THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF ENERGY

NATIONAL CLEAN COOKING STRATEGY

(2024 – 2034)

MAY, 2024

Table of Content

ABREVIATION ..... **III**

PREFACE ..... **IV**

FOREWORD ..... **V**

CHAPTER ONE **1**

1.INTRODUCTION **1**

1.1. The Concept of Clean Cooking 1

1.2. Background 1

1.3. Guidelines Considered in the Preparation of the Strategy 2

1.4. Outcomes of the Strategy 2

1.5 Methodology 2

1.6. Benchmarking 2

CHAPTER TWO **6**

2. SITUATIONAL ANALYSIS **6**

2.1. Fuels and Technologies Used in the Country 6

2.2. Effects of Using Traditional Cooking Solutions 11

2.3. Barriers to the Use of Clean Cooking Solutions 11

2.4. Cross Cutting Issues 13

CHAPTER THREE **15**

3. MAIN AND SPECIFIC OBJECTIVES **15**

3.1. Vision 15

3.2. Mission 15

3.3. Main Objective 15

3.4. Specific Objectives and Challenges 15

CHAPTER FOUR. **17**

4. STRATEGIES, TARGETS AND OUTCOME INDICATORS **17**

4.1. Public and Institutional Awareness on Cooking Solutions 17

4.2. Access to raw Materials and reliable infrastructure of clean cooking solutions 17

4.3. The cost of Clean Cooking Energy, Appliances and Efficient Cooking Stoves 18

4.4. Policy, Laws, Regulations and Guidelines on Cooking Solutions 19

4.5. Investment in the Clean Cooking Initiatives 20

4.6. Capacity of Clean Cooking Project Implementers 21

4.7. The Scope of Research, invention and Innovation in Technologies Related to Clean Cooking 21

4.8. Cross-cutting Issues 22

CHAPTER FIVE **25**
5. IMPLEMENTATION MATRIX OF THE STRATEGY **25**
RESPONSIBILITIES OF CLEAN COOKING STAKEHOLDERS **39**
CHAPTER SIX **40**
6. RESPONSIBILITIES OF CLEAN COOKING STAKEHOLDERS **40**
6.1. Responsibilities 40
CHAPTER SEVEN **42**
7. MONITORING AND EVALUATION **42**
7.1. Monitoring and Evaluation Framework 42
7.2. Data Collection and Analysis 43
7.3. Monitoring and Evaluation Report 43
Appendix No. 1: Performance Indicators 44
Appendix No. 2: Action Plan of the National Clean Cooking Strategy (2024 – 2034) 54

ABREVIATION

AIDS	Acquired Immune Deficiency Syndrome
AQG	Air Quality Guideline Level
CAMARTEC	The Centre of Agricultural Mechanization and Rural Technology
CBOs	Community Based Organizations
COSTECH	Commission for Science and Technology
ERA	Electricity Regulatory Authority
EWURA	Energy and Water Utilities Regulatory Authority
FBOs	Faith Based Organizations
HIV	Human Immunodeficiency Virus
ICS	Improved Cookstove
ITMOs	Internationally Transferred Mitigation Options
LPG	Liquefied Petroleum Gas
MMscf	Million Standard Cubic Feet
MTF	Multi-Tier Framework
MW	Megawatt
NACTVET	National Council for Technical and Vocational Education and Training
NBS	National Bureau of Statistics
NCMC	Tanzania National Carbon Monitoring Centre
NEEC	National Economic Empowerment Council
NEMC	National Environment Management Council
NGO's	Non-Governmental Organization
OSHA	Occupational Safety and Health Authority
PCCB	Prevention and Combating of Corruption Bureau
PM	Particulate Matter
PO- RALG	President's Office - Regional Administration and Local Government Authority
PPP	Public-Private Partnership
REA	Rural Energy Agency
SDGs	Sustainable Development Goals
SE4ALL	Sustainable Energy for All
Shillings	Tanzanian Shillings
TAFF	Tanzania Forest Fund
TAFORI	Tanzania Forestry Research Institute
TANESCO	Tanzania Electric Supply Company Limited
TANROAD	Tanzania National Roads Agency
TARURA	Tanzania Rural and Urban Road Agency
TBS	Tanzania Bureau of Standards
TEMDO	Tanzania Bureau of Standards
TFS	Tanzania Forest Services Agency
TIC	Tanzania Investment Centre
TPA	Tanzania Ports Authority
TPDC	Tanzania Petroleum Development Corporation
TRA	Tanzania Revenue Authority
TRC	Tanzania Railway Corporation
UNIDO	United Nations Industrial Development Organisation

PREFACE

Clean cooking is a specific agenda that has taken significant importance in policies, plans and strategies of various Governments worldwide. The importance of this agenda is driven by the increasing environmental degradation, climate change, and health impacts associated with the use of traditional cooking methods. Goal Number 7 of the United Nations Sustainable Development Goals focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all. However, there are still challenges in accessing affordable, sustainable, and reliable energy for various uses, particularly for cooking, especially in Sub-Saharan African countries, including Tanzania. This situation causes many people and some institutions to continue using traditional cooking solutions, which further exacerbates environmental, health, economic, and social impacts.



The Government of the United Republic of Tanzania, in collaboration with various stakeholders, has been formulating and implementing policies and strategies aimed at promoting the use of clean cooking solutions and environmental conservation. Despite the implementation of these policies and strategies across various sectors and institutions, there is no national guideline providing specific direction to ensure universal adoption of clean cooking solutions and elimination of traditional sources. Based on that situation, Her Excellency Dr. Samia Suluhu Hassan, President of the United Republic of Tanzania, during the opening of the National Clean Cooking Conference in 2022, directed the preparation of a National Strategy to provide guidance on the use of clean cooking solutions.

In that context, the government has prepared the National Clean Cooking Strategy, which provides guidance for the country's transition to using clean cooking solutions. This strategy aims to ensure that 80 percent of Tanzanians use clean cooking solutions by the year 2034.

Therefore, I take this opportunity to call upon all stakeholders, including Sectoral Ministries, Public Institutions, Government Departments, Regional Administration and Local Government Authorities, Civil Society Organizations, Private Sectors, Development Partners, and the general public, to actively participate in implementing this strategy. It is my belief that by the year 2034, our country will have made significant progress in increasing the adoption of clean cooking solutions, enabling environmental conservation, improving community health and well-being, fostering economic growth, and contributing to the achievement of the United Nations Sustainable Development Goals by 2030.

.....

Dr. Doto Mashaka Biteko (MP)
DEPUTY PRIME MINISTER AND MINISTER FOR ENERGY

FOREWORD

The Government of the United Republic of Tanzania, through various national and international policies, recognizes the importance of using clean cooking energy as a crucial tool in addressing environmental, health, social, and economic challenges. These policies outline objectives to improve the lives of citizens through the use of clean cooking solutions. To achieve these goals, the Government has prepared this Strategy, which provides guidance on the use of clean cooking solutions in the country through the efforts of various stakeholders.



This strategy is divided into seven chapters. The first chapter is an Introduction that provides a summary on the concept of clean cooking, the background, the guidelines considered in the preparation of the strategy, the outcomes of the strategy, methodology used and benchmarking. The second chapter gives elaborations on the current situation of fuels and technologies used in the country, the effects of using traditional cooking solutions, barriers to the use of clean cooking solutions, and cross-cutting issues. The third chapter outlines the vision statement, mission, main objective, and specific objectives. The fourth chapter outlines the strategies, targets, and outcome indicators for implementing specific objectives. The fifth chapter presents the implementation matrix of the Strategy, specifying objectives, strategies, targets, outcome indicators, implementation timelines, and stakeholders responsible for strategy implementation. The sixth chapter identifies the responsibilities of clean cooking stakeholders, while the seventh chapter presents the monitoring and evaluation framework for implementation of the Strategy.

I would like to take this opportunity to express my gratitude to all stakeholders who participated in the preparation of this Strategy. I acknowledge the involvement of various stakeholders, including Ministries, Regional Administration and Local Government Authorities, Independent Departments, Government Agencies, Public Institutions, Private Sector, Non-Governmental Organizations, and Development Partners. Last but not least, I would like to thank all members of the National Clean Cooking Working Group who participated in the preparation of this Strategy.

.....

Eng. Felchesmi Jossen Mramba
PERMANENT SECRETARY

INTRODUCTION



1.INTRODUCTION

1.1. The Concept of Clean Cooking

According to the World Bank Multi-Tier Framework (MTF) of 2020, clean cooking is attributed to efficiency, convenience, fuel availability, safety, affordability and the avoidance of exposing users to toxic and hazardous environments. Additionally, the World Health Organization Guidelines of 2021 state that clean fuel and technologies are assessed based on the levels of fine particulate matter not exceeding 2.5 µm and carbon monoxide emissions. Fuel and technology combinations will be classified as clean if they achieve:

i. Annual average air quality guideline level (AQG, 5 µg/m3) or the Interim Target-1 level (IT1, 35 µg/m3) for Particulate Matter with a size of 2.5 µm (PM2.5); and

ii. 24-hour average air quality guideline level (AQG, 4 mg/m3) or the Interim Target-1 level (IT-1, 7 mg/m3) for carbon monoxide (CO).

Thus, in the context of the National Clean Cooking Strategy, clean cooking refers to fuels and appropriate technologies that collectively produce a minimum level of toxic emission when used appropriately. This concept aims to ensure the safety, sustainability, and easy accessibility of cooking energy, saving time, and reducing usage costs, as well as minimizing environmental and health impacts for users. It is also a crucial tool in implementing national and international commitments aimed at combating climate change and reducing greenhouse gas emissions.

1.2. Background

The National Clean Cooking Strategy arises from the need for a comprehensive national plan to address the increasing environmental degradation and the health, economic, and social impacts associated with the use of traditional cooking methods. Due to the cross-cutting nature of cooking energy issues, there have been challenges in implementing strategies to mitigate these impacts. Since Tanzania gained independence in 1961, there has never been an integrated national plan to reduce the use of traditional solutions.

According to the National Energy Policy of 2015, the increasing demand for solid biomass based fuels for cooking coupled with traditional wood to energy conversion technologies, cooking methods and the use of inefficient stoves have contributed to environmental degradation. Furthermore, the policy indicates that the use of woodfuel in rural and urban areas has also contributed to health problems associated with smoke and recommends necessary exploration of possibilities for fuel switching to other forms of energy such as compressed natural gas, liquefied petroleum gas (LPG) and electricity.

This strategy has been prepared to fulfill the objective of the National Energy Policy of 2015, which aims to improve quality of life by promoting the use of modern fuels. It specifically targets the following policy statements (i) enhance fuel switch from woodfuel to modern energy; and (ii) facilitate adoption of appropriate cooking appliances to promote alternatives to woodfuel.

Moreover, the implementation of this Strategy will enable the achievement of the objectives outlined in various national policies, including the National Environmental Policy of 2021 which aims to strengthen forest conservation for environmental preservation through the use of cost-effective and readily available alternative energy sources for cooking; the National Forest Policy of 1998 which aims to ensure sustainable availability of forest products and services by maintaining a sufficient forest area under strict management; the National Health Policy of 2007 which directs the establishment of a good and sustainable system of conserving, preserving, and protecting the environment for the benefit of the health of the people and future generations; and the National Women and Gender Development Policy of 2000 which focuses on conserving the environment to reduce the burden to women of fetching firewood and water to facilitate their participation in social activities.

During the opening of the National Clean Cooking Energy Dialogue held in November 2022, Her Excellency Dr. Samia Suluhu Hassan, President of the United Republic of Tanzania, issued directives for

the preparation of a National Clean Cooking Strategy to provide guidance on transitioning to the use of clean cooking solutions. Additionally, the President directed that 80 percent of Tanzanians should transition to the use of clean cooking solutions within ten years.

Therefore, the purpose of this Strategy is to ensure the availability of clean, safe, affordable, sustainable, and reliable cooking energy. This Strategy outlines implementation strategies, targets, outcome indicators, and the stakeholders responsible for implementing the Strategy and their roles. Other issues addressed in the Strategy include the implementation timeline and the action plan for its execution.

1.3. Guidelines Considered in the Preparation of the Strategy

The preparation of this strategy considered relevant national and international policies, laws, regulations, and guidelines related to clean cooking solutions. These guidelines include: the United Nations Sustainable Development Goals for 2030 (SDGs 2030), the African Union Agenda 2063, the Sixth East African Community Development Strategy (2021/22 – 2025/26), Tanzania's Sustainable Energy for All Agenda (SE4ALL 2015), the National Development Vision 2025; and the Election Manifesto of the Ruling Party CCM for 2020 – 2025. Other guidelines include the Third Five-Year National Development Plan (2021/22 – 2025/26), the National Master Plan for Conservation and Environmental Management (2022 - 2032), Tanzania's Nationally Determined Contribution (2021), the National Energy Policy of 2015, the National Environmental Policy of 2021, the National Forestry Policy of 1998, the National Health Policy of 2007, the National Policy on Women and Gender Development of 2000, and the Education and Training Policy of 2014, and the Agriculture Policy of 2013.

1.4. Outcomes of the Strategy

This strategy has established strategies, targets, and outcome indicators that will serve as tools to ensure the following outcomes:

i. Increased awareness among citizens and institutions on the importance of using clean cooking solutions;

ii. Increased access of clean, affordable, sustainable, and reliable cooking solutions by improving infrastructure, ensuring availability of raw materials, and simplifying procurement processes;

iii. Reduced cost of clean energy, appliances and efficient cook stoves;

iv. Existence of enabling policies, laws, regulations and guidelines to facilitate the adoption of clean cooking solutions;

v. Increased investment in clean cooking solutions, thereby contributing to economic growth;

vi. Enhanced capacity to effectively implement clean cooking projects;

vii. Expanded scope of research and innovation in technologies related to cooking solutions and

viii. Decrease of HIV and AIDS transmission and promotion of gender equality and good governance in clean cooking.

1.5 Methodology

This strategy has been developed by reviewing various documents related to cooking solutions, including policies, laws, regulations, guidelines, and publications from within and outside the country.

The development of this strategy involved Ministries, Independent Departments, Regional Administrations and Local Government Authorities, Government Agencies and Public Organizations. This ensured that they understand their responsibilities well and execute them accordingly. Other stakeholders involved included the Private Sector and Non-Governmental Organizations, who were engaged through meetings, dialogue and consultation. Additionally, development partners have been involved through discussions on areas of collaboration, funding for specific projects, and sectoral assistance.

1.6. Benchmarking

Another method used in the preparation of this Strategy is the analysis of various policies and strategies of countries which have succeded or are keen to increase the use of clean cooking solutions. Those countries include:

1.6.1 India

According to the World Bank statistics of the year 2023, 71.1 percent of the Indian population had access to clean cooking energy in 2021. In promoting the use of clean cooking energy in India, the Public Institution managing Natural Gas is responsible for development of natural gas transmission infrastructure. The Regulatory Authority initiates and oversees the bidding process for allocating specific zones for the construction of the infrastructure for natural gas distribution. One of the criteria of the evaluation process is the number of households to be connected to natural gas in proximity to the identified project. The Private Sector develops natural gas distribution networks to customers and pays for transmission tariffs.

With regard to the promotion of LPG, the Government of India, through the Ministry of Petroleum and Natural Gas, has been implementing the "Pradhan Mantri Ujjwala Yojana Scheme" since 2016. This scheme aims at providing LPG cylinders to low-income households. According to the Ministry of Petroleum and Natural Gas in India, as of 30th January, 2023, a total of 95,870,119 households had benefited from the scheme.

The private sector in India is responsible for production of biogas plants. The feedstocks for the biogas plants is from agricultural, municipal and industrial wastes. The produced biogas provides sustainable energy including cooking energy. The produced gas is also compressed into special cylinders (tanks) for easier transportation.

The experience drawn from India highlights how the Private Sector is involved in the distribution of natural gas, whereby this Strategy has developed specific strategies for allocating specific zones to implement distribution projects. Additionally, subsidy programs for clean cooking solutions targeting low-income households is the notable experience, whereby specific strategies have been developed to implement such programmes to promote the use of clean cooking solutions nationwide. Furthermore, the establishment of biogas industries is a viable solution for producing clean cooking energy in the country.

1.6.2 Kenya

According to the World Bank Statistics for the year 2023, 23.9 percent of the population in Kenya had access to clean cooking energy in 2021. In promoting the use of clean cooking energy, financial support is provided through the provision of affordable loans for LPG cylinders. According to the Kenya Market Assessment Final Report of 2013, Microfinance Institutions collaborate with suppliers to provide affordable and low interest loans. The main objective of this program is to make the initial cost of purchasing cylinders more affordable through a long-term repayment schedule.

Also, in Kenya, the Energy Policy of 2004 aims to develop biogas technology for household use. The government has made development efforts in collaboration with various development partners, whereby according to the Ministry of Energy report of 2023, it is estimated that Kenya has approximately 20,000 biogas systems. Additionally, the government has policies and strategies aimed at promoting the use of biogas, providing technical and financial support, and building infrastructure networks for distributing biogas in various areas. The Kenya Ethanol Cooking Fuel Master Plan of 2021 outlines strategies for the development of bioethanol so as to increase its usage for cooking. The proposed strategies for increasing the usage and demand for bioethanol include: removing the Value Added Tax (VAT) on bioethanol for cooking to stimulate demand; creating an enabling environment for Private Sector participation in bioethanol projects; and designating specific areas for growing bioethanol feedstocks. Other Strategies were promoting bioethanol markets through affordable loans; establishing strategies to benefit from climate funds; and encouraging results-based financing to support development of the bioethanol industry. Bioethanol is expected to make a significant contribution to the energy mix in Kenya in achieving the goal of 100% clean cooking access by 2028.

The experience drawn from Kenya is on how financial institutions are involved in providing low-interest loans to enable clean cooking entrepreneurs to investment. Additionally, this Strategy has utilized this experience in formulating and enhancing Strategies to develop bioethanol so as to increase its usage for cooking in the country.

1.6.3 Uganda

According to World Bank statistics for the year 2023, 0.7 percent of the population in Uganda had access to clean cooking in 2021. Despite this low level, the Government of Uganda has been striving to promote the increased usage of clean cooking through various initiatives including the introduction of a special electricity tariff framework for cooking approved by the Uganda Electricity Regulatory Authority (ERA), this framework was launched in 2021. The framework aimed at contributing to reducing the use of charcoal and firewood for cooking starting from January 2022 by making the cost of cooking tariff in households cheaper than using charcoal. The ERA introduced a Declining Block Tariff Structure that allows for differentiated tariff levels based on the amount of energy consumed. In this system, the electricity price decreases as the usage increases beyond the threshold set by the Authority. This system aims to encourage the use of electricity for cooking by ensuring that users who cook with electricity benefit from lower prices.

The experience taken from Uganda is on how to increase the use of electricity for cooking through prepaid meter payments (LUKU). This Strategy has utilized this experience in preparing strategies to increase electricity usage through a system of paying different electricity tariffs to encourage electricity use in cooking in the country.

1.6.4 Ghana

According to World Bank statistics for the year 2023, 30.3 percent of the population in Ghana were using clean cooking energy in 2021. In promoting the use of clean cooking energy, the Ghanaian Government developed the Clean Cooking Energy Strategy (2020 - 2024) in 2019. Additionally, the government has joined the international Paris Agreement. This agreement aims to address climate change and reduce greenhouse gas emissions, including carbon dioxide emissions and other gases contributing to global warming. It also provides opportunities for countries to engage in the ITMOs trade (Internationally Transferred Mitigation Outcomes), where nations can exchange emissions reduction credits.

According to Ghana's Framework on International Carbon Market and Non-market Approaches report of 2022, Ghana utilizes and benefits from Article 6 of the Paris Agreement through approaches that encourage collaboration with various countries. The collaboration focuses on three main areas which are: partnerships with the private sector; technology and knowledge transfer; and, the ITMOs trade. These actions support Ghana in implementing its climate change mitigation strategies.

The experience drawn from Ghana illustrates how to reduce the costs of using clean cooking solutions through subsidies that can be derived from carbon trading. This Strategy has utilized this experience in formulating strategies to leverage funds and international environmental programs to promote the use of clean cooking energy in the country.


SITUATIONAL
ANALYSIS

CHAPTER

2

2. SITUATIONAL ANALYSIS

Fuels and technologies that emit low levels of toxicity are recognized to be clean. These energies and technologies include electricity, biogas, natural gas, LPG, bioethanol, solar energy, improved cookstoves and briquettes with standards acceptable by the Standards Regulatory Authority.

According to the World Bank's 2023 Report, the number of Tanzanians using clean cooking solutions has been gradually increasing but at a slow rate from 1.5 percent in 2010 to 6.9 percent in 2021. This percentage is below the global average of 71 percent for the year 2021. Figure 1 illustrates the trend of clean cooking usage in Tanzania from 2010 to 2021.

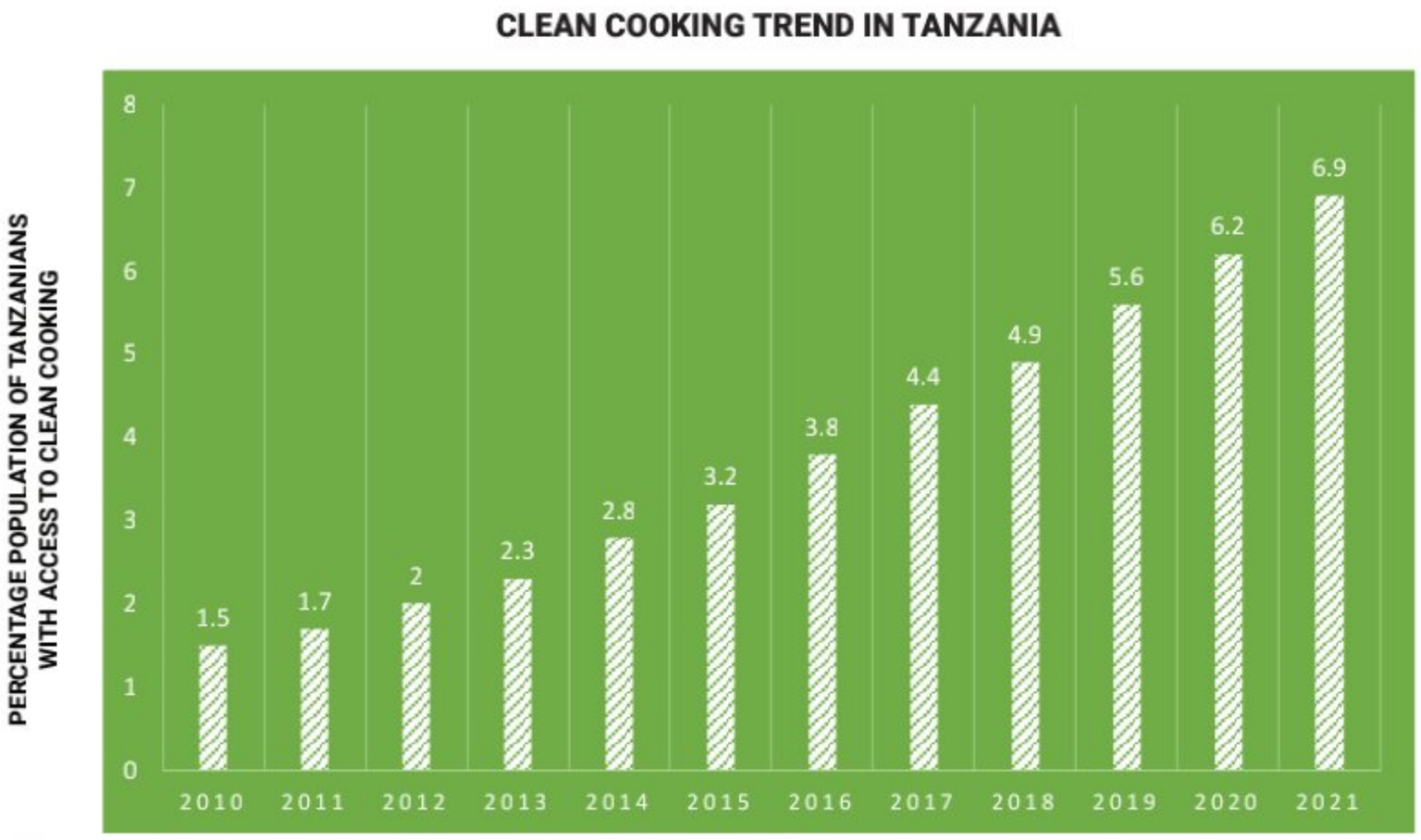


Figure 1: Access to Clean Fuels and Technologies for Cooking (percent Of Population) from 2010 - 2021

Source: World Bank, 2023

2.1. Fuels and Technologies Used in the Country

Fuels and technologies used for cooking in the country include animal dung and plant residues, firewood, charcoal, kerosene, briquettes, bioethanol, LPG, natural gas, biogas, electricity, improved cookstoves and solar energy cookstoves. According to the Cooking Energy Action Plan 2022, approximately 82 percent of the primary energy used in the country comes from biomass. For cooking purposes, it is estimated that around 90 percent of households in the country rely on wood and charcoal as their primary cooking energy, with wood accounting for 63.5 percent and charcoal for 26.2 percent of usage. The remaining 10 percent includes LPG at 5.1 percent, electricity at 3 percent, and other energy sources at 2.2 percent as shown in Figure No. 2.

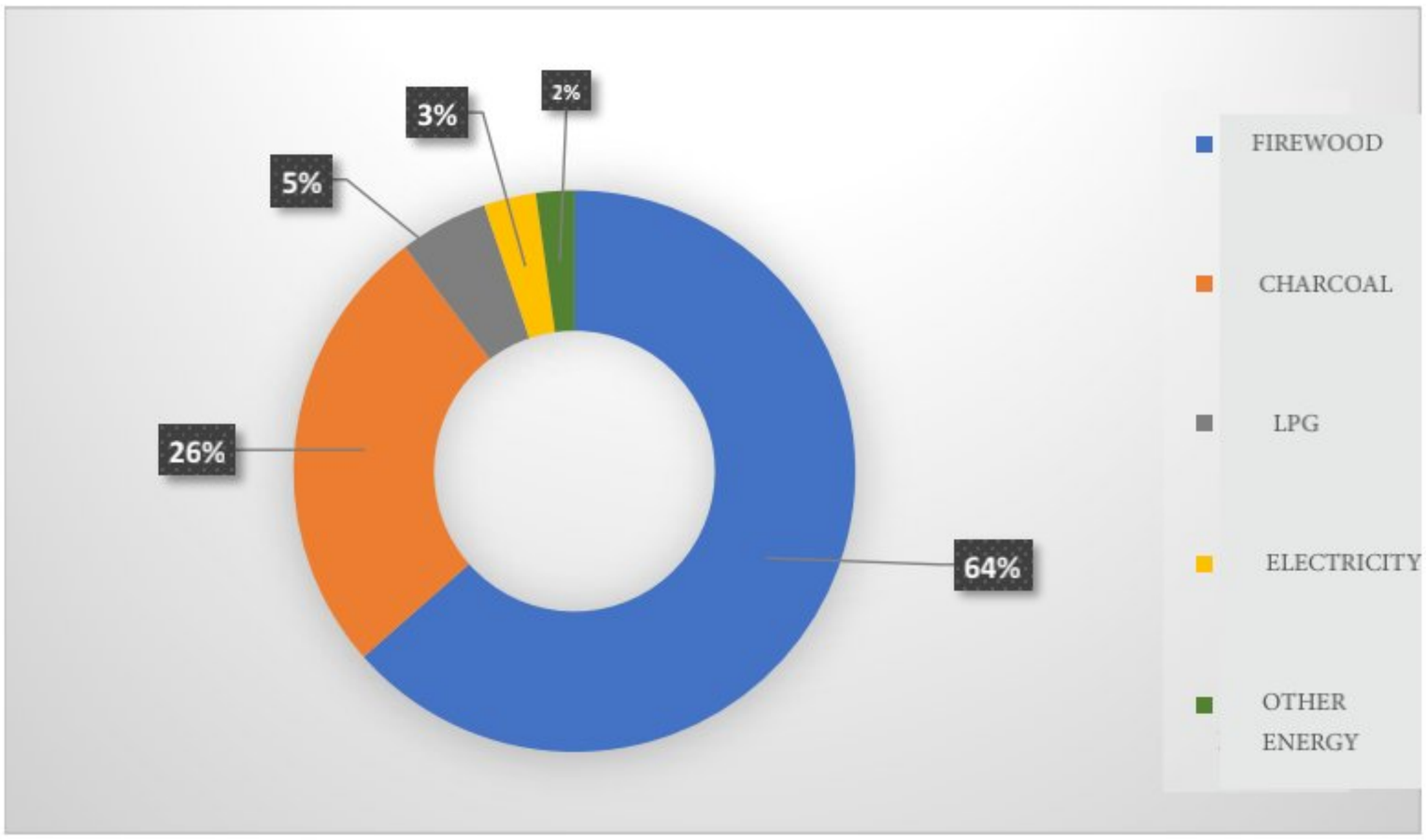


Figure 2: Household Cooking Energy Use, Mainland Tanzania 2019/20

There are technologies in the market which include improved cookstoves, that enhance efficient usage of various energy sources. Improved cookstoves require less firewood or charcoal depending on their quality. Despite the presence of modern energies and cooking technologies, many households continue to use unsafe and polluting energy sources due to various reasons, including perceptions and economic factors.

The Government in collaboration with various stakeholders, has been implementing strategic projects to enhance energy access in the country. These projects include electricity generation and distribution; exploration, production, and distribution of natural gas; LPG, biogas and bioethanol. The current situation regarding the availability, cost, and distribution of cooking fuels and technologies in the country is as follows.

2.1.1 Animal Dung and Plant Residues

Energy from animal dung, such as from cattle is obtained by drying the dung, and using it as a fuel source in charcoal or wood-fired stoves. This energy source is predominantly available in rural areas in Pastoral communities.

Plant residues are used as energy sources both in households and industries, utilizing various types of stove technologies. Animal dung and plant residues as energy sources are not costly since they can be collected from livestock and nearby fields.

2.1.2 Firewood

According to the Household Budget Survey of 2017/18, firewood is predominantly used in rural areas, whereby 84.8 percent of households rely on this energy source compared to 17.4 percent in urban areas. The demand for firewood in rural areas is high because it is believed to be the most affordable energy option. However, the availability of firewood in the country remains a challenge as people often have to travel long distances to get this energy source, which negatively affects other developmental activities, including access to education for children.

2.1.3 Charcoal

According to the Cooking Energy Action Plan 2022, approximately 10 to 12 tons of logs are burned to produce 1 ton of charcoal. Charcoal is the predominant source of energy in urban areas because it is believed to be affordable and is also available in small quantities based on the user's income. Additionally, charcoal can be easily transported, distributed, and stored. According to The Potential and Optimal Strategies for Charcoal Sub-Sector Development in Tanzania of 2019 report, charcoal consumption is widespread in urban areas, with over 50 percent of the charcoal produced in the country being used in Dar es Salaam. Moreover, according to the Household Budget Survey of 2017/18, 60.5 percent of households in urban areas use charcoal, compared to 11.5 percent in rural areas.

Although charcoal usage has been a source of income in the country, its use has health and environmental implications. According to the Contribution of Forest Sector to the National Economy of 2021 report, in 2020, the For-

estry Sector in Tanzania produced and sold 1.9 million tons of charcoal, contributing 44.22 percent to the sector's revenue, which is approximately 2 trillion Shillings.

The increase in demand for charcoal in the country is due to population growth, urbanization, ease in accessibility, transportation, distribution, and storage of charcoal and increased prices of alternative energy sources. The ability to buy in small quantities and the low cost of stoves using charcoal compared to other energy sources contribute to this increase. The cost of purchasing one kilogram of charcoal is approximately 1,500 Shillings, and it is estimated that an average household of six people uses two kilograms of charcoal to cook three meals per day.

2.1.4 Kerosene

Kerosene has been used for many years as a cooking fuel in certain areas of the country. However, it is important to recognize that the use of kerosene for cooking comes with various challenges, including safety concerns as it can cause fires or explosions. Due to its high flammability and ability to spread fire easily, its use for cooking can be hazardous to the users' safety.

Kerosene emits odor and smoke when burned, which can affect the indoor air quality in households or kitchens. This can have health implications by causing respiratory problems. The smoke from kerosene contains chemicals such as carbon monoxide and particulate matter (PM2.5), which can lead to respiratory diseases, cardiovascular diseases and lung cancer.

2.1.5 Briquettes

Briquettes is an alternative charcoal produced from various plant residues and agricultural waste, which are bound together using a binder such as clay, starch (including cassava and sweet potato flour), molasses and/or glue. These residues include materials such as paper, sawdust, wood shavings, dry leaves and rice husks. The use of these residues not only produces energy but also helps to preserve the environment. The composition used to make alternative charcoal determines its quality and price.

Briquettes can also be produced using coal dust which is mixed with wood dust, along with molasses, and compressed to form the alternative charcoal. The challenge in producing this charcoal is on how to reduce the level of emissions present in it, shortage of machinery for producing the required amount of briquettes and lack of sufficient knowledge to obtain the correct mixture to reduce the heat content in this charcoal. The entire production and distribution chain for the produced coal briquettes has not been established to facilitate its availability.

The production of briquettes began in the 1980s at the Center for Agricultural Mechanization and Rural Technology (CAMARTEC) in Arusha. Currently, there are many companies involved in the development of this technology. However, the lack of markets, high costs and availability of raw materials are obstacles to the advancement of this technology.

The challenges facing the development of briquettes technology include limited awareness among the community regarding the energy source and high initial production costs, including the cost of machines for production and drying. Also, the heat content of briquettes varies depending on the type of raw material used and some forms of this energy source require special stoves that add extra cost to the user. One of the raw materials used in the production of charcoal briquettes is dust from charcoal which is a forest produce that contributes to deforestation. The cost of briquettes ranges from 500 Shillings to 1,500 Shillings per kilogram, depending on the raw material used.

2.1.6 Bioethanol

Bioethanol is obtained from carbohydrates of sugar ot starchy crops via alcoholic fermentation. Among other uses, it can be used for cooking. The Government in collaboration with the United Nations Industrial Development Organization (UNIDO), has been implementing a project of promoting the use of Bioethanol as an alternative cooking energy since 2018. This project intends to reach 500,000 households in the city of Dar es Salaam whereby over 10,000 households have already been reached.

Under this project, the cost of a single-plate stove is approximately 38,000 Shillings and a double-plate stove is approximately 90,000 Shillings. These prices have been subsidized to half the actual price of the stoves. The price of bioethanol fuel is 2,500 Shillings per litre and can be used for four hours. The adoption of bioethanol technology in the country has not spread extensively due to challenges in obtaining raw materials. Limited awareness among users and the absence of guidelines to promote the use of this energy and technology have also contributed to the slow rate of adoption.

2.1.7 LPG

LPG is a fuel stored in cylinders and is derived from the refining of crude oil, and natural gas with a propane and butane content exceeding 15 percent. Tanzania has been importing LPG from other countries because the ongoing exploration in the country has not discovered oil and there is no crude oil processing plant. The natural gas discovered in the country has a low propane content (0.3 percent) and butane content (0.06 percent), which is insufficient for LPG production.