TOTAL	41,971	44,786	48,247	51,547	45,394	44,341	45,597

2.4.6 Carbon Finance and Green Bonds

Carbon finance is playing a critical role in bridging the affordability gap that limits the uptake of clean cooking solutions. At present, the clean cooking sector in Kenya has produced 16.7 million tCO2e in form of carbon credits among 17 developers[112]. Should the entire Kenyan population embrace clean cooking solutions during a complete transition from 2023 to 2030, this sector could generate an estimated US$700 to US$800 million in carbon-finance[113]. Moreover, between now and 2050, it is anticipated that 61% of all carbon credits issued in Kenya will be for clean cooking[114]. A leading promoter of clean cooking solutions, KOKO Networks recently reported that they have provided carbon value equivalent to US$100 million to their customers and enabled access to clean cooking solutions for over one million households in Kenya[115]. Similarly, BURN Manufacturing leverages carbon finance to significantly lower the prices of the improved cookstoves. Carbon finance subsidises the selling prices by up to 90% of the cost-reflective price[116]. The company is also raising a green bond to facilitate their expansion and reach. Green bonds are financial instruments that raise finance for projects that have an environmental impact or benefit. As it targets the west African market, BURN Manufacturing aims to increase its monthly production capacity from 400,000 to 600,000 units. BURN Manufacturing currently employs 2,000 factory and field staff, half of whom are women[117].

112 CCA (2023). *Kenya Carbon Markets Regulations, A Clean Cooking Perspective.* Washington DC.

113 CCA (2023). *Kenya Carbon Markets Regulations, A Clean Cooking Perspective.* Washington DC.

114 Ibid

115 Wilson, T. (2023) Start-up taps carbon markets to boost clean cooking in Africa. Financial Times. https://www.ft.com/content/5ab93324-685d-43c8-b30d-b5332b1a378d

116 BURN Manufacturing. (2023). The role of carbon finance in increasing access to clean cooking. A response to the Kenya's draft carbon market regulations. BURN Manufacturing, Nairobi.

117 ibid

CHAPTER THREE

Target Setting: Where do we want to be?

3.1 Simulating Possible Pathways

3.1.1 Introduction to the modelling approach

There are numerous stakeholders in the cooking sector in Kenya, each with unique perspectives, motivations, and aspirations. This process was guided by the objectives of fostering national ownership, transparency, inclusion, and broad representation. It also sought to balance national circumstances with international obligations. To identify the most appropriate and acceptable pathway, this process uses modelling to simulate various scenarios to quantify the implications and impacts of adopting various approaches. While scenario modelling cannot predict what will happen in the future with certainty, it can indicate what specific actions are likely to result.

Various impact areas, including environmental, social, and economic impacts, can be considered in scenario modelling through the representation of pre-defined indicators. As a result, it can provide useful insights into how specific measures such as policies and targets may affect those indicators. Five scenarios up to 2050 are analysed, each representing different sector directions. These are i) Business as Usual (BAU-S), ii) Implemented Policies (IP-S), iii) Gas Focused (GF-S), iv) Net Zero (NZ-S) and v) Composite Scenario (CP-S). The model assumptions and the basis and description of each scenario are provided in Table 16 and Table 17 below. An Excel-based tool built by New Climate Institute was employed for the modelling exercise.

Table 16: Modelling assumptions

#	Assumption	Description
1	Population (2024)	52,573,967
2	Household size (2024)	3.64
3	Daily cooking demand (number of meals per person)[118]	2.50
4	Final energy demand for a standard meal for 4 persons (MJ)[119]	3.64
5	Conversion factor, solid biomass to charcoal[120] (%)	10-30
6	Conversion factor, solid biomass (sugarcane) to bioethanol[121]	0.44
7	Current forest area (thousand ha)[122]	4,413
8	Value of a statistical life (VSL)[123] (US$ million)	0.23

A baseline is defined in terms of the current type of fuel and cooking technology used per household in urban and rural areas based on data collected by the 2019 National Cooking Sector Study[124].

118 Nerini, F. F., Ray, C. and Boulkaid, Y. (2017) 'The cost of cooking a meal. the case of Nyeri County, Kenya', Environmental Research Letters, 12(6). doi: 10.1088/1748-9326/aa6fd0.

119 Ibid

120 Johnson, O. W. et al. (2018) 'Overcoming barriers to sustainable charcoal in Kenya': Available at: https://cdn.sei.org/wp-content/uploads/2018/10/181025g-gill-johnons-kenya-charcoal-transrisk-db1810h-1.pdf (Accessed: 6 March 2021).

121 Miskat, M. I. et al. (2020) 'Assessing the theoretical prospects of bioethanol production as a biofuel from agricultural. residues in bangladesh: A review', Sustainability, 12(20), pp. 1–18. doi: 10.3390/su12208583.

122 UN-REDD Programme (2017) Kenya. Available at: https://www.unredd.net/regions-and-countries/africa/kenya.html

123 For more information on how VSLs are used and derived see: OECD, Valuing mortality impacts: https://www.oecd.org/environment/tools-evaluation/valuingmortalityimpacts.htm

124 MoE. (2019). *Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level.* Ministry of Energy, Government of Kenya.

Fuel type usage is categorised as single or multiple fuel type usage. In the latter case, multiple fuel type usage is further disaggregated into primary and secondary fuel type usage, given that more than 50% of Kenyan households use more than one type of cooking fuel. The fuel types considered in the tool include fuelwood, charcoal, liquified petroleum gas (LPG), kerosene, electricity, bioethanol, and biogas.

Technologies considered are traditional cookstoves (kerosene, traditional wood, traditional charcoal); and clean cookstoves (LPG, electric cooking appliances, biogas, and bioethanol). To develop the scenario projections, other time-dependent driving factors including population projections, urbanisation rate and thermal efficiency are input to the tool. The thermal efficiency of each individual technology changes over time as the technology is further developed. The cooking energy demand refers to the amount of energy that is needed to cook a standard meal and is a constant input parameter. The household size is also constant over time but varies across urban and rural households. The average household sizes are assumed to be 3.5 and 4.7 people per household in urban and rural areas, respectively. An imperative parameter to determine GHG and non-GHG emissions is the energy demand for cooking. That is, the energy required to deliver the heat required to cook a meal, taking into consideration fuel conversion factors[125] and the thermal efficiency of the stove. Based on the energy demand, emissions are derived for air polluting and greenhouse gases, based on fuel combustion emission factors. The considered air polluting gases include PM2.5, NOX and SO2 emissions, while GHGs are expressed as CO2 equivalents (CO2e).

Table 17: Four Modelling Scenarios

Scenario	Based on	Characteristics	Reference
BAU-S	Historic Trends	• Continued moderate uptake of LPG. • Slow decrease in solid biomass consumption • 90% of solid biomass users have access to improved cookstoves by 2050 (61% by 2030) • Kerosene is phased out by 2030	MoEP (2019) Kenya Cooking Sector Study[126]
IP-S	Kenya Bioenergy Strategy	• 100% access to improved solid biomass cookstoves by 2028 • Traditional cookstoves phased out by 2028. • Primary focus on modern and clean biogas and bioethanol cookstoves (LPG and improved biomass with 44% and 24% access by 2028, respectively; biogas and bioethanol with 25% access by 2028) • Smaller focus on electric cookstoves (4% access by 2028)	MoEP (2020) Bioenergy Strategy 2020-2027[127]
GF-S	IEA Africa case Hystra Study	• 50% access to LPG • 12% access to bioethanol, electricity, and biogas • 100% access to improved biomass cookstoves by 2030[129]	IEA (2020)[130] & Hystra (2023)[131]

125 The fuel conversion factor refers to the process of transforming fuel input to useful heat output that can be used for cooking. As an example, energy is lost in the process of converting woody biomass into charcoal.

126 MoE. (2019). *Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level*. Ministry of Energy, Government of Kenya.

127 MoE. (2020). Kenya Bioenergy Strategy 2020-2027. Ministry of Energy, Government of Kenya

128 Universal access among solid biomass users

129 Similar growth rates are assumed beyond 2030.

130 IEA (2020). *Kenya fuels and technologies used for cooking by scenario, 2018-2030*. Available at: https://www.iea.org/data-and-statistics/charts/kenya-fuels-and-technologies-used-for-cooking-by-scenario-2018-2030.

131 Hystra (2023). *Strategic recommendations to accelerate LPG development in Kenya – Intermediary* Report, Hystra and AFD

Scenario	Based on	Characteristics	Reference

NZ-S	Regional best practices and top-down assumptions	• Strong focus on electrification (urban) and biogas (rural):
		  • 35% access to electric cookstoves by 2030
		  • 42% access to biogas and bioethanol by 2030
		• LPG serves as a transitioning fuel in urban areas; 27% access by 2030.
		• Overall solid biomass use is reduced to 77% by 2030 of which 100% has access to improved cookstoves by 2030.
		• Traditional biomass use is completely phased out in 2050.
			IEA (2020)[132] & Lambe et al (2020)[133]

CP-S[134]	Various policies (Bioenergy strategy, Bioethanol master plan eCooking Strategy, LPG Strategy) and consultations	• A focus on at least one clean cooking technology as part of their stack. • Access rates: 50% (LPG stoves), 30% (bioethanol) 10% (electricity) 3% (biogas technology), 7% (low emission/clean burning sustainable biomass e.g., briquettes and pellets). • A complete phase-out of kerosene for cooking.	

Data availability in the residential cooking sector is often constrained. There are data gaps as well as inconsistencies between different data sources. These uncertainties present limitations to the modelling exercise and must be considered when interpreting the results. The most relevant data limitations for this study were found with regards to the lack of recent historical data with sufficient granularity; population and urbanisation growth; inconsistent data on fuel and technology use; a lack of data on the fraction of renewable energy use (fNRB); and a discrepancy of non-GHG emission factors in the literature.

Across all mitigation scenarios apart from BAU-S, the GHG emissions follow a steep decline from the base year until 2028-2030 when universal access to improved cooking is achieved as shown in Figure 17. This is due to the high proportion of solid biomass cooking in the first year, which is gradually phased out but largely replaced by significantly more efficient improved biomass cookstoves. Achieving further GHG reductions beyond this level requires a shift to clean cookstoves.

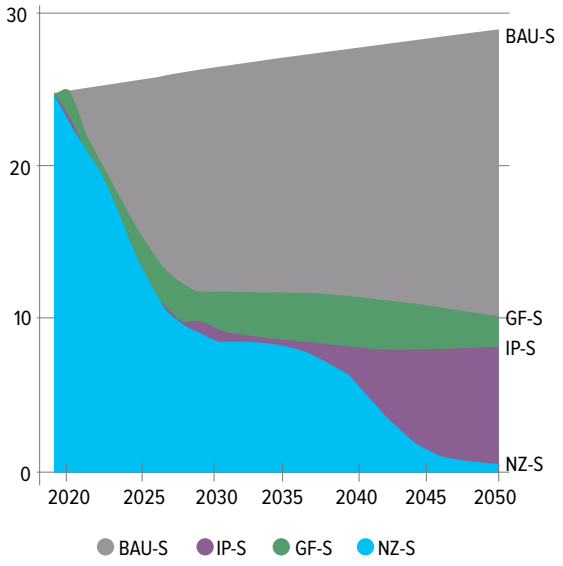


Figure 17: GHG Emissions across all Scenarios (in $MtCO_2e$)

132 IEA (2020) *SDG7: Data and Projections*. Available at: https://www.iea.org/reports/sdg7-data-and-projections/access-to-clean-cooking.

133 Lambe, F., Nyambane, A. and Bailis, R. (2020) 'Beyond Fire Backcasting a Pathway to Fully Electric Cooking in Rural Kenya by 2030'. Available at: https://www.sei.org/publications/beyond-fire-backcasting/

134 This scenario (Composite Policy Scenario) is not modelled as its targets are focussed on access (ownership) of clean cooking solutions rather than primary use.

This is mainly observed in the NZ-S scenario where a shift to biogas and bioethanol and electric cooking takes place. The energy demand by scenario as shown in Figure 18 is directly linked to the type of cooking technology and its efficiency. Electric cooking being the most efficient technology led to the lowest overall energy demand, and the NZ-S, which is heavily reliant on electrification, has the lowest energy demand[135]. Due to the high reliance on traditional cooking, the BAU-S has the highest energy demand, followed by the GF- and IP-S.

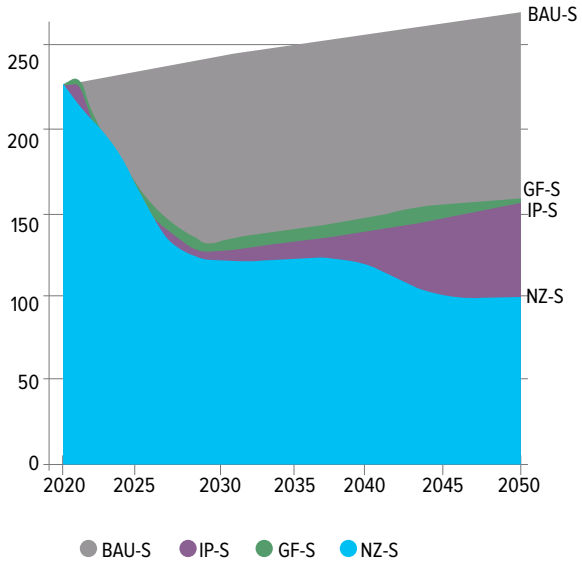


Figure 18: Energy Demand across all Scenarios (in PJ)

3.1.2 Fuel Use by Number of Households

The fuel use by number of households varies across scenarios (Figure 19, Figure 20, Figure 21 and Figure 22) and over time, depending on the share of households using more than one cooking technology. As many households use multiple fuels for cooking, the total accumulated percentage may exceed 100%. That is, percentages beyond 100% represent multiple-fuel user households. Many households which switch to more efficient fuels are expected to continue to stack incumbent technologies in the near- to mid-term.

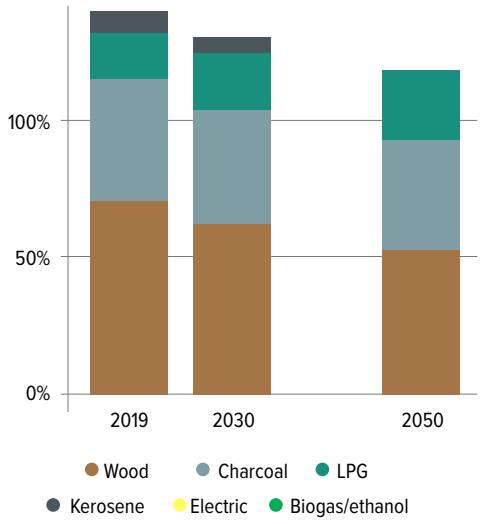


Figure 19: Fuel use by number of households (%) BAU-S

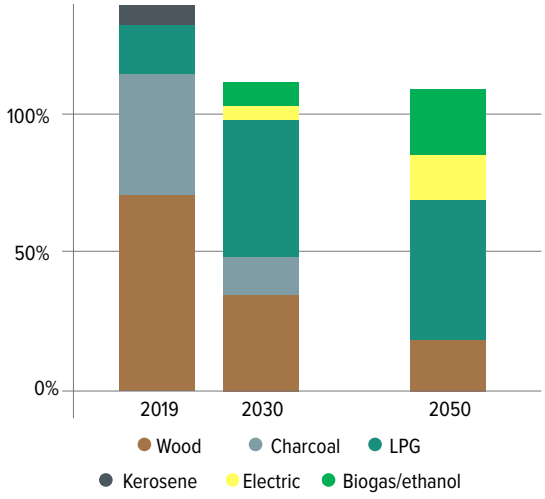


Figure 20: Fuel use by number of households (%) GF-S

135 Despite the assumption of constant energy consumption to meet cooking demand used in this modelling exercise, modern energy-efficient electric appliances employing mechanisms such as pressurisation, automation and insulation are able to dramatically reduce the amount of energy required to cook specific meals. As a result, the energy demand from the electric appliances is likely even lower than shown here.

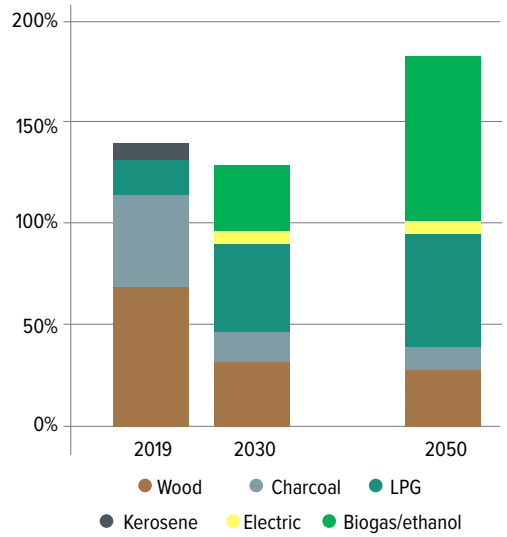


Figure 21: Fuel use by number of households (%) IP-S[136]

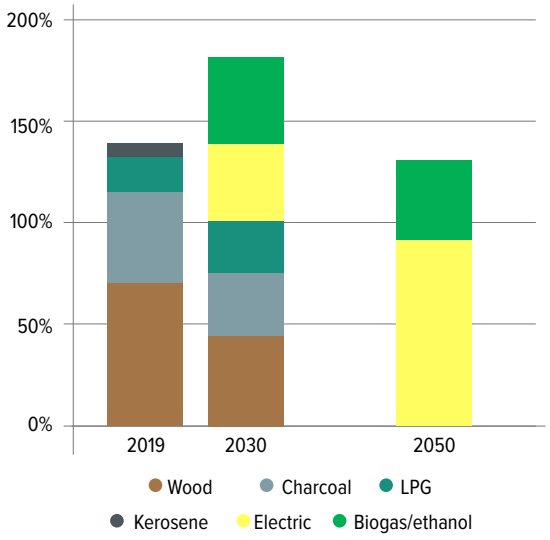


Figure 22: Fuel use by number of households (%) NZ-S

The number of required new cookstoves to be distributed, by scenario and technology, between 2019 and 2030 is presented in Table 18. Across the mitigation scenarios, the total number of cookstoves remains relatively similar (13.6 million in the IP scenario, 13.3 million in the GF scenario, and 12.5 million in the NZ scenario).

Table 18: Number of required new cookstoves between 2019 and 2030 across all Scenarios.

2019 – 2030 (million cookstoves)				
Fuel/technology	**BAU**	**IP**	**GF**	**NZ**
Improved biomass	4.3	5.0	6.4	4.6
LPG	1.1	3.5	4.8	0.9
Kerosene	0.0	0.0	0.0	0.0
Biogas and bioethanol	0.0	4.8	1.5	3.5
Electric	0.0	0.2	0.6	3.4

Note: The values do not consider the technical lifetime of different technologies but are assumed to be distributed once.

3.1.3 Health Impacts

The number of premature deaths due to air pollution is directly linked to the combustion of fuels. Since electric cooking emits negligible air pollutants locally (i.e., area where the cooking is taking place), it does not lead to increased air pollution in the home. Thus, the NZ-S scenario leads to the lowest number of premature deaths, while the BAU results in the highest number, followed by the GF-S and the IP-S (Figure 23 and Figure 24).

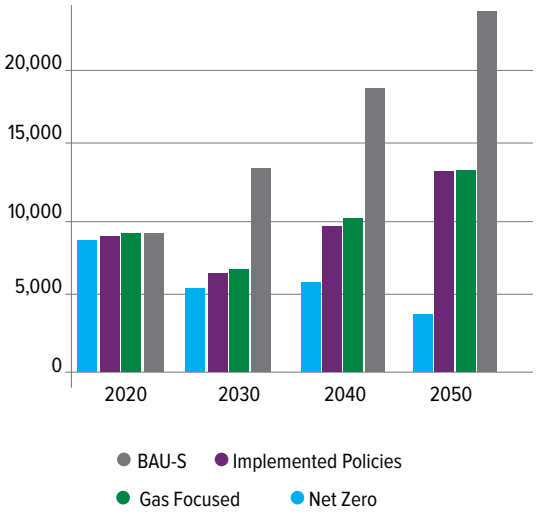


Figure 23. The number of premature deaths across all scenarios as a result from air pollution caused by the combustion of fuels for cooking.

136 By 2050, increased urbanization is anticipated, so the prevalence of electric cooking may still be somewhat higher compared to the levels observed in 2030.

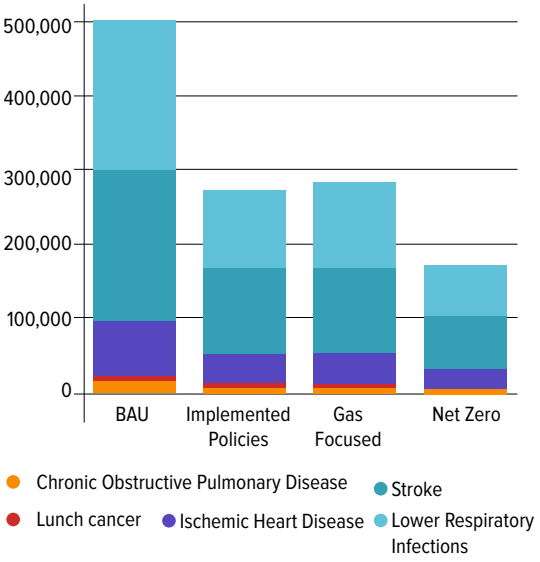


Figure 24. The number of cumulative premature deaths by cause and scenario between 2020 and 2050 as a result from air pollution caused by the combustion of fuels for cooking.

3.1.4 Economic Impacts

The estimated required capex expenditures required to acquire the new cookstoves is shown in Figure 25. Due to the higher capital cost of electric and biogas cookstoves, the total capital cost of the NZ-S is highest[137]. However, when also accounting for the costs related to the number of premature deaths caused by air pollution (Figure 26), they by far outweigh the capex costs, making the NZ-S the most cost competitive based on this perspective.

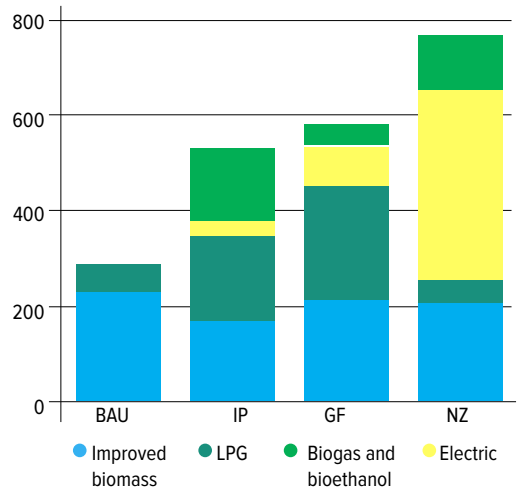


Figure 25: Capital expenditures by technology and scenario between 2019 and 2030.

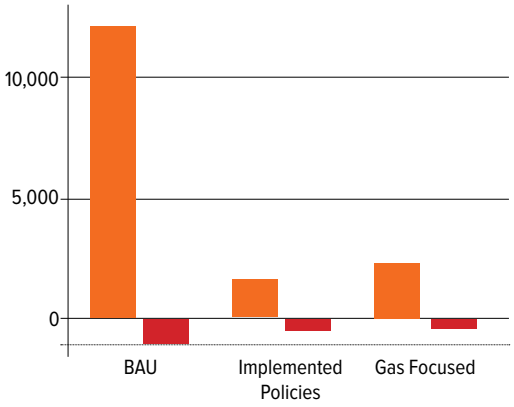


Figure 26: Additional costs related to premature deaths compared to the capex in the NZ scenario (mil US$)

3.1.5 Environmental Impacts

The equivalent area of land deforested resulting from the use of unsustainable biomass for residential cooking is highest in the BAU scenario as shown in Figure 27 below, followed by the GF-S, IP-S, and NZ-S. This analysis does not incorporate any rates of regrowth, regeneration, and afforestation that is expected to occur. It demonstrates the total volume of wood stock consumed by residential cooking rather than the rate of deforestation. This is directly linked to the overall use of cooking technologies reliant on fuel wood and charcoal. While improved solid biomass cookstoves use less fuel, they still contribute to forest degradation if unsustainable biomass is used. Figure 28 illustrates annual forested area equivalent consumed per year, per each scenario.

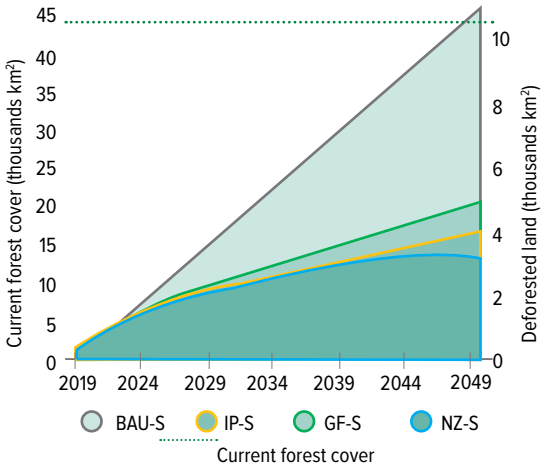


Figure 27. Forested area equivalent lost from the use of unsustainable biomass (cumulative)

137 Bioethanol stoves also have a high CAPEX albeit KOKO Networks uses carbon credits to subsidize the stove costs by about 80%. Without the subsidy, a two-burner bioethanol stove would cost KES7,500 but KOKO uses carbon credits to reduce the cost to KES1,500.

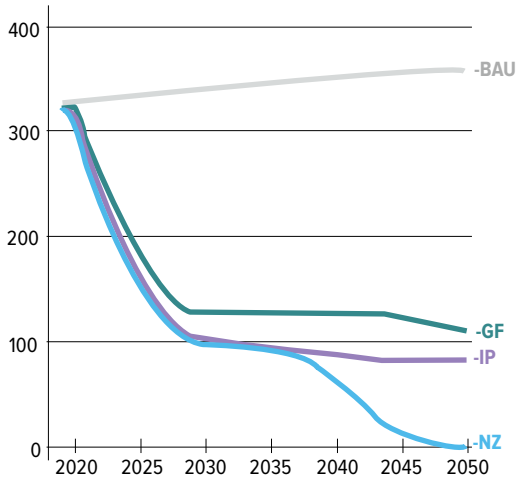


Figure 28. Annual forested area equivalent consumed across all scenarios (km²/year).

The analysis of modeling results across four scenarios reveals that advocating for clean cooking solutions like biogas, electric cooking, and bioethanol produces greater environmental and health advantages. The scenario emphasising high electric cooking usage (NZ-S) exhibits low energy demand due to the presence of efficient electric appliances. However, the adoption of clean and efficient cooking technologies entails higher costs compared to traditional, inefficient stoves, reflecting the expenses associated with technological advancements. Moreover, the adoption of electric cooking in Kenya must consider the elevated residential electricity tariffs, ranging from US$ 0.16 to 0.23, making it less affordable. In contrast, countries in Sub-Saharan Africa with high electric cooking rates and lower tariffs, such as Zambia (approximately US$ 0.025/kWh) and Ethiopia (between US$ 0.04 to 0.06), showcase an opportunity to scale cooking with electricity by addressing the cost of electricity. Alternatively, efficient electric cookers can be promoted to bring the cost of cooking with electricity low. Despite the higher capital costs associated with electric and biogas cookstoves in the health and environmentally beneficial scenario, the overall capital investment is justified by the superior health benefits derived from adopting these clean cooking solutions.

The adoption of electric cooking in Kenya must consider the **elevated residential electricity tariffs**, ranging from **US$ 0.16** to **0.23**, making it less affordable.

The business-as-usual scenario, characterised by the prevalent use of traditional cooking methods, incurs the lowest capital requirements but results in a higher number of premature deaths and increased deforestation due to unsustainable biomass harvesting. The business-as-usual and NZ-S scenarios present contrasting outcomes, with one illustrating the adverse impacts of persisting with traditional cooking (BAU-S) and the other showcasing substantial benefits from clean cooking solutions (NZ-S), albeit with a higher initial capital investment. These results reinforce the need to move away from the BAU-S. The intermediate scenarios, GF-S and IP-S, predominantly feature a higher percentage of LPG use. While the benefits of these scenarios are lower compared to NZ-S, they surpass those of the business-as-usual, representing a transitional path toward the ideal clean cooking scenario.

The insights derived from the analysis contribute to the formulation of the 2028 fuel mix target (composite scenario below). The emphasis is placed on promoting renewable fuels such as electricity, biogas, and bioethanol. Additionally, LPG is recognised as a crucial transitional fuel despite being a fossil fuel. Notably, in Kenya, where 31.49% of households use clean cooking solutions (LPG, electricity, and bioethanol), 31% of them utilise LPG. The substantial uptake of LPG has occurred with minimal attention from funding agencies. Shifting households from charcoal to LPG for cooking, while LPG itself is a fossil fuel, holds substantial potential for greenhouse gas abatement. This underscores the importance of including LPG in the target fuel mix for 2028.

3.2 Composite Policy Scenario (2028 Fuel Mix)

Roundtable discussions were held between the 18th and 22nd of October 2023 with representatives from various sub-sector groups, including the government and development agencies, electric cooking stakeholders, ethanol stakeholders, solid biomass stakeholders, and LPG stakeholders, among others.

A composite policy scenario (CP-S) outlining the energy mix for the 2028 goal was reached based on projections from various government planning documents such as the Bioenergy Strategy 2020-2027, Bioethanol Master Plan, the eCooking Strategy (under development), and the LPG Strategy (under development), as well as discussions during the roundtable.

Key considerations in arriving at the cooking fuel mix *(Table 18 and Figure 29 below)* include:

- LPG growth policy and LPG strategy (under development) which seeks to promote the use of LPG among residential and institutional users.
- In this strategy, electric cooking devices refer to appliances capable of preparing a majority of the dishes made by a standard stove. This category encompasses hotplates, induction cookers, and electric pressure cookers. The Least Cost Power Development Plan (LCPDP) projects an installed capacity of 4,200 MW by 2028, creating a system-wide constraint on the use of electric cooking appliances. Within the ecooking strategy's transition scenario, there is an expectation of a gradual increase in the adoption of Electric Pressure Cookers (EPCs) and induction cookers. The projection indicates a rise to 9.5% by 2028 for their utilisation as primary cooking solutions and an increase to 10.8%, encompassing their use as secondary sources of cooking solutions[138]. Further analysis shows if more than 10% of households switch to electric cooking, demand for electricity for cooking will begin to strain the power supply system. .
- Recent growth in the number of households using bioethanol for cooking demonstrates that the option, when coupled with innovative distribution and financing that lowers the cost of entry, can rapidly scale.
- Funding a nationwide transition towards clean cooking by 2028 will require substantial capital to pay for the clean cooking stoves and appliances for households, particularly those living in rural and remote regions. Allocating financial resources will be necessary to ensure that the households that acquire the clean cooking solution are able to regularly purchase the associated fuels and use these as their primary cooking solution. This process does not foresee any viable strategies of attaining universal primary use of clean cooking fuels/technologies by instituting a practical national subsidy scheme to support the use of clean fuels by 2028. Hence the strategy aims to ensure that all households have access to a clean cooking solution as part of their stack and as many as possible using clean fuels as their primary fuel, as a bare minimum. The strategy proposes a second phase of implementation where approaches such as cross-subsidy schemes can be gradually implemented.
- Budgetary constraints on national resources because of the current debt repayment obligations
- Other complementary targets set out in the Bioenergy Strategy, Bioethanol Masterplan and the eCooking Strategy.
- This process does not run an optimisation model because the aspects to optimise (e.g., least cost, health benefits, environmental benefits, GHG abatement potential, etc.) must be predetermined, which is not the case.

138 MoEP. (2024). The Kenya National Electric Cooking Strategy. Ministry of Energy, Government of Kenya.

The composite policy scenario as shown in Table 19 and Figure 29 below aims to have at 50% (LPG stoves), 30% (bioethanol) 10% (electricity) 3% (biogas technology), 7% (low emission/clean burning sustainable biomass e.g., briquettes and pellets), of households in Kenya owning the designated clean cooking technology as part of their stack as a bare minimum. This scenario does not aim to eliminate any cooking fuel but to introduce every household in Kenya to an appropriate clean cooking solution. The strategy also proposes a second implementation phase (2028-2032) where households are assisted to adopt these clean cooking technologies and fuels as their primary option.

Table 19: Percentage and Number of Households Accessing a Clean Cooking Solution by 2028

#	Type	2019 (%)[139,140]	2019 (HHs)	2028 (%)[141]	2028 (HHs)
1	LPG	29.7%	3,818,075	50%	7,577,493
2	Biogas technology	0.1%	12,855	3%	454,650
3	Bioethanol	<1%	0	30%	4,546,496
4	Electricity	2.8%	359,953	10%	1,515,499
5	Other (Low emission clean burning sustainable biomass)	<1%	0	7%	319,700
	TOTAL		**4,190,883**		**15,154,985**

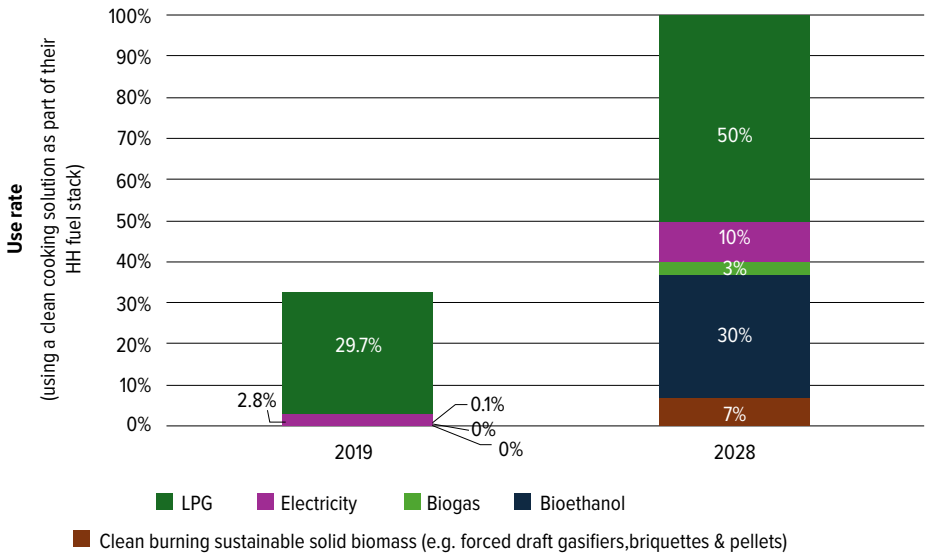


Figure 29: Composite Policy Scenario (CP-S) 2028

139 Percentage of households using the designated fuel as part of their stack.

140 MoE. (2019). Kenya Cooking Sector Study: Assessment of the supply and demand of cooking solutions at the Household level. Ministry of Energy, Government of Kenya.

141 Percentage of households having the respective clean cooking technology as part of their stack

3.2 Cost and Benefits analysis for the composite scenario

Additional analysis was carried out to compute the costs and benefits associated with the implementation of the composite scenario. The costs encompass private expenditures for households (fuel and stove purchases) and government costs (such as subsidies), while the benefits encompass time savings, improvements in health, and environmental gains. The Benefits of Actions to Reduce Household Air Pollution (BAR-HAP) tool was employed to model these costs and benefits. The BAR-HAP tool is selected due to its capability to evaluate the costs of various policy interventions. These interventions comprise (i) fuel subsidies, (ii) stove subsidies, (iii) Behavioural Change Communication (BCC), (iv) stove financing, and (v) fuel bans.

Additionally, the flexibility of BAR-HAP, in particular in relation to the percentage (%) use of each clean cooking solutions (i.e. at 45%, 75% and 100%) made it more appropriate for the CP-S, which represents the pathway on which the strategy as a whole has been built. The analysis specifically focused on stove subsidies and the subsidisation of bioethanol, which is presently the only fuel-receiving subsidy through carbon credits. The details of data inputs and assumptions can be found in Table 20 below. Note that the model provides for two categories of costs i) government (administrative, fuel and stove subsidy, programme costs) and ii) private (after subsidy expenditure by households to purchase fuel and stoves, on learning and stove maintenance) costs[142].

Table 20:Data inputs and assumptions

#	Assumption	Description
1	Population (2024)	52,573,967
2	Household size (2024)	3.64
3	Fraction of households buying wood	23%
4	Stove subsidy (ICS, bioethanol, pellet, ethanol, electric)[143]	80%
5	Bioethanol fuel subsidy[144]	80%
6	Cooking time with traditional technology (hours/day)	2.6
7	Firewood collection time (hours/day)	1.0
8	Scale-up period[145]	4 years
9	Social cost of carbon[146] (US$/tCO2e)	18.69

Figure 30 below showcases the costs and benefits of transitioning to clean cooking solutions at different stove use levels (45%, 75%, and 100%). As anticipated, the most significant benefits are observed when households fully utilise the stove at 100%.

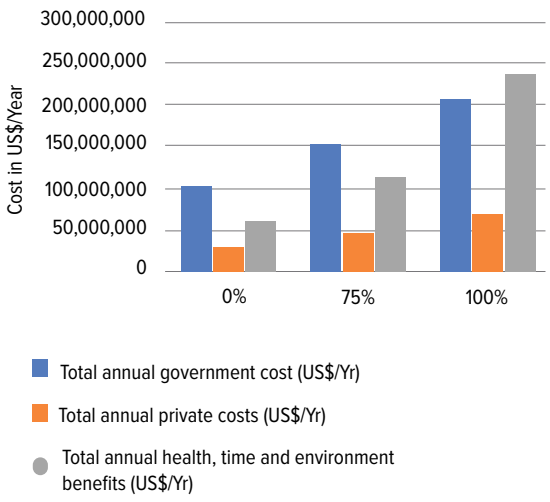


Figure 30:Costs and benefits of transitioning to clean cooking

142 Das, I., Lewis, J. J., Ludolph, R., Bertram, M., Adair-Rohani, H., & Jeuland, M. (2021). The benefits of action to reduce household air pollution (BAR-HAP) model: A new decision support tool. Plos One, 16(1), e0245729. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0245729

143 The 80% stove and fuel subsidy are informed by current KOKO subsidies on stoves. Without the 80% subsidy, a bioethanol stove will cost KES7500, but it retails at KES1500 due to generated carbon credits.

144 No subsidy for all the other fuels. This will be primarily financed through generated carbon credits and later through monetized health benefits once trading in averted DALY's gains traction.

145 Preparatory time for HHs to acquire the stove

146 The social cost of carbon is the monetary estimate of all the costs of emitting one ton of carbon equivalent.

The total annual government (US$ 210,711,189) and private costs are (US$ 71,568,309). Figure 31 below shows a breakdown of these costs. The bulk of government costs are fuel (US$178 million) and stove subsidy (US$10.3 million). Whereas the fuel (US$178 million) and stove (US$10.3 million)

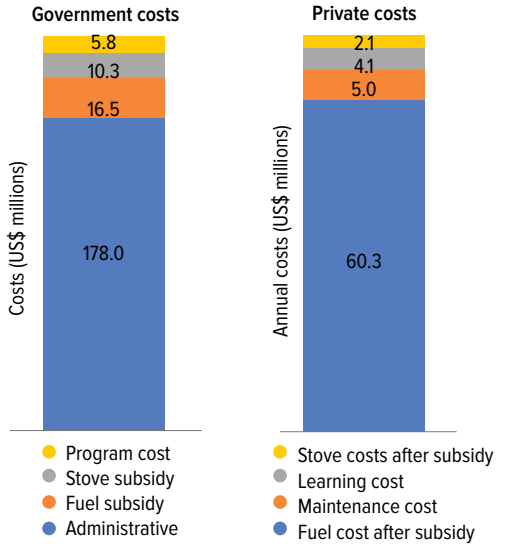
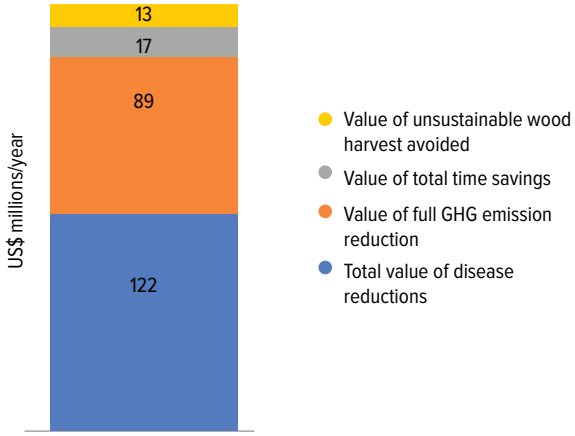


Figure 31: Breakdown of government and private costs.

subsidy costs are allocated[147] to the government, they will be partly[148] be financed through private sector initiatives leveraging trading of clean cooking co-benefits (e.g., carbon credits, averted DALYs, time savings) generated from the sustained use of clean fuels and technologies. Thus, there will be no additional costs to the government other than the annual administrative (US$16,540,666) and programme (US$5,845,863) costs. Implementing the strategy and a sustained (100%) of the acquired clean cooking technologies will result in total social and private benefits of US$240,106,966.

The benefits are higher than this as the tool does not incorporate calculations on job created and



revenues to the government such as taxes. ANNEX 3: has the detailed costs and benefits of transitioning to clean cooking solution with 100% utilisation of the stove. Figure 32 show the monetised annual value of various private and social benefits.

Figure 32: Annual private and social benefits (100% use rates).

Below is a breakdown of the private and social benefits at 100% utilisation of the clean cooking solutions.

3.2.1 Health benefits

In Kenya, the WHO data attributes about 22,283 deaths and 889,402 DALYs to household air pollution[149]. Implementing the KNCTs and 100% usage of acquired stoves would avert 26,588.8 deaths[150] and 622,782 DALYs (ANNEX 3). Figure 33 and Figure 34 show the breakdown of reduced mortality and morbidity per disease when households use the acquired clean cooking solutions entirely.

147 The model provides for two categories of costs i) government and private (expenditure by households to purchase fuel and stoves) costs.

148 As discussed in section 4.2.2. and 4.5, the MOEP through the clean cooking fund will aggregate clean cooking co-benefits from projects without t e wherewithal to access carbon markets and finances from other outcome buyers to finance the uptake and use of clean cooking solutions. More finances would result if Kenya operationalizes Article 6.2 of the Paris Agreement. This will boost the actions of private sector players with access to carbon markets and finance from other outcome buyers.

149 World Health Organisation. (2022). Household air pollution attributable deaths. The Global Health Observatory. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/household-air-pollution-attributable-deaths

150 This number is higher than the baseline number because the assumption as years increase the 22,283 annual deaths attributable to HAP would increase in BAU with population increase.

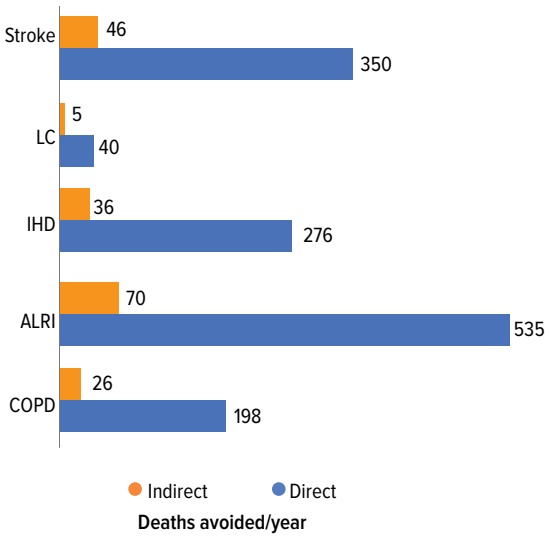


Figure 33: Mortality reductions per disease (100% use rate)

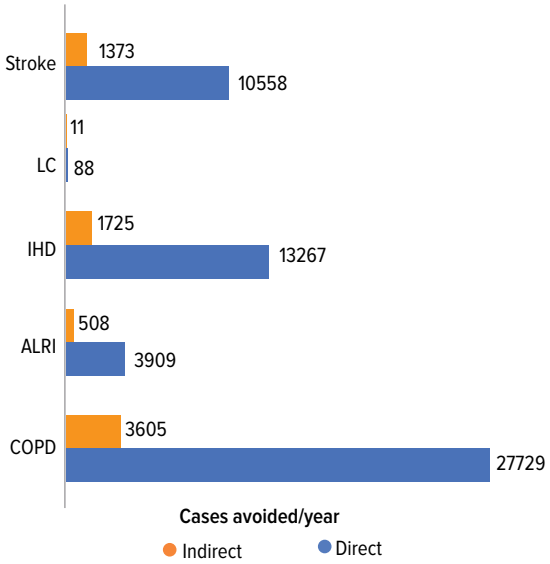


Figure 34: Morbidity reductions per disease (100% use rate)

3.2.2 Time Saving Benefits

A household adopting clean cooking solutions would save approximately 789.7 hours per year. The total annual time savings is 606,822,901 hours, equivalent to US$ 16,627,403 per year. The involvement of women and girls in firewood collection and other unpaid household chores results in significant time losses compared to men[151]. Research in Kiambu County found a robust negative association between girls' time collecting firewood and the likelihood of attending school[152] . A similar study in Tanzania revealed that a one-hour increase in firewood collection due to dwindling biomass resources would result in 25 minutes less in school per week, translating into one-fifth fewer grades two decades later[153]. Furthermore, it implies that the child will lose about 1.7% of their annual income when they are older[154].

3.2.3 Environmental benefits

Figure 35 shows the annual emission reductions and their equivalent monetary value. Sustained usage of clean cooking solutions will result in the reduction of basic (CO2, N2O, and CH4) and total (basic + CO, OC, and BC) climate-forcing pollutants (in tons of CO2 equivalent). The annual basic tCO2e reductions with 100% use rates are 7,009,708tCO2e, equivalent to US$37,444,313, while the full annual reductions are 16,644,605tCO2e (which is 11% of the Kenya's baseline emissions of 143MtCO2e), equivalent to US$89,022,631. The unsustainable annual wood harvest avoided is 4,323,197 tons, equivalent to US$12,700,896.

The annual emission reductions of **16MtCO2e** is **11%** of Kenya's baseline emissions of **143MtCO2e**

151 Rogers, M. H. (2014). Environment and Development: Essays on the Link Between Household Welfare and the Environment in Developing Countries [PhD Thesis]. University of Minnesota.

152 Ndiritu, S. W., & Nyangena, W. (2011). Environmental goods collection and children's schooling: Evidence from Kenya. Regional Environmental Change, 11(3), 531–542.

153 Rogers, M. H. (2014). Environment and Development: Essays on the Link Between Household Welfare and the Environment in Developing Countries [PhD Thesis]. University of Minnesota.

154 Rogers, M. H. (2014). Environment and Development: Essays on the Link Between Household Welfare and the Environment in Developing Countries [PhD Thesis]. University of Minnesota.

The avoided unsustainable wood harvest is equivalent to 466,543ha (≈11% of Kenya's forest cover of 4.2 million hectares) based on an average wood production of 3.2 tonnes per hectare.

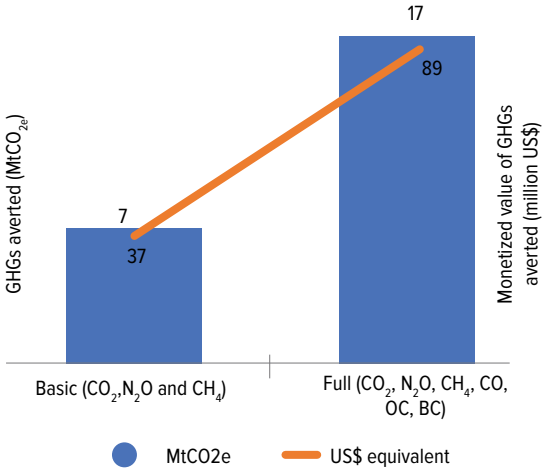


Figure 35: Emission reductions and equivalent monetized values.

Various estimates regarding emissions from fuel combustion in residential cooking are available in the literature. According to the 2019 National Cooking Sector Study, annual emissions in the residential cooking sector are estimated at 13.6MtCO2e, excluding carbon oxide, black carbon, and organic carbon. When including these three gases, the total increases to 20.5MtCO2e. A report by Dalberg suggests annual emissions from household biomass fuel use in Kenya's residential cooking sector range from 22 to 35MtCO2e, with the upper limit accounting for emissions from fuel production as well[155]. The baseline emissions assumed in the model utilised in the present study align broadly with the figures found in the existing literature.

The avoided unsustainable wood harvest is equivalent to **466,543ha** (≈11% of Kenya's forest cover of **4.2 million hectares**) based on an average wood production of **3.2 tonnes** per hectare.

155 Dalberg (2018) 'Scaling up clean cooking in urban Kenya with LPG & Bioethanol: A market and policy analysis'. https://southsouthnorth.org/wp-content/uploads/2018/11/Scaling-up-clean cooking-inurban-Kenya-with-LPG-and-Bio-ethanol.pdf

CHAPTER FOUR

Logic of Intervention: How to get there?

4.1 Overview of the Strategy

The Kenya National Cooking Transition Strategy (KNCTS) provides an ambitious but practical roadmap for achieving universal access to clean cooking by 2028. It is guided by baseline information, extensive literature and data review, wide consultation, and various analyses. The strategy also aims to improve coordination among key actors promoting energy access, attract investments from both the public and private sectors, and serve as a foundational long-term planning framework for periods beyond 2027. This vision is based on the strength of strategic collaboration among the national government, sub-national governments, the private sector, development partners, and research institutions.

This strategy identifies the three most binding constraints to the rapid and widespread adoption of clean cooking solutions in Kenya: i) supply gaps, ii) affordability gaps, and iii) availability low-cost or no-cost traditional fuels. This strategy aims to guide and orient the country toward the goal of universal access through five interconnected action agendas.

Additionally, the five-point agenda will guide the sector to realise the targets under the composite policy scenario (CP-S) which aims to at 50% (LPG stoves), 30% (bioethanol) 10% (electricity) 3% (biogas technology), 7% (low emission/clean burning sustainable biomass e.g., briquettes and pellets), of households in Kenya owning the designated clean cooking technology as part of their stack as a bare minimum. Figure 36 below outlines the proposed Action Agenda with five focus plans. Figure 37 below shows how these actions are directly targeted at the most binding constraints and positioned as barrier removal options.

These action plans are further broken down into components which are discussed below. Action agendas 1, 2 and 3, will tackle the supply and affordability gaps. Action agenda 4 will raise awareness about the consequences of using traditional fuels to reduce dependency on readily available low-cost and no-cost traditional fuels. The overarching action agenda 5 will ensure that this strategy is instituted, implemented, and supported, while also ensuring that future plans are built on this framework. The implementation budget is estimated to be KES 65 billion (US$ 435 million) spread over five years. This includes private sector investments, carbon finance and other climate finance options, public finance, philanthropic contributions, and development agency assistance.

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Figure 36: Summary of the Five Point Agenda

		IMPLEMENTATION LEVERS		
		Policy & Institutional	Financing	Technical, Planning and M&E
ACTION AGENDA	1. Bridge the supply gap for clean cooking solutions	x	x	
	2. Bridge the affordability gap for demand side	x	x	
	3. Promote local manufacturing and fuel production for local use and export	x	x	
	4. Reframe and raise awareness of the role of clean cooking	x	x	x
	5. Institute accountability, planning, and continuous tracking progress	x	x	x

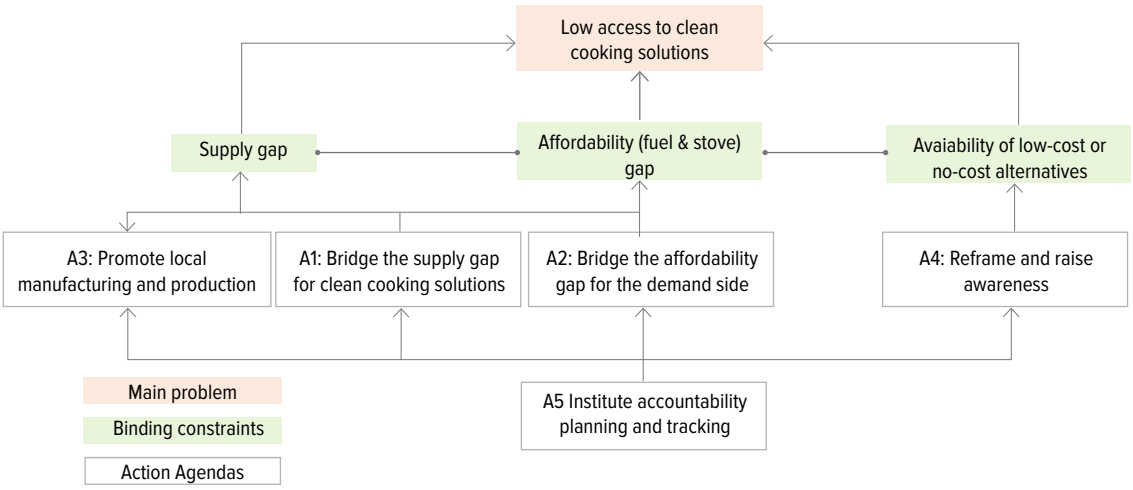

Figure 37: Targeting the Action Agenda

To address these constraints, the government, as the ecosystem's lead agent, will need to either i) apply command-and-control measures that limit choice such as charcoal bans, ii) tax the use of traditional forms of fuels to reduce or eliminate demand, and/or iii) subsidise supply, access, and use, to achieve universal access to clean cooking[156]. The evidence available strongly suggests that the first alternative is ineffective and merely establishes an illicit industry that enriches a limited number of participants. Charcoal bans in Kenya[157], Malawi[158], Tanzania[159] for example have proved ineffective and counterproductive in some cases. Such bans could apply on government-managed institutions such as educational, health, and correctional institutions. Traditional fuels (especially firewood) and cooking applications (e.g., three-stone open fire) are rarely purchased and even when they are, this is done in the informal market, making the second alternative impractical. The third option is difficult to execute due to the high cost, sustainability challenges, and risk of leakage, among other factors. However, this is perhaps, the only viable approach to rapidly accelerate access to clean cooking solutions in sub-commercial and non-commercial market segments. Public, philanthropic, and development capital should be deployed in ways that catalyse private sector participation and generate new business opportunities.

Subsidising supply, access, and **use** - though difficult to execute - is the only viable approach to rapidly accelerate access to clean cooking solutions in sub-commercial and non-commercial market segment.

The five-point agenda aims to implement various forms of command-and-control measures; provide subsidies for supply, access, and use; and strengthen current institutional structures, including establishing a process to oversee the strategy's implementation. Reframing the central role of cooking will be part of this, together with a sustained awareness campaign about the negative impacts of using traditional cooking solutions.

156 Khavari, B., Ramirez, C., Jeuland, M., & Fuso Nerini, F. (2023). A geospatial approach to understanding clean cooking challenges in sub-Saharan Africa. *Nature Sustainability, 6*(4), 447-457. https://doi.org/10.1038/s41893-022-01039-8

157 Wekesa, C., Mutta, D., Larwanou, M., Kowero, G., & Roos, A. (2023). Effects of charcoal ban on value chains and livelihoods in Kenyan coast – Stakeholders' perceptions. *Environmental Development, 45*, 100809. https://doi.org/10.1016/j.envdev.2023.100809

158 Smith, H. E., Hudson, M. D., & Schreckenberg, K. (2017). Livelihood diversification: The role of charcoal production in southern Malawi. *Energy for Sustainable Development, 36,* 22-36. https://doi.org/10.1016/j.esd.2016.10.001

159 Mabele, M. B. (2020). The 'war on charcoal' and its paradoxes for Tanzania's conservation and development. *Energy Policy, 145*, 111751. https://doi.org/10.1016/j.enpol.2020.111751

4.2 Five Point Agenda

4.2.1 Bridge the supply gap for clean cooking solutions

Table 21 below has a summary of the strategic plan for action agenda 1 on bridging the supply gap.

Table 21: Summary of Action Agenda 1

Purpose	To address the supply chain gaps by (i) leveraging the existing public institutions (educational, health, and correctional) as anchor clean fuels demand points through a hub-and-spoke model that reaches adjacent households[160] and, (ii) creating incentives for stove and appliance distributors to expand their distribution networks.				
Description	Through policy, the national and sub-national governments institute a policy that bans the use of traditional forms of cooking in all public institutions, which will institute a transition to clean cooking fuels, including electricity, bioethanol, LPG, and renewable solid biomass (pellets and briquettes) options, and biogas technology. Suppliers will be selected through a transparent and competitive process, which will also require them to create supply provisions for adjacent households. Commercial and out-grower schemes for energy crop cultivation and production will be initiated. Building on the KOSAP component on cooking, provide supply-side incentives to expand to unreached regions. This initiative includes displacement settings.				
Budget	KES 27.3 billion (US$ 181,425,000).				
Timelines	Y2024	Y2025	Y2026	Y2027	Y2028

There are several case studies that illustrate instances where governments initiated or stimulated substantial demand for a product through a policy action, which then resulted in a transformation or the emergence of a new market. These include Brazil and its bioethanol blending mandate ; Nepal's biogas for institutions program[161]; Nepal's biogas for institutions program[162]; Kenya's shift to online provision of public services which has led to the proliferation of cyber cafes across the country among others.

Governments, through command-and-control measures, can rapidly create substantial demand for a product or service which can then be leveraged to achieve other goals. Kenya has 45,597 educational institutions[163], 13,579 health facilities[164], and 134 correctional facilities[165] – most of which are managed by government agencies. These institutions i) use substantial amounts of traditional fuels especially firewood, and ii) are close to human settlement areas as show in Figure 38.

160 This action point prioritizes both institutions and households.

161 Mingo, S., & Khanna, T. (2014). Industrial policy and the creation of new industries: Evidence from Brazil's bioethanol industry. *Industrial and Corporate Change, 23*(5), 1229-1260. https://doi.org/10.1093/icc/dtt039

162 Gautam, R., Baral, S., & Herat, S. (2008). Biogas as a sustainable energy source in Nepal: Present status and future challenges. *Renewable and Sustainable Energy Reviews, 13*(1), 248-252. https://doi.org/10.1016/j.rser.2007.07.006

163 KNBS. (2022). *Statistical Abstract, 2022.* Kenya National Bureau of Statistics, Nairobi.

164 Moturi, A. K., Suiyanka, L., Mumo, E., Snow, R. W., Okiro, E. A., & Macharia, P. M. (2022). Geographic accessibility to public and private health facilities in Kenya in 2021: An updated geocoded inventory and spatial analysis. *Frontiers in Public Health, 10*. https://doi.org/10.3389/fpubh.2022.1002975

165 World Prison Brief (2022). Kenya – Pretrial/Remand Prison Population Trends. https://www.prisonstudies.org/country/kenya

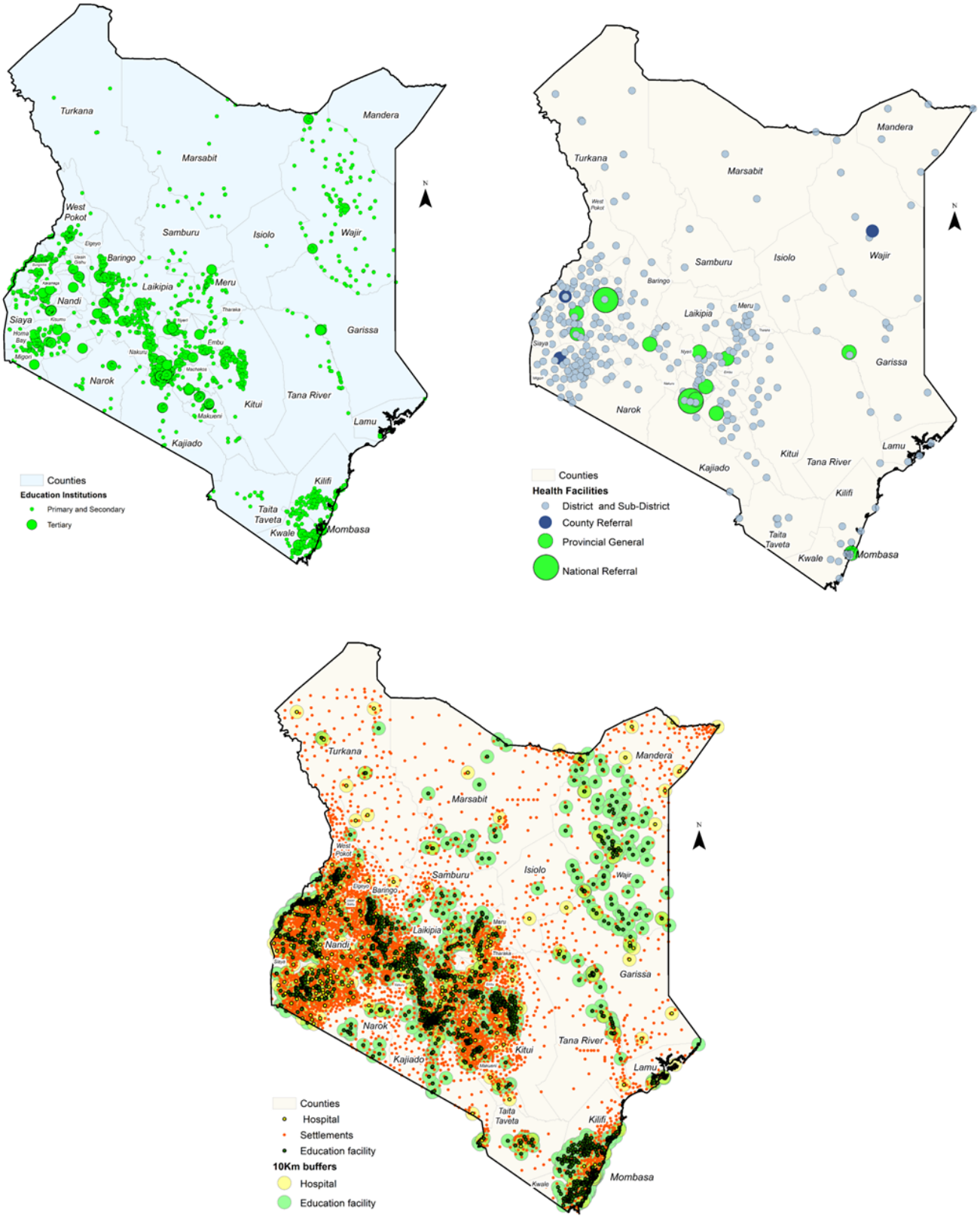

Figure 38: Proximity of education and health facilities to human settlement (source: EED Advisory, 2023)

This action agenda proposes:

Through a hub-and-spoke model[166], leverage the proximity of public institutions to households to develop a clean fuels supply chain (bioethanol, biogas, pellets, electric cooking, and LPG).

- Estimate total energy demand across public institutions.
- Group institutions into demand clusters to creates economies of scale that will attract private sector interest. Figure 39 illustrates demand clusters for two counties (Samburu and Kitui).

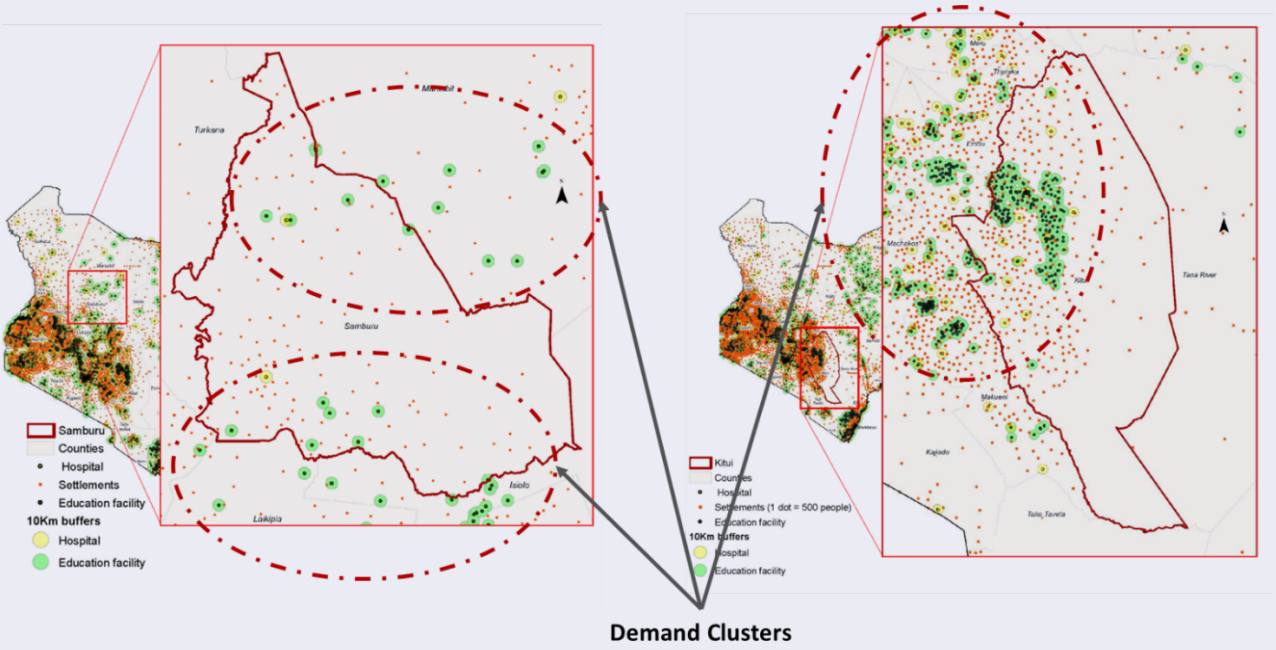

Figure 39: Example of demand clusters in Samburu and Kitui counties

- Competitively tender to identify the least cost option (technology and fuel) per cluster. Ensure that a third of the slots are allocated to women and youth led enterprises to ensure inclusivity.
- Require each service provider to also provide the clean fuel to the households in the institution's catchment area.
- Once the demand clusters have been tendered out, implement a Results Based Financing (RBF[167]) program to supply clean cooking stoves and appliances that are compatible with the fuel in use in the respective areas.
- Like the tender process, the RBF should be issued to the most competitive offers through a price discovery process that awards the incentives to the offers requiring the least incentives subsidies.
- Products eligible should meet the ISO/WHO guidelines defining clean cooking technologies. They should also be required to provide warranties and after sales support.

166 The Hub-and-spoke model is the centralization of activities or resources at the hub, which facilitates efficient communication, coordination, and distribution to the peripheral spokes.

167 Programs providing Results-Based Financing (RBF) can be organized to include initial financial support to help businesses initiate their expansion efforts. This support could take the form of a grant or a loan, similar to what is observed in programs like KOSAP and MCFA.

- Given that this initiative is focused on regions with limited access to these solutions, there is a likelihood that a significant portion of the population may lack awareness regarding (i) the various types of clean cooking solutions and (ii) the economic and health advantages associated with using these solutions for cooking. It will be essential for companies to develop a strategy to raise awareness within their operational areas. This was a critical lesson for the KOSAP project.
- As the allocation of funds in Results-Based Financing (RBF) initiatives hinges on the capacity to validate outcomes, companies applying for supply opportunities in these hubs must exhibit proficiency in maintaining sales records. Alternatively, chosen firms can undergo training on effective record-keeping methods, expediting the verification of sales by independent assessors. This approach aims to minimise delays in disbursing funds to solution providers.

It is critical to determine the appropriate price or size of an RBF incentive. The risk of market distortion, as with other forms of assistance, is an important consideration. When RBFs are priced incorrectly, they can create perverse incentives, prop up unsustainable business models, promote unhealthy dependency, and drive down or crowd out private sector investments. When determining the price, consider the impact of other ecosystem issues that support similar objectives or enable complementary efforts, such as pre-financing options, grants, technical support, and business support. Prices can be set using auction methods, relative estimates, benchmarking, and other methods. This action agenda proposes the auction method, which, if properly implemented, can result in RBF price discovery.

4.2.2 Bridge the affordability gap for the demand side

Table 22 below has a summary of the strategic plan for action agenda 2 on bridging the affordability gap for the demand side.

Table 22:Summary of Action Agenda 2

Purpose	Lowering the upfront cost of acquiring clean cooking solutions will address the affordability gap and promote the use of clean cooking solutions. This action agenda will leverage finance from trading clean cooking co-benefits (e.g., carbon financing, and clean impact bonds[168]), consumer financing, among other sources of funds, and post 2028 implement a clean cooking cross-subsidy program for Post 2028. The cross-subsidy programme will address the affordability gap related to the use of clean cooking fuels. Many of the households who will need to transition to clean cooking fuels do not use commercial cooking solutions (e.g., the three stone open fire) or fuels (e.g., firewood). Merely facilitating access to a clean cooking solution may not lead to continuous use.				
Description	Building on the KOSAP component on cooking, expand the component to include demand-side subsidies. Leveraging the National Carbon Registry[169], aggregate the carbon credits and co-benefits being generated in transitioning to clean cooking in Kenya and use the revenues to subsidise the cooking solution. This will ensure that all households use at least one clean cooking solution in their stack. Design a cross-subsidy programme to start in 2028, that will target the most vulnerable households first through databases such as those used by the National Safety Net Program. This programme could, once there is a critical mass of users of clean cooking solutions, institute a marginal tax (between 0.5% - 1%) to be used to subsidise the cost of fuel for these vulnerable households.				
Budget	KES 32.7 billion (US$ 218,541,750)				
Timelines	Y2024	Y2025	Y2026	Y2027	Y2028

168 International Finance Corporation. (2023). Clean Impact Bond: Mobilizing Finance for Clean Cooking. IFC. https://www.ifc.org/content/dam/ifc/doc/2023-delta/ifc-clean-impact-bond-052023.pdf

169 As its currently proposed, the Climate Change Amendment Act, 2023 does not provide for aggregation and only onboards projects that already have access to carbon markets

Apart from addressing the supply gap, it is imperative to focus on making the stoves affordable. A key insight from the KOSAP project highlighted that merely closing the supply gap wasn't enough for households to acquire stoves. In response to this, the project underwent enhancements by subsidising 50% of the stove cost, particularly because the project was in the underserved counties of Kenya[170]. Building on the KOSAP cooking component to establish a national clean cooking support facility that will bridge the affordability gap for the demand side and accelerate universal access by 2028. The sector can take advantage of carbon financing (discussed in the next section below), as demonstrated by companies that have utilised funds from carbon credits to lower the expenses associated with cooking solutions.

Subsidies aimed at increasing access to clean cooking are justified by three main arguments for using price interventions to influence the use of various fuels and technologies. The first reason is to internalise externalities associated with traditional forms of energy, such as greenhouse gas emissions, negative health effects, and environmental degradation. The second argument is closing the current access and affordability gap and the third is that SDG 7 will be unattainable without them[171].

The following are some of the concerns associated with subsidies: ownership, sustainability, targeting, impact, and market distortion. Removing subsidies once provided often has negative political ramifications even after they have run their course, and this creates the risk of subsidy inertia, raising sustainability concerns[172]. Sustainability concerns are more pronounced among "use subsidies" (supporting the use of an energy solution, e.g., subsidy to electricity tariffs or petroleum products) as opposed to "access subsidies" (supporting access or connection, e.g., LPG tank subsidies or a connection subsidy).

Without proper targeting (ensuring only those that deserve a subsidy receive it), there is evidence that subsidies can benefit the middle to upper-class community members the most[173]. Subsidies that are poorly structured can also distort commercially viable markets, undermining what would be considered a sustainable model for advancing energy access solutions. Subsidy recipients demonstrate little to no ownership due to their disconnection from the solution promoted, especially if they receive products and services at no cost.[174] These beneficiaries often do not care for the product, use it for other applications than its intended purposes, or sell the product. The evidence emphasises the significance of cultivating deep ownership among beneficiaries right from the start. To instil this, potential beneficiaries are typically asked to make cash or in-kind contributions. Energy subsidies can be extended to product suppliers (supply-side subsidies) or beneficiaries (demand-side subsidies) depending on the programme design and effectiveness of the subsidies vis-à-vis the target group. The following actions will be considered in providing demand side subsidies:

i. Leveraging on carbon financing

Kenya ratified the Paris Agreement, promising to implement actions to achieve ambitions set in the Nationally Determined Contributions (NDCs) by reducing greenhouse gas emissions by 30% compared to the business-as-usual scenario, aiming for 143MtCO2e by 2030[175]. Article 6 of the Paris Agreement provides for market and non-market approaches to enable countries to meet their NDC targets. These approaches include:

a. **Internationally Transferred Mitigation Outcomes (ITMOs)** – – Under Article 6.2, a country can transfer carbon credits earned from reducing GHG emissions to help another country meet climate targets.

b. **Voluntary markets** – Article 6.4, akin to the clean development mechanism, sets up a system for trading greenhouse gas emission reductions among countries, overseen by the Conference of Parties, the decision-making entity of the UN Framework Convention on Climate Change.

170 Key Informant interview with the project implementors.

171 Dutta, S., Kooijman, A. & Cecelski, E. (2017) *Energy Access and Gender: Getting the Right Balance.* The World Bank, Washington DC.

172 IMF (2013). Energy subsidy reform: lessons and implications, International Monetary Fund. https://www.imf.org/en/Publications/Policy-Papers/Issues/2016/12/31/Energy-Subsidy-Reform-Lessons-and-Implications-PP4741

173 Troncoso, K. and A. S. da Silva (2017). LPG fuel subsidies in Latin America and the use of solid fuels to cook. Energy Policy 107: 188-196.

174 Dupas, P. (2014). Short-run subsidies and long-run adoption of new health products: Evidence from a field experiment. *Econometrica 82*(1): 197-228.

173 Ministry of Environment and Forestry. (2020). Updated Nationally determined contribution. https://leap.unep.org/en/countries/ke/national-legislation/kenyas-updated-nationally-determined-contribution-ndc-2020-2030

175 Ministry of Environment and Forestry. (2020). Updated Nationally determined contribution. https://leap.unep.org/en/countries/ke/national-legislation/kenyas-updated-nationally-determined-contribution-ndc-2020-2030

This enables both private and public entities to back activities that produce transferable reductions and removals of greenhouse gas emissions.[176]

c. **Non-market methods** – Article 6.8 acknowledges non-market methods to encourage mitigation and adaptation. It introduces collaboration via finance, technology transfer, and capacity building without involving emission reduction trading.

The Paris Agreement requires ITMOS to (i) safeguard environmental integrity, (ii) prevent double-counting, and (iii) be voluntary and authorised by Parties. In this regard, Kenya is developing legislation and institutional frameworks to operationalise Article 6 fully. These include (i) the Climate Change (Amendment) Act, 2023 and (ii) the draft Climate Change (Carbon Markets) Regulations, 2023, which, among others, provides for setting up a National Carbon Registry, setting up a National Authority to provide guidance on Article 6.2 and 6.4, and guidance on benefit sharing. Kenya is exploring adopting an emission trading system and considering the feasibility and structure of a carbon tax as outlined in the Draft National Green Fiscal Incentives Policy Framework from December 2022[177].

This strategy suggests that the Ministry of Energy and Petroleum (MoEP) should facilitate the aggregation of tradable clean cooking co-benefits (carbon credits and averted DALYs and times savings) generated from projects implemented by value chain actors who do not have the wherewithal to access outcome buyers (e.g., through voluntary carbon markets). The Climate Change (Carbon Markets) Regulations, 2023 provides for private investors, governments, non-governmental organisations, and businesses to voluntarily buy and sell carbon credits that represent certified emissions removals or reductions of greenhouse gases in the atmosphere. Therefore, the MoEP could sustain the fund by selling aggregated carbon credits and other clean cooking co-benefits through the proposed clean cooking fund, as outlined in section 4.5.

This revenue could assist subsidise the upfront cost of the stoves and the recurrent cost of the fuel. Lessons can be drawn from Ghana, which has implemented the relevant institutional, administrative, legal, and infrastructure arrangements to participate in Article 6. This included publishing Ghana's framework on international carbon markets and non-market approaches[178]. Ghana and Switzerland signed the first-ever (by an African Nation) voluntary Internationally Transferred Mitigation Outcome (ITMO) proceeds, which will, among others, help five million households obtain improved cookstoves and off-grid solar home systems[179,180]. The Ghana-Switzerland cooperation established the KLIK Foundation to purchase ITMOs from Ghana, under which two activities –clean cooking and national clean energy programme – are being developed[181].

Consumer financing in Kenya has emerged as a vital facilitator for accessing clean cooking solutions. Given the substantial upfront costs associated with clean cooking technologies, introducing innovative financing approaches could expedite the adoption of these solutions across various consumer segments. The intended recipients are individuals with the financial means to purchase stoves through instalment plans. Various consumer financing models are available, including:

i. **Pay-As-You-Go (PAYGO):** This method enables consumers to pay for their cooking solutions through manageable instalments. In Kenya, where mobile money platforms such as M-Pesa are prevalent, PAYGO has proven to be highly effective. Companies like M-KOPA Solar and M-GAS have successfully utilised this model, allowing customers to make incremental payments until they own the product outright.

176 Galt, H., Mikolajczyk, S., Long, I., Maggiore, M., Bravo, F., & Tierney, M. (2023). The role of voluntary carbon markets in clean cooking. Climate Focus and Modern Energy for Cooking Services.

177 Government of Kenya. (2022). Draft National Green Fiscal Incentives Policy Framework. The National Treasury and Economic Planning. https://www.treasury.go.ke/wp-content/uploads/2023/01/Draft-Green-Fiscal-Incentives-Policy-Framework.pdf

178 Republic of Ghana. (2022). Ghana's framework on international carbon markets and non market approaches. https://cmo.epa.gov.gh/wp-content/uploads/2022/12/Ghana-Carbon-Market-Framework-For-Public-Release_15122022.pdf

179 Jennifer, L. (2022). Nations Strike First-Ever "ITMO" Emissions Trading. ITMO Emissions Trading. https://carboncredits.com/first-ever-emissions-trading-itmo/

180 Gold Standard. (2023). Implementing Article 6 – An overview of preparations in selected countries. https://www.goldstandard.org/sites/default/files/implementing_article_6-an_overview_of_preparations_in_selected_countries.pdf

181 KLIK Foundation. (2023). KliK International: We buy ITMOs in Ghana. https://www.klik.ch/en/international/partner-countries/ghana

ii. **Microfinancing and Bank Financing:** This involves offering small loans to individuals or groups without requiring traditional collateral. Institutions such as Equity Bank, Faulu Kenya, and Kenya Women Finance Trust (KWFT) extend microloans explicitly for purchasing clean cooking technologies. These loans are tailored to suit the financial circumstances of borrowers, ensuring that even low-income households can afford these technologies.

iii. **Savings and Credit Cooperative Organizations (SACCOs):** SACCOs represent community-based financing models where members can save and borrow funds at favourable rates. These funds are often utilised for purchasing household items like clean cookstoves.

These innovative financing models have played a significant role in driving the adoption of clean cooking technologies in Kenya. They demonstrate potential solutions for bridging the affordability gap on the demand side.

ii. Design a Clean cooking cross-subsidy program for Post 2028

There are several cases where communities have received clean cooking solutions but have been unable to use the fuel continuously due to the high cost of the fuel, availability, or the prevalence of low-cost or no-cost traditional fuels. As previously stated, concerns about sustainability are more pronounced among "use subsidies" (supporting the use of an energy solution, such as a subsidy to electricity tariffs or petroleum products) than among "access subsidies" (supporting access or connection, e.g., LPG tank subsidies or a connection subsidy). Cross-subsidisation is a long-term approach that collects a portion from most users and redistributes it to households that would not have been able to afford the cost of energy otherwise. Kenya already cross-subsidises electricity generated by fossil fuel-powered mini-grids by instituting a single national tariff that equalises electricity costs for all users..

This action agenda proposes:

i. Rapid expansion in the use of clean cooking fuels leveraging the existing network of public institutions.

ii. Applying a marginal tax on all clean cooking fuels (e.g., 0.5% - 1%)182 that will be redistributed to households that cannot afford to sustain use. These will be identified through databases such as the National Safety Net Program. The implementation of such a subsidy programme will be carefully designed to target only the deserving households, devoid of leakages to the rest of the population.

iii. Implement the cross-subsidy program starting in 2028 after gathering a critical mass of new users of clean cooking fuels.

4.2.3 Promote Local Manufacturing and Fuel Production for Local Use and Export.

Table 23 below has a summary of the strategic plan for action agenda 3.

Table 23: Summary of Action Agenda 3

Purpose	To address the supply chain gaps by promoting local manufacturing of stoves and appliances targeting domestic and export markets as well as cultivation of energy crops. This will create jobs, promote livelihoods, boost foreign exchange earnings, and increase energy independence.				
Description	The national government through the Special Economic Zones Authority designates quotas in Special Economic Zones for local manufacturing of stoves and appliances. Similarly, the national government and sub-national governments provides quotes for locally grown renewable and sustainable energy crops including bioethanol, biogas, briquettes, pellets, and other renewable biomass options				
Budget	KES 1.8 billion (US$ 12,430,600)				
Timelines	Y2024	Y2025	Y2026	Y2027	Y2028

182 This is indicative during the program design a different tar rate will be proposed.

The Special Economic Zones Act of 2015 established and defined Special Economic Zones (SEZ). They are designated areas for the assembly, manufacturing, and delivery of goods and services subject to special economic regulations.

There are 24 SEZs in Kenya as shown in Figure 40 below. Fiscal incentives provided by SEZs include lower corporate income tax of 10%, preferentially rated withholding tax of 5%, zero-rating of VAT for supply of goods and services, and exemption from stamp duty. Within SEZs, the government should allocate space for clean cooking stoves and appliances aimed at the export market with quotas to be sold in the local market.

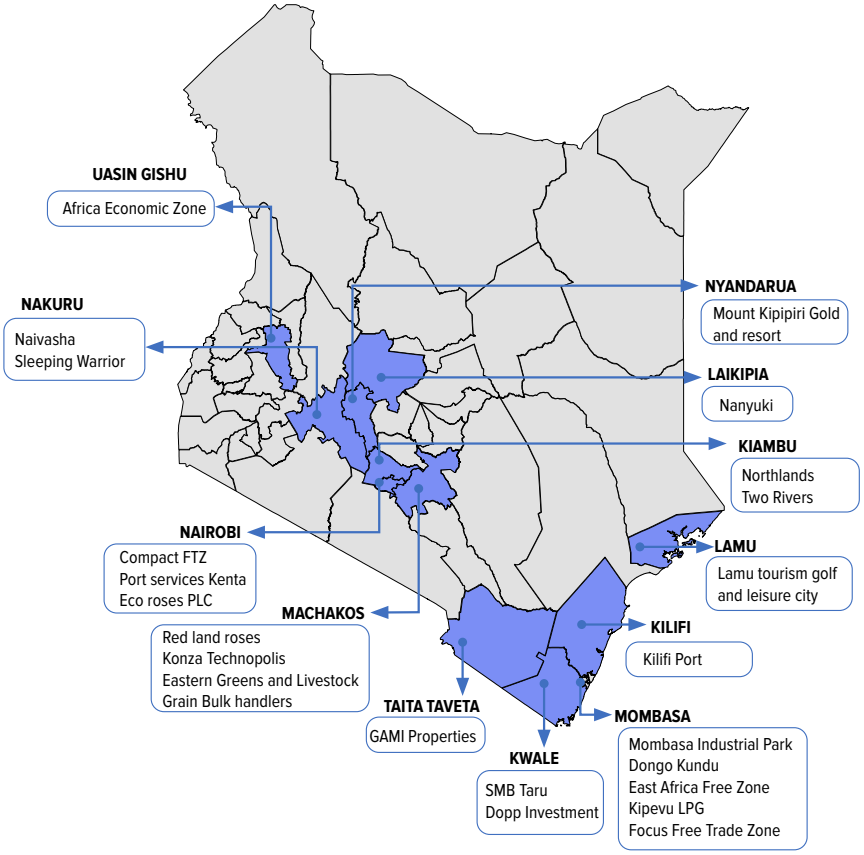

Figure 40: List of SEZ in Kenya

The bioethanol supply gap is estimated to be between 57 million litres and 192 million litres per year[183]. Sugarcane, corn, cassava, and sorghum are among the feedstocks that can be used to produce ethanol fuel, though sugarcane is the most used. Cassava crops can also produce additional products that generate extra revenue streams, such as cassava flour, starches for sizing paper and textiles, and sweeteners. Potential out growers can use these for subsistence or commercial purposes. A rejuvenated ethanol production sector has the potential to create 370,000 jobs, mostly among small holder farmers[184].

A **rejuvenated ethanol production sector** has the potential to create **370,000 jobs,** mostly among small holder farmers

183 Dalberg. (2020). *Kenya Ethanol Fuel Master Plan.* Funded by South South North.

184 ibid

These crops can be cultivated through large-scale means or throughout-growers. Kenya has extensive experience with growing commercial crops throughout- grower schemes. Lessons from the tea, coffee, and milk sector can be applied to this. Given the current emphasis on utilising electricity for cooking, there is a chance to assemble electric cooking appliances with the aim of developing capacity for future manufacturing in this sector[185]. Insights from BURN Manufacturing (a local company engaged in the assembly of electric appliances) will play a crucial role in establishing assembly enterprises in Kenya focused on electric cooking solutions.

Large scale bio-LPG production from municipal solid waste (MSW) and agricultural residue has the potential to supplement and eventually replace traditional fossil fuel LPG albeit the technology is nascent. The most promising conversion process is the Cool LPG process has been tested by GTI Energy and BioLPG LLC / GLPGP, along with their 12 corporate partners and major first plant announcements were expected in late 2023[186]. The Cool process reforms methane and carbon dioxide from anaerobic digestion of MSW first into synthesis gas and into bio-LPG (a mixture of propane and butane). Once the technology has been proven, the Kenyan government can utilise its connections with funding partners that are backing the advancement of BioLPG technology. This can facilitate the transfer of technology to county governments and private sector entities keen on producing BioLPG in Kenya. Possible sites for setting up bio-LPG production plants in Kenya include Industrial Area, Dandora, Athi River, Dandora and Ruai[187].

Likewise, production of other renewable energy options including prefabricated biodigesters, pellets, biodiesel, and briquettes should be encouraged.

This action agenda proposes:

i. Designate spaces for clean cooking stove and appliance assemblers and manufacturers in the SEZs and streamline the onboarding process.
   a. Identify suitable SEZs that meet the requirements for clean cooking stove and appliances manufacturing and assembly.
   b. Sensitise clean cooking stove and appliance manufacturers and assemblers on the opportunities at the SEZs.
   c. Invite applications from qualified manufacturers and assemblers for consideration.
   d. Through wide consultation, identify an appropriate quota rate for local sales of products from the SEZs. .

ii. Stimulate the cultivation of energy crops (including sugar cane, sugar beets, and cassava) and the production of briquettes, pellets, and other renewable biomass sources..
   a. Promote energy crop cultivation in high-yield regions e.g., the coastal belt for sugar cane and cassava.
   b. Mass sensitisation and field extension services among small holder farmers on the potential for cultivating energy crops including cassava and sugar cane, and production of briquettes, pellets, and other renewable biomass sources.
   c. Provide offer tax breaks for five years to ethanol producers and distributors who buy feedstock from local farmers, boosting local production capacity to meet and surpass growing demand.

iii. Address the tax unpredictability issue for the cooking sector and provide import tax exemptions for fuel production equipment (e.g., micro distilleries for bioethanol, briquetting machine and extruders for pellets). The exemption should be extended for machinery and imported components (e.g., electronic components for smart metered appliances, solar PV, energy storage and DC appliances) to support the assembly and manufacture of clean cooking appliances.

iv. Establish an assembly plant for clean cooking stoves/appliances e.g., ecooking appliances in Kenya[188].

185 MoEP. (2024). The Kenya National Electric Cooking Strategy. Ministry of Energy, Government of Kenya.

186 GLPGP. (2023). BioLPG Production at Scale in SSA: key elements needed for its development and efficient use as a clean cooking fuel. Report for the Modern Energy Cooking Services programme. Global LPG Partnership.

187 GLPGP. (2023). BioLPG Production at Scale in SSA: key elements needed for its development and efficient use as a clean cooking fuel. Report for the Modern Energy Cooking Services programme. Global LPG Partnership.

188 MoEP. (2024). The Kenya National Electric Cooking Strategy. Ministry of Energy, Government of Kenya.

4.2.4 Reframe and Raise Awareness on the Role of Clean Cooking.

Table 24 below has a summary of the strategic plan for action agenda 4.

Table 24: Summary of Action Agenda 4

Purpose	To address the i) lack of understanding among policy makers, development agencies, private sector actors on the role and potential of clean cooking as a driver for socio-economic growth, high potential GHG abatement option, reducing negative impacts of household air pollution, and alleviating environmental degradation, and ii) lack of understanding among end users on the harmful impacts of using traditional cooking fuels to minimize its use.				
Description	Popularizing the KNCTS Strategy and socializing it among political and business leaders; establishing a process for overseeing the implementation and tracking of the KNCTS; instituting sustained awareness campaigns among end users - like the HIV-AIDS campaigns of the 1990s - on the harmful impacts of traditional fuels.				
Budget	KES 44,250,000 (US$ 295,000)				
Timelines	Y2024	Y2025	Y2026	Y2027	Y2028

For many decades, cooking has been framed as a gendered residential issue. However, the sector's challenges and opportunities extend beyond home cooking. Cooking is a potential source of foreign exchange, a mechanism to reduce Kenya's fossil fuel imports, a potential source of jobs across the stoves and fuels value chain, a high potential GHG abatement option creating opportunities for carbon projects, a potential source of substantial revenue for the electricity utility, and a viable source of government taxes, among other things. The sector's players must reframe the opportunities presented by the cooking sector for it to receive the attention it deserves. This new positioning of cooking should be done at the highest level of political office and among private sector players as well.

Addressing supply and affordability issues only may be ineffectual in areas where low-cost or no-cost traditional fuel is widely available. There is a need to carry out a vigorous campaign that raises awareness about the dangers of using traditional fuels. This should gather lessons from the HIV/AIDS awareness campaigns from the 1990s. The goal should be to reduce the desire for and use of traditional fuels.

This action proposes:

i. Launch the KNCTS strategy.

ii. Formulate a clean cooking communication strategy, continuing with the ongoing initiative by the MoEP through the BCC strategy, to shift perceptions toward clean cooking's role and potential.

iii. Awareness creation on the role of clean cooking solutions among political and business leaders.

iv. Awareness creation on the negative impacts of using traditional fuels and technologies among end user.

v. Awareness creation among the value chain actors on waste generated from transitioning to clean cooking. For example, the e-waste from electric appliances, plastic waste from prefabricated biodigesters.

4.2.5 Institute Accountability, Planning, and Continuous Tracking of Progress.

Table 25 below has a summary of the strategic plan for action agenda 5.

Table 25: Summary of Action Agenda 5

Purpose	To establish long-term accountability processes that will oversee the implementation of the KNCTS, track progress, and ensure continuity so that future plans build on this framework.				
Description	The current Technical Working Group (TWG) continues as the interim secretariat in-charge of the KNCTS as a formal institution is set up. This institution should consist of representatives from government, private sector, development agencies, and research agencies.				
Budget	KES 6.2 billion (US$ 41,339,235)[189]				
Timelines	Y2024	Y2025	Y2026	Y2027	Y2028

The current Technical Working Group reviewing this strategy development should evolve into an interim secretariat that will serve as the KNCTS's custodian until a formal implementation unit to oversee the implementation of the strategy is established. Kenya, in general, and the energy sector in particular, has had several plans in the form of strategic plans, action plans, and master plans that have not been implemented. Subsequent and associated plans also fall short in building on prior planning initiatives. To oversee the implementation of this strategy, a formal KNCTS implementation unit comprised of representatives from the key stakeholder groups in the cooking industry should be established.

The implementing unit shall be entrusted with the following responsibilities: i) formulate a comprehensive action plan to direct the process of strategy implementation including a monitoring and evaluation framework[190]; ii) develop and raise awareness to rally a critical mass to support the strategy; iii) ensure that the strategy is mainstreamed into government funding and programming cycles, iv) facilitate additional fundraising efforts in support of the strategy's implementation; v) provide periodic progress reports to stakeholders; (vi) modify and update the strategy considering evolving circumstances; (vii) leveraging on the knowledge management platform[191] and implementing committee, consolidate sector data and initiate periodic household surveys to track use of clean cooking solutions[192]; (viii) commission a study on the approaches to deal with waste generated at the end of the life cycle of the clean cooking appliances, and (ix) working with the relevant government institutions address gaps in the policy frameworks e.g., finalising the Draft Improved Biomass Cookstoves Regulations (2013) and continuously lobby harmonisation of fiscal incentives across the range of clean fuels and technologies promoted by the strategy. The Ministry of Energy and Petroleum is updating energy policies to incorporate clean cooking, which will culminate in amending the Energy Act to legally enshrine clean cooking.

This action agenda proposes:

i. Extend the role of the current Coordination Committee into the interim KNCTS implementation unit to oversee its implementation.
ii. Establish a formal implementation unit led by the Ministry of Energy and Petroleum in close collaboration with other ministries and the sub-national governments to oversee the implementation of the strategy.
    a. Ensure that the KNCTS is mainstreamed into the government funding processes.
    b. Support fundraising efforts to complement government funding.
    c. Implement a systematic approach to conducting periodic surveys of the cooking sector to monitor progress within the industry. The subsequent cooking sector survey should take place in 2025, followed by another in 2028. After that, comprehensive surveys ought to be conducted every five years.
iii. Establish a cooking sector planning committee, like the LCPDP committee that oversees long-term planning in the electricity sector.

189 This is 10% of the total budget

190 There is an ongoing process by the Ministry of Energy and Petroleum that is setting Key Performance Indicators (KPIs) for the cooking sector in Kenya. The output of the process will be detailed KPIs.

191 Ministry of Energy and Petroleum. (2023). The National Knowledge Management Strategy for the Cooking Sub-sector in Kenya. Government of Kenya.

192 There are various tools, such as the Clean Household Energy Solutions Toolkit (CHEST) by WHO, which tracks different levels (primary, use as part of the stack, etc.) of cooking solution use. These tools are recommended for designing the questionnaires for tracking the use of cooking solutions.

4.3 Workplan[193]

#	ACTION AGENDA & COMPONENTS	2024				2025				2026				2027				2028			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Bridge the supply and Affordability gap																					
i	Establish a framework for transitioning public institutions		1																		
ii	Implement the public institution transition framework					2															
iii	Design a national clean cooking support facility			3																	
iv	Implement the national clean cooking support facility								4				5				6				7
Promote local manufacturing and production																					
i	Designate spaces for clean cooking entrepreneurs within SEZs			8					9												
ii	Stimulate the cultivation of energy crops				10		11														
iii	Provide import tax exemptions for ethanol production equipment					12															
Design a cross-subsidy program																					
i	Rapid expansion of clean cooking fuel use in public institutions								13				14				15				
ii	Design a national clean cooking fuel cross-subsidy scheme									16											
iii	Pilot the national clean cooking fuel cross-subsidy scheme													17					18		
Reframe and raise awareness																					
i	Launch the KNCTS strategy	19																			
ii	Formulate a communication strategy to shift perceptions		20																		
ii	Awareness creation among political and business leaders			21																	
iii	Awareness creation among end-users			22																	
Institute accountability, planning and tracking																					
i	Convert the current TWG into an interim KNCTS secretariat	20																			
ii	Establish and mainstream the KNCTS secretariat		21																		
iii	Establish a cooking sector planning committee		22			23										24					

193 There is an ongoing process by the Ministry of Energy and Petroleum that is setting Key Performance Indicators (KPIs) for the cooking sector in Kenya. The output of the process will be detailed KPIs.

Key Milestones

Below are the milestones as presented in the work plan above. The work plan above indicates when the milestone should be achieved.

- Draft framework for transitioning public institutions to clean cooking finalised.
- Launch of the public institutions clean cooking transition framework.
- Design of the national clean cooking facility finalised.
- Launch of the national clean cooking facility.
- First progress report on the implementation of the national clean cooking facility.
- Second progress report on the implementation of the national clean cooking facility.
- Third progress report on the implementation of the national clean cooking facility.
- Policy to promote clean cooking in SEZs finalised.
- Launch of the promotion of clean cooking in SEZs programme.
- Policy statement on stimulating cultivation of energy crops launched.
- Programme to stimulate the cultivation of energy crops launched.
- Policy statement on import tax exemptions for ethanol production equipment finalised and gazetted.
- First progress report on the implementation of the public institutions transition framework.
- Second progress report on the implementation of the public institutions transition framework.
- Third progress report on the implementation of the public institutions transition framework.
- Design of the clean cooking cross-subsidy program finalised.
- Launch of the clean cooking cross-subsidy pilot.
- Launch of the clean cooking cross-subsidy programme.
- KNCTS launched.
- Communication strategy finalised.
- Launch of the awareness creation campaigns among leaders and users.
- Current TWG converted into the interim KNCTS secretariat.
- Clean cooking planning committee established and launched.
- Second national cooking sector survey commissioned.
- Third national cooking sector survey commissioned.

4.4 Capital Requirement

The following section provides high level estimates for the capital required to implement the KNCTS Action Agenda. Budget estimates are not typically included in strategies. This exercise provides ballpark figures for the transition's cost (see Table 26 below). The estimation exercises only consider the downstream costs for residential users and ecosystem system services that can be delivered realistically within the next five years. This is informed by the following considerations: i) the lack of data on institutional users, ii) lack of data on commercial users, and iii) limited time to target and implement upstream and midstream infrastructural interventions.

Table 26: Estimating Downstream Cost of Investments and Ecosystem Support Services[194]

#	ACTION AGENDA & COMPONENTS	BUDGET (US$)
A1: Bridge the supply gap for clean cooking solutions		
i	Establish a framework for transitioning public institutions	Program design – consultant ($50,000) **Total = US$ 50,000**
ii	Implement the public institution transition framework	Implementation of action plan (2 MoEP staff over 5 years at $50,000 per year) **Total = US$ 500,000**
iii	Design a national clean cooking support facility	Program design – consultant ($75,000) Cost of distribution (supply side subsidy) – US$ 181,300,000 **Total = US$ 181,375,000[195]**
iv	Implement the national clean cooking support facility	Implementation of action plan (2 MoEP staff over 5 years at $50,000 per year) **Total = US$ 500,000**
	Total budget for A1:	**KES 27.3 billion (US$ 181,425,000).**
A2: Bridge the affordability gap for the demand side		
i	Design a national clean cooking support facility	Program design – Consultant (US$ 75,000) Cost of the stove (demand side subsidy) - US$ 196,176,750[196] **Total = 196,251,750**
ii	Implement the national clean cooking support facility	Implementation of action plan (1 MoEP staff over 5 years at $50,000 per year) **Total = 250,000**
iii	Design a national clean cooking fuel cross-subsidy scheme	Design a cross-subsidy scheme – consultant ($100,000) **Total = US$ 100,000**
iv	Pilot the national clean cooking fuel cross-subsidy scheme	Project support team (2 MoEP consultants at $40,000 for 2 years) **Total = US$ 160,000**
	Total budget for A2:	**KES 29.5 billion (US$ 196,761,750)**
A3: Promote local manufacturing and production		
i	Designate spaces for clean cooking entrepreneurs within SEZs	Identify and develop a policy statement – consultant ($ 50,000) **Total = US$ 50,000**

194 The forthcoming Financing Strategy for the Clean Cooking Sector is expected to provide a more detailed breakdown of the costs involved

195 See assumptions and calculations in Annex 2. The ecooking strategy provides a detailed budget for promoting cooking with electricity is Kenya.

196 See assumptions and calculations in Annex 2.

#	ACTION AGENDA & COMPONENTS	BUDGET (US$)
ii	Stimulate the cultivation of energy crops	Feasibility study to develop an action plan – consultant ($150,000) Identify and develop a policy statement – consultant ($ 50,000) Implementation of action plan (2 MoEP staff over 5 years at $50,000 per year) **Total = US$ 700,000**
iii	Remove of tarrif if barriers for clean cooking solutions	Policy declaration **Total = US$ 0**
iv	Establish an assembly plant for clean cooking (e.g., ecooking appliances in Kenya[197]	**Total: US$ 11,480,600**
	Total budget for A3:	**KES 1.8 billion (US$ 12,430,600)**
A4: Reframe and raise awareness		
i	Launch the KNCTS strategy	National sensitization workshops (5 regional workshops at $5000) Presentation at forums e.g., the SEforALL,IEA forum 2024 (US$ 20,000 Presentation at the COP29 (US$20,000) Meeting with potential partners in the US and Europe (US$ 20,000) Materials to promote the KNCTS including a website (US$ 10,000) **Total = US$95,000**
ii	Formulate a communication strategy to shift perceptions	Design and implement a communication strategy – consultant ($200,000) **Total = US$ 200,000**
ii	Awareness creation among political and business leaders	Costed in A4 (ii) above **Total – US$ 0**
iii	Awareness creation among end-users	Costed in A4 (ii) above **Total = US$ 0**
	Total budget for A4:	**KES 44,250,000 (US$ 295,000)**
A5: Institute accountability, planning and tracking		
i	Administration costs[198]	Total cost = US$ 39,561,235[199]
ii	Convert the current TWG into an interim KNCTS secretariat	Costed in (i)
iii	Establish and mainstream the KNCTS secretariat	Costed in (i)
iv	Establish a cooking sector planning committee	Costed in (i)
	Total budget for A5:	KES 5.9 billion (US$ 39,561,235)
	TOTAL	**KES 65 billion US$ 435,173,585**

197 Adopted from the Kenya National electricity Strategy by MoEP 2024.

198 There are multiple activities under action agenda 5 that will be funded by this fund.

199 10 % of the total budget for the other 4 action agendas.

4.5 Potential sources of funding for the Strategy

This strategy recommends establishing a clean cooking fund situated outside the governmental framework or distributing funds for programmes. This recommendation is informed by insights from the KOSAP project, where Kenya's laws dictate that when financing projects through the government, funds must follow a route through the National Treasury. The bureaucratic processes involved in approving budgets and disbursing funds to government entities introduces project delays. The following considerations should be considered in shaping the fund:

i. This system could take the shape of a scalable pooled fund, initially funded, and consistently replenished by diverse capital sources such as the public sector, development agencies, philanthropic organisations, and other contributors.

ii. Establish a governing board for the proposed fund, comprising representatives from the government, sector associations, and development agencies.

iii. Utilise government funding in the initial round of financing to showcase the functionality of the fund's structure. Other countries have adopted similar approaches to demonstrate government commitment to the sector. For instance, the Mwinda Fund, instituted by the government of the Democratic Republic of Congo (DRC), is a national subsidy programme with the objective of facilitating access to electricity and energy services for low-income households. This includes provisions for solar home systems, mini-hydro projects, and clean cooking solutions. The government's ambitious goal is to secure US$ 500 million by 2024, intending to extend electricity access to 15 million residents in rural areas[200] To spearhead the financing of this initiative, the government has approached the World Bank, which is considering injecting US$100 million into the programme. A noteworthy development occurred in January 2021 when President Félix Tshisekedi demonstrated support for the sector by presenting a substantial US$ 5 million contribution to the Mwinda Fund, marking a significant milestone in the advancement and recognition of the energy sector. Similarly, the government of Bangladesh with support from the World Bank created the Infrastructure Development Company Limited (IDCOL) in 1997. The GOB gives IDCOL equity funds, while various donor agencies offer grants and loans[201]. The IDCOL finances various projects programmes including clean cooking and off-grid energy access.

The Endev selected EED Advisory to undertake a separate study on resource mobilisation for the Kenya Clean Cooking and Transition Strategy and the Kenya Electric Cooking Strategy. Table 27 below presents an overview (non-exhaustive) of different sources of finance to fund the implementation of the strategy with more details envisioned in the ongoing study by Endev.

Table 27: Overview of possible financing instruments

#	Financing instrument	Description	Examples of financiers and platforms	Pros	Cons
1	Government	Government spending on clean cooking from national public budgets,	National treasury	Commitment by government by financing some initiatives raises the ambition thereby attracting other financiers	Delayed disbursement of funds to enterprises implementing clean cooking initiatives

200 GOGLA. (n.d). The Voice of the Off-Grid Solar Energy Industry. Democratic Republic of Congo. https://www.gogla.org/wp-content/uploads/2022/12/DRC-Country-Brief.pdf

201 Ahmed, J. U., Talukder, N., & Ahmed, A. (2020). Infrastructure Development Company Limited Solar Home System Program: A Sustainable Solution for Energizing Rural Bangladesh. South Asian Journal of Business and Management Cases, 9(2), 219–236. https://doi.org/10.1177/2277977920905305

2	Equity	Raising capital through sale of shares	• Company directors • Family and friends • Venture capitalists • Angel investors • Initial public offering	• Venture capital and Angel investors provide finance that would be difficult to access for start-ups. • Does not add to existing debt hence no payment obligations	• The enterprise will have to cede a fraction of ownership. • The enterprise will have to share profits. • The enterprise will have to cede some control of the company to the investors
3	Debt	• Provided by banks, MFIs, SACCOs, and cooperatives. • Can be secured or non-secured loans	• Company directors • Banks (e.g., Equity Bank)[202] • MFIs • Funds such as Youth Fund and the Financial Inclusion Fund (Hustler Fund) • BIX Capital	• SMEs needing loans from banks and MFIs can apply anytime. • The Youth Inclusion Fund	• High-interest rates and transaction costs • Early-stage SMEs may lack collateral
4	Grant	• Grants are valuable for funding risky early-stage project development and bridging gaps in affordability and project viability[203]. • Beneficiaries are identified through a competitive process. • Issued by development organizations and banks to stimulate SMEs to reach the bottom of the pyramid end users	• AECF • UNDP • JICA • RVO • GIZ	Disbursements are offered up-front, allowing SMEs to implement projects immediately.	Program-based; hence SMEs have to wait for financing windows to open, which are often unpredictable.
5	Result based financing (RBF)	• Beneficiaries are identified through a competitive process. • Selected enterprises must meet pre-agreed targets and targets verified before receiving funding. • SMEs must prove traction and be ready to scale.	• World Bank Group • ESMAP's Clean Cooking Fund[204] • EnDev • NEFCO (MCFA) • CLASP (Global LEAP RBF) • AECF	• Enhances cooking technology and fuel affordability for end users. • Enables SMEs to reach new, underserved markets. • Performance indicators tied to payment enhance accountability[205]	• Early-stage SMEs without sufficient financial history may not qualify. • Participants must acquire working capital and upfront investment from other sources. • Program-based; hence SMEs must wait for financing windows to open

202 Equity Holding PLC. (2024). Equity Launches Clean Cooking Initiative to Support Learning Institutions Transition to Cleaner, Sustainable and Environmentally Friendly Sources of Cooking and Lighting. https://equitygroupholdings.com/ke/newsroom/24-press-release/104-equity-launches-clean-cooking-initiative-to-support-learning-institutions-transition-to-cleaner-sustainable-and-environmentally-friendly-sources-of-cooking-and-lighting

203 SEforAll. (2021). Energising finance: Understanding the landscape. https://www.seforall.org/system/files/2021-10/EF-2021-UL-SEforALL.pdf

204 Although it targets countries with historically low clean cooking finance such as Rwanda, Burundi, Ghana, Mozambique, Myanmar, Niger and Uganda,

205 Perakis, R., & Savedoff, W. (2015). Does results-based aid change anything? Pecuniary interests, attention, accountability, and discretion in four case studies. CGD Policy Paper, 52.

5	Result based financing (RBF)	• RBF enables donors to engage more actively with enterprises in capacity building and technical assistance, while also closely monitoring program outcomes[206].	• GIZ • RVO • World Bank's Carbon Initiative for Development (Ci-Dev)		
6	Carbon finance	• Article 6 of the Paris Agreement provides for market and non-market approaches to finance NDCs. • Involves selling CO_2e averted from a clean cooking project, where one ton of CO_2e equals one carbon credit. • The emission reductions must be verified	• Governments through ITMOs • Private companies e.g., Alphabet, Apple, Microsoft etc. • World Bank's Carbon Initiative for Development (Ci-Dev)	Enhances project financial sustainability by generating capital for i) financing new end users ii) financing operation and maintenance, e.g., for biodigesters.	• Volatile carbon market from US$2 to $12 tCO2 in 2019, with an average of US$3.5 tCO2 paid in the clean cookstove market[207] • Complex application procedures and high certification/ transaction costs hence the need for aggregators • Development of enabling frameworks and policies to fully operationalize Article 6 in Kenya is not complete
7	Crowdfunding	• It entails funding a company or project by raising small amounts of money from numerous individuals (the crowd) through online platforms. • Crowdfunding models include Peer-2-Peer business lending, Peer-2-Peer micro-lending, donation, reward, and equity[208]. • Crowdfunding for clean cooking remains modest, with only $8 million raised across the sector from 2014 to 2020[209].	• Energise Africa • Kiva direct lending, • Charm Impact, • Bettervest, • Lendahand • PlusPlus • Trine, • CrowdCredit • GlobalGiving, GoFundMe	• Crowdfunding platforms are designed for small loans and could be suitable for early-stage cooking companies if they can repay the loans. • Flexibility in campaign timing and number of tranches • Faster transaction speed (usually 3 months, quicker than many impact funds) • Diverse funding sources	• The risk of sharing borrower information online includes potentially disclosing basic details like age, gender, loan purpose, business, and family information, as well as photographs[210]. • Borrowers might have challenges choosing the appropriate platform to meet their requirements.

206 Ibid

207 Donofrio, S., Maguire, P., Zwick, S., Merry, W., Wildish, J., & Myers, K. (2021). State of the voluntary carbon markets 2020. Forest Trends & Ecosystem Marketplace, 1203.

208 Energy4Impact, & MECS. (2021). Clean cooking: Scaling up with crowdfunding. https://mecs.org.uk/wp-content/uploads/2021/06/Clean-Cooking-Scaling-With-Crowdfunding.pdf

209 Energy4Impact, & MECS. (2021). Clean cooking: Scaling up with crowdfunding. https://mecs.org.uk/wp-content/uploads/2021/06/Clean-Cooking-Scaling-With-Crowdfunding.pdf

210 Ibid

8	Averted disability-adjusted life years (ADALYs)	• Mimics carbon finance with a focus on the health impacts accrued from averting household air pollution. • Compounds the number of healthy life years saved due to reduced exposure to black carbon and particulate matter	• IFC Clean Impact Bond[211] • Osprey Foundation	Would generate additional capital to enhance project sustainability	Yet to gain traction with impact buyers

4.6 Risks

4.6.1 Delayed implementation

The ambitious target of universal access by 2028 would require it immediate implementation. Public sector projects are vulnerable to delays and often fail to meet the timelines set out. Projects in the energy sector including the Last Mile Connectivity Project (LMCP) and the Kenya Off-grid Solar Access Project (KOSAP) have experienced such delays. The need to start with attracting the capital needed to implement this strategy also may contribute to this delay. Although these should be complementary and part of this process, there is also a risk that some stakeholders may prefer to focus on implementing the LPG strategy or the eCooking strategy and this could manifest as parallel, or even competing processes, which may cause further delays. The MoEP should ensure that all the related activities are jointly coordinated and built upon the whole rather than a focus on parts.

4.6.2 Aversion towards supporting LPG.

Although clean, LPG being a fossil fuel[212] is often excluded from programmes led or supported by development agencies. For instance, the first round for the Modern Cooking Facility for Africa (MCFA) managed by the Nordic Environment Finance Corporation (NEFCO) and GIZ initiatives, excluded LPG from the list of eligible fuels. Its second round will, however, incorporate LPG cooking solutions in selected countries). On the extreme, some stakeholders will not only opt not to support LPG but may oppose it proactively due to competing goals for other clean cooking fuels. These exclusions limit financing options for suppliers needing patient capital to expand into underserved markets. LPG is expected to play a transitional role to bridge the gap between the current state and a low-carbon future. Access to LPG is the primary way to provide clean cooking access for almost half of households globally to achieve SDG 7.1.2 by 2030[213]. Over the past decade, 70% of those who got access did it using LPG[214]. LPG is a by-product of oil and gas production and refining, and despite being a fossil fuel, it is one of the least harmful to the climate when used as a cooking fuel[215]. If not collected during operations, LPG is burned off or "flared" into the atmosphere as waste, adding to greenhousegases[216]. Using sustainably harvested biomass for cooking produces about 60% more greenhouse gas emissions than cooking the same meal with fossil fuel LPG[217]. The MoEP should be clear on the role of LPG in the transition.

211 International Finance Corporation. (2023). Clean Impact Bond: Mobilizing Finance for Clean Cooking. IFC. https://www.ifc.org/content/dam/ifc/doc/2023-delta/ifc-clean-impact-bond-052023.pdf

212 Floess, E., Grieshop, A., Puzzolo, E., Pope, D., Leach, N., Smith, C,J., Gill-Wiehl, A., Landesman, K. and Bailis, R. (2022). Climate and health implications of adopting modern cooking fuels on a global scale. Research Square.

213 International Energy Agency. (2023). A vision for clean cooking. https://iea.blob.core.windows.net/assets/75f59c60-c383-48ea-a3be-943a964232a0/AVisionforCleanCookingAccessforAll.pdf

214 Ibid

215 Nigel, G., Aunan, K., & Rehfuess, E. (2017). Liquefied Petroleum Gas as a Clean Cooking Fuel for Developing Countries: Implications for Climate, Forests, and Affordability. KFW Development Bank. https://www.ccacoalition.org/sites/default/files/resources//2017_Liquid-Petroleum-Clean-Cooking_KfW.pdf

216 Puzzolo, E., Cloke, J., Parikh, J., Evans, A., & Pope, D. (2020). National scaling up of LPG to achieve SDG 7: Implications for policy, implementation, public health and environment. https://livrepository.liverpool.ac.uk/3165227/1/MECS_LPG%20for%20national%20scale%20up_Briefing%20Paper_Jan-2020.pdf

217 International Energy Agency. (2022). Africa energy outlook 2022. www.iea.org/weo.

4.6.3 Climate Change Amendment Act.

Carbon finance is expected to provide a substantial portion of the capital needed to implement this strategy. The Climate Change Amendment Act, which among other things introduces at 25% tax, has raised concerns among stakeholders in the cooking sector. Carbon finance has provided consumer subsidy to clean cooking adopters in Kenya, resulting in price reductions of between 45-90%[218] for clean cooking technologies and, overall, a faster pace of adoption. The biggest concerns include the expected processing time, administrative fees, benefit sharing structure, and developers' qualifications. These requirements will make it even harder for indigenous entrepreneurs who struggle to develop carbon projects and whose businesses risk being outcompeted by those that are able to integrate carbon finance. This strategy proposed a light-touch regulatory approach between now and 2028 to avoid the risk of disrupting the carbon finance flows. This approach will only require developers to register their projects with the relevant government authorities.

4.6.4 Shifting sentiments towards carbon markets

The carbon markets have suffered criticism and negative publicity which has led to key investors divesting from these markets. BP Shell, Nestle, Delta Airlines among others have issued statements explaining that they shall no longer invest in carbon projects due to the uncertainty associated with the current methodologies and implementation practices. Compounding this further, the UNFCCC has issued revised rates for the fraction of non-renewable biomass (fNRB) for countries in Africa, most of which are significantly lower than the current rates. If adopted these rates will potentially reduce the attractiveness of carbon projects to developers and consequently, a decline in the amount of GHG abated. However, the deficits could be met by selling other clean cooking co-benefits such as averted disability adjusted life years (ADALYS) and time savings. Regarding integrity, there are ongoing initiatives to restore confidence in the carbon markets. For instance, the Integrity Council for Voluntary Carbon Markets (ICVCM) has introduced its Core Carbon Principles (CCPs)[219], establishing essential guidelines for high-quality carbon credits and significantly enhancing their integrity. Furthermore, standards organizations have updated the cookstove methodology to improve integrity and are set to update the REDD+ methodology, which employs artificial intelligence and satellite data for more accurate data[220].

4.6.5 Volatility of the local currency

The Kenya Shilling has lost significant value against the dollar over the last few years and is projected to continue with a downward trajectory over the short-term. This is in part due to substantial repayments of national debt including the portion raised through a series of Euro Bonds. This volatility negatively affects the perception of the country are an attractive investment destination. Many of the clean cooking businesses raise capital in foreign currencies and collect revenue in local currency. This leads to uncertainty and difficulty in planning future revenues. Coupled with high inflation rates, a weak Kenyan shilling means that clean cooking solutions would mostly be expensive and unaffordable for most households. The outcome would be declining use of clean solutions for those with access as they switch to cheaper polluting fuels and inaccessibility (due to high cost) for those without access, hindering their transition.

4.6.6 High public debt burden

Kenya's public debt-to-GDP ratio hit 69%[221] by May 2022. Consequently, a significant portion of government revenue is allocated to servicing debt, leaving little capacity for subsidising social programmes like clean cooking. For instance, the government scrapped the unsustainable subsidy ordered by the President in 2018 and lowered the limit for qualifying for the monthly lifeline power subsidy, equivalent to a 24.1% discount, from 100kWh to 30kWh.

218 Self-reported company data from various companies including KOKO Networks and BURN Manufacturing

219 Integrity Council for Voluntary Carbon Markets. (2024). Core carbon principles, assessment framework and assessment procedure. https://icvcm.org/wp-content/uploads/2024/02/CCP-Book-V2-FINAL-6Feb24.pdf

220 Africa Carbon Markets Initiative. (2023). ACMI's Narrative on African Carbon Markets: A transformative force for good. https://africacarbonmarkets.org/acmis-narrative-on-african-carbon-markets/

221 National Treasury and Planning. (2022). Annual public debt management report for financial year 2021/2022. https://www.treasury.go.ke/wp-content/uploads/2023/06/Annual-Public-Debt-Report-2021-2022.pdf

Additionally, EPRA introduced a new tariff band (31-100kWh) and increased the electricity tariff for this band by 19% from 21.99KES/kWh to 26.10KES/kWh, thereby disincentivising a transition to electric cooking[222]. Elevated public debt has led to higher loan interest rates[223], constraining local clean cooking company's access to affordable financing. This may adversely affect KNCTS Action Agenda 2 to promote local manufacturing, as domestically manufactured clean cooking technologies will become costlier than imports. This has also reduced Government's appetite to create more institutions or start projects.

4.6.7 Implementing a clean fuels cross-subsidy

Cross-subsidy programmes require a majority of users to subsidise the minority. The current state of play has a minority of the population using clean cooking fuels. Applying a tax on this minority to cross-subsidise the current users of traditional fuels who cannot afford to continuously use clean cooking fuels will have a negative effect on the market. The MoEP should rapidly implement this plan to ensure that more households and most institutions are using clean fuels by 2028 and depending on the use rates then, implement this cross-subsidy programme. The risk would be a failure to ensure that a significant proportion of users transition to using clean fuels at scale by 2028.

222 Energy and Petroleum Regulatory Authority (2023). Retail electricity tariff review for the 2022/23-2025/26 fourth tariff control period (TCP) effective 1st April 2023. https://www.epra.go.ke/retail-electricity-tariff-review-for-the-2022-23-2025-26-4th-tariff-control-period-tcp-effective-1st-april-2023/

223 Kumar, M., & Woo, J. (2010). Public debt and growth. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1653188

ANNEX ONE

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ANNEX TWO

Budget assumptions

#	Item	Amount	Description
1	Total HH (units)	8,500,000	Total absolute deficit
2	Total HH (Q1)	1,100,000	Requires demand side subsidies
3	Total HH (Q3)	5,500,000	Requires demand and supply side subsidies
4	Total HH (Q4)	1,900,000	Requires supply side subsidies
5	KES - USD	150	Exchange rate
6	Av. demand side subsidy (% of sell value)	75%	Average price of demand side subsidy[124] i.e., 75% of sell price
7	Av. supply side incentive per unit	3750	Average price of supply side subsidy per unit

FUEL	%	#UNITS	Price (KES)	Price (US$)	Q1 # Units	Total DSS (KES)	Total (US$)	Q3 # Units	Total (KES)	Total (US$)	Sub-total DSS(KES)	Sub-total DSS(US$)
LPG	50%	3,592,297	4,000	27	550,000	1,650,000,000	11,000,000	2,750,000	18,562,500,000	123,750,000	8,250,000,000	55,000,000
Electric	10%	1,484,646	10,998	73	110,000	907,293,750	6,048,625	55,000	6,598,968,750	43,993,125	4,536,468,750	30,243,125
Bioethanol	30%	4,514,357	2,500	17	330,000	618,750,000	4,125,000	1,650,000	9,281,250,000	61,875,000	3,093,750,000	20,625,000
Biogas	3%	672,903	50,000	333	33,000	1,237,500,000	8,250,000	165,000	6,806,250,000	45,375,000	6,187,500,000	41,250,000
Biomass stoves*	7%	454,650	8,500	57	77,000	490,875,000	3,272,500	385,000	3,898,125,000	25,987,500	2,454,357,000	16,362,500
Total						**4,904,418,750**	**32,696,125**		**45,147,093,750**	**300,980,625**	**24,522,093,750**	**163,480,625**

*Low emission/ clean sustainable biomass stoves

FUEL	%	#UNITS	Price (KES)	Price (US$)	Sub-total sss(KES)	Sub-total sss(US$)	Q4 # Units	Total SSS (KES)	Total SSS (US$)	Grand Total (KES)	Grand Total (US$)
LPG	50%	3,592,297	4,000	27	10,312,500,00	68,750,000	950,000	3,562,500,000	23,750,000	23,775,000,000	158,500,000
Electric	10%	1,484,646	10,998	73	2,062,500,000	13,750,000	190,000	712,500,000	4,750,000	8,218,762,500	54,791,750
Bioethanol	30%	4,514,357	2,500	17	6,187,500,000	41,250,000	570,000	2,137,500,000	14,250,000	12,037,500,000	80,250,000
Biogas	3%	672,903	50,000	333	618,750,000	4,125,000	57,000	213,750,000	1,425,000	8,257,500,000	55,050,000
Biomass stoves*	7%	454,650	8,500	57	1,443,750,000	9,625,000	133,000	498,750,000	3,325,000	4,887,750,000	32,585,000
Total					**20,625,000,000**	**137,500,000**		**7,125,000,000**	**47,500,000**	**57,176,512,500**	**381,176,750**

Description of cost	Total (KES)	Total (US$)
Total cost of stove subsidies (Demand side subsidies)	32,693,512,500	217,956,750
Total cost of distribution of stoves (Supply side subsidies)	27,195,000,000	181,300,000
Grand total	**59,888,512,500**	**399,256,750**

224 Based on Willingness To Pay estimates

ANNEX THREE

Costs and Benefits for the fuel mix of 2028

Outcome	Stove use rates (the % of time a household uses a newly received or purchased cookstove.)		
	45%	75%	100%
Costs			
Total cost annual costs (Government + Private) (US$/Yr)	139,094,407	201,380,771	282,279,498
Total annual government cost (US$/Yr)	106,844,920	153,363,593	210,711,189
Total annual private costs (US$/Yr)	32,249,487	48,017,178	71,568,309
Private and social benefits			
Total annual health, time, and environment benefits (US$/Yr)	63,380,883	115,995,909	240,106,966
Health Benefits			
Total annual morbidity reduction (YLD)/Yr)	2518.5	5,198.8	11,565.4
Total annual mortality reduction (YLL/Yr)	3997.8	9.885.4	26,588.8
DALYs Avoided	90,701.5	213,318.8	622,781.6
Total annual value of disease reductions (US$/Yr)	15,591,402	37,282,215	121,755,035
Value of morbidity reductions (US$/yr)	1,056,645	2,710,055	15,054,411
Value of mortality reductions (US$/Yr)	14,534,757	34,572,160	106,700,625
Total time savings (Hours/year)	282,385,202	464,432,099	606,822,991
Average time savings for adopting households (Hours/Household-Yr)	367.5	604.4	789.7
Value of annual total time savings (US$/Yr)	6,721,261	11,065,841	16,627,403
Environmental benefits			
Basic (CO_2, N_2O, CH_4) reduction in climate forcing pollutants (tonsCO_{2e}/Yr)	3,266,782	5,369,695	7,009,708
Full (CO_2, N_2O, CH_4, CO, OC, BC) reduction in climate forcing pollutants (tonsCO_{2e}/Yr)	7,746,452	12,739,834	16,644,605
Value of basic (CO_2, N_2O, CH_4) reduction in climate forcing pollutants (US$/Yr)	15,157,446	24,941,283	37,444,313
Value of full (CO_2, N_2O, CH_4, CO, OC, BC) reduction in climate forcing pollutants (US$/Yr)	35,990,102	59,251,115	89,023,631
Unsustainable wood harvest avoided annually (t/Yr)	1,988,745,648	3,285,848.8	4,323,677.2
Value of unsustainable wood harvest avoided annually (US$)	5,078,117	8,396,738	12,700,896

ANNEX FOUR

List of stakeholders consulted

We extend our deepest appreciation to the following individuals whose unwavering support, dedication, and partnership were crucial in developing this strategy.

No.	Name
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1	Eng. Isaac Kiva
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17	Eng. Nickson Bukachi
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18	Victor Kirwa
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Access Coalition	
25	Patricia Mbogo

EED Advisory	
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27	Daniel Wanjohi
28	Ruth Gichuhi
29	Tom Shikorire
30	Abigael Okoko
31	Ruth Anyango
32	Mary Kisaka

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No.	Name
Public sector institutions:	
1	Ministry of Energy and Petroleum (MoEP)
2	Ministry of Health (MoH)
3	Ministry of Environment & Forestry (MoEF)
4	Energy and Petroleum Regulatory Authority (EPRA)
5	Kenya Bureau of Standards (KEBS)
6	Sustainable Energy Technical Assistance (SETA)
7	Kenya Power and Lighting Company (KPLC)
8	Rural Electrification and Renewable Energy Corporation (REREC)
9	Kenya Medical Research Institute (KEMRI)
Academia	
10	Loughborough University
11	Strathmore University
Development Partners	
12	Agence Française de Développement (AFD)
13	Foreign, Commonwealth & Development Office (FCDO)
14	UK Partnerships for Accelerating Climate Transitions (UK PACT)
15	Palladium
16	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
17	Green Climate Fund (GCF)
18	Energizing Development (EnDev)
19	Clean Air Africa
20	KEMRI
21	Modern Energy Cooking Services (MECS)
22	Loughborough University
23	Gamos East Africa
24	Climate Compatible Growth (CCG)
25	Global Alliance for People and Planet (GEAPP)
26	Sustainable Energy for All (SEforALL)
27	Clean Cooking Alliance (CCA)
28	Rockefeller Foundation
29	Climate Emergency Collaboration Group (CECG)
30	Access Coalition
31	Energy Transitions Council / E3G

Associations	
32	Kenya Private Sector Alliance (KEPSA)
33	Electricity Sector Association of Kenyan (ESAK)
34	Clean Cooking Association of Kenya (CCAK)
35	Global LPG Partnership (GLPGP)
Consultants and delivery partners	
36	EED Advisory
37	Strathmore Energy Research Centre
38	World Resources Institute (WRI)
39	Allstar Consulting
40	Integral Media
41	Kenya Power
42	Clean Cooking Alliance (CCA)
43	Dale Agro
44	Nuvoni Centre for Innovation Research
45	Hystra
46	Biogas Systems
47	Integral Media
48	Sustainable Community Development Services (SCODE)
49	Kisambara Ventures
50	PowerPay Africa
51	Kenya Power Institute of Energy Studies and Research (IESR)
Private Sector, NGOs and CSCO	
52	Biogas Network Kenya (Bio-NET)
53	Kenya Association of Manufacturers (KAM)
54	Kenya Industrial Research and Development Institute (KIRDI)
55	Burn Manufacturing
56	Wisdom Innovations Limited
57	Eco-charcoal
58	Maka Digital Solutions
59	Eco-bora
60	D.light
61	Eco-Charcoal
62	Better Cooking Company
63	Ecosafi
64	Total Energies
65	Petroleum Institute of East Africa (PIEA)
66	Koko Networks
67	Kenya Biogas Stakeholders Network (Kenya Bio-Net)
68	Giraffe Energy
69	SistemaBio
70	E-Moto Limited
71	CIST Africa
72	Blue Flame Stoves
73	Leocome Limited
74	ENTEC

75	Seedballs Kenya
76	C-Quest Capital
77	Equity Bank
78	Energy Dealers Association
79	Integral Advisory
80	AECF
81	United Briquettes Producers Association (UBPA)