ENERGY FOR WHAT?

CONTEMPORARY ENERGY ISSUES & DILEMMAS IN KENYA

SID
Society for International Development

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INTRODUCTION TO KENYA'S ENERGY COMPENDIUM

INSIDE

In 2018, the Society for International Development (SID) published Energy for Whom? Scenarios for Eastern Africa. This short booklet offered three imagined futures for energy in Eastern Africa up to the year 2050.

Would the region be committed to the large-scale technologies of the 20th century? Would new energy systems exploit the region's renewable solar, wind and geothermal potential? Or would multiple distributed, small-scale energy systems evolve to meet local necessities? In any energy future, what would be the impact on people's lives?

Following their scenario work, SID decided to create a Compendium of energy in Kenya. This is the work presented here.

For decades, even centuries, countries around the world have transformed themselves from agricultural to industrial societies with the help of investments in fossil fuels, hydropower and large-scale complex energy technologies.

However, as societies in Eastern Africa prepare to join their ranks, global conditions have changed economically, socially and especially environmentally.

Since the end of World War II in the mid-1940s, the growth of human societies and consumption has accelerated to the point where we are now hitting critical planetary limits, including the risk of catastrophic climate change.

These limits pose multiple dilemmas for leaders around the world, with an unusually difficult challenge for East Africans who can no longer pursue a path of 'development as usual', especially in energy.

In this situation, what energy choices now exist to modernize the economy and improve peoples' lives? How will important energy choices be made?

Kenya's Compendium of Energy explores the details of today's energy challenges in one country, using statistical graphs, diagrams and photographs as illustrations. The Compendium is organized in six parts.

In putting together this collection of material, SID have repeatedly found that energy is a topic central to Kenya's future, but rarely understood by people.

It is the hope of the entire SID team and the authors here that our efforts might increase the understanding of a subject that, one way or another, will shape everyone's life and the future of Kenya's economy and society.

ONE

In the first section, **Introduction to the Compendium,** there is a short description of the purpose of the Compendium, followed by basic statistics describing Kenya's energy supply and demand along with a short comment on the nature of available energy data.

TWO

The second section, **Energy in People's Lives,** takes on the perspective of households, looking first at energy choices in rural and urban households as well as popular energy knowledge in a poor neighbourhood of Nairobi.

This section also considers the impact of new energy developments in rural areas and concludes with thoughts on educating energy professionals.

THREE

From this grassroots perspective, the third section jumps into **Energy Policy and the Dilemmas of Fossil Fuels.** The articles here include a review of the assumptions that underlie current policy preferences as well as unpacking Kenya's Energy Act of 2019 and the role of taxes in power generation.

Energy policy thinking, however, rarely includes the dominant fuel used in Kenya, biomass – the wood, charcoal or agricultural wastes used in some businesses and in many homes for cooking.

FOUR

That is why the fourth section asks, **Biomass Energy: Renewable, But Is It Sustainable?** This section considers the role of women in energy policy decisions and looks at how energy prices affect household energy choices, encouraging the use of biomass. It concludes by arguing, contrary to many policy expectations, that biomass energy is here to stay.

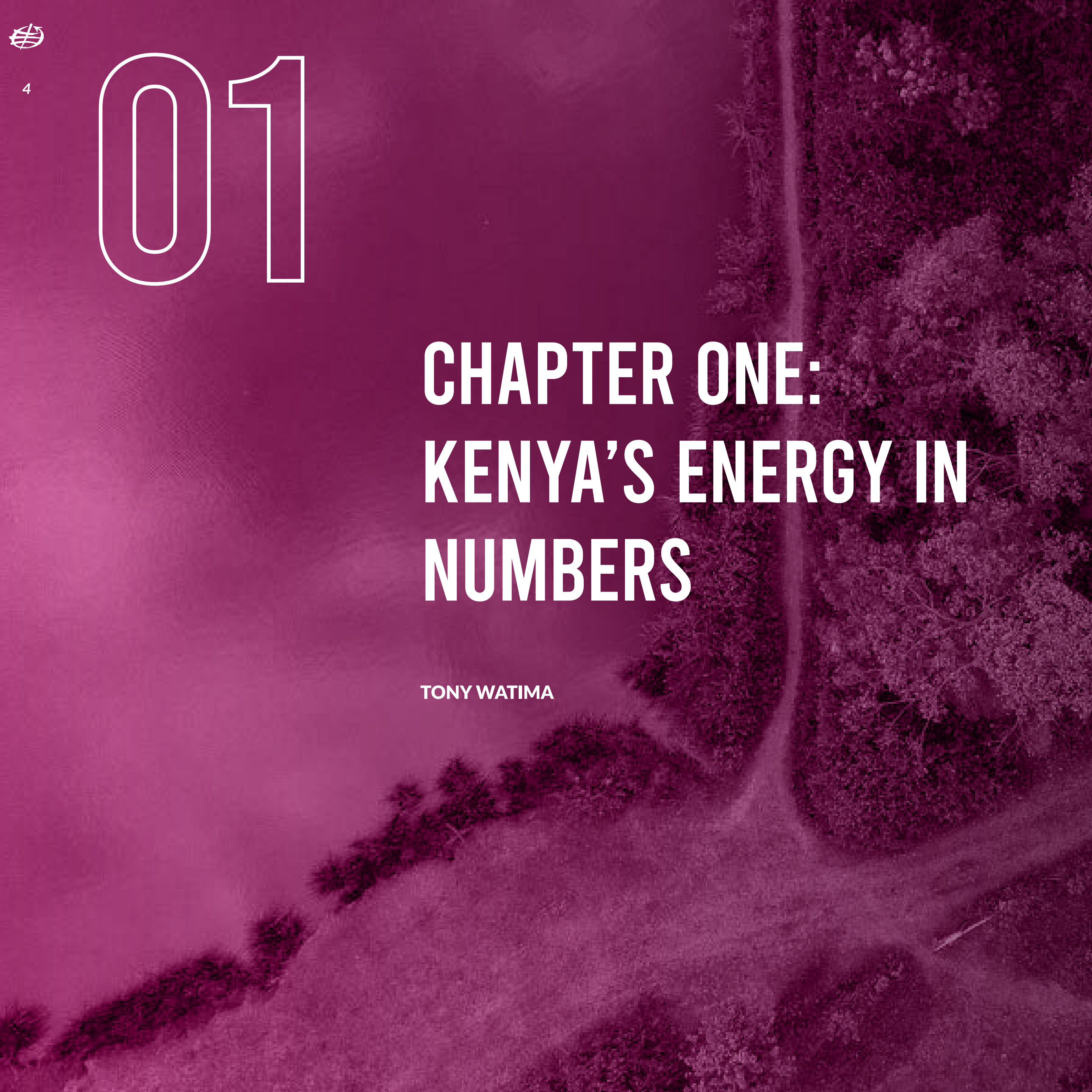
FIVE

Although biomass is the most common household fuel, the fifth section covers centralised grid electricity. Grid electricity, also known as 'power', dominates policy thinking and in Kenya, much of this electricity already comes renewable sources.

However, electricity from the grid is very expensive, raising the question: **Grid Electricity: Renewable, But Is It Affordable?** This section identifies what is behind the price Kenyans pay for electricity, identifies additional renewable technologies that might be introduced, and identifies options for financing green power.

SIX

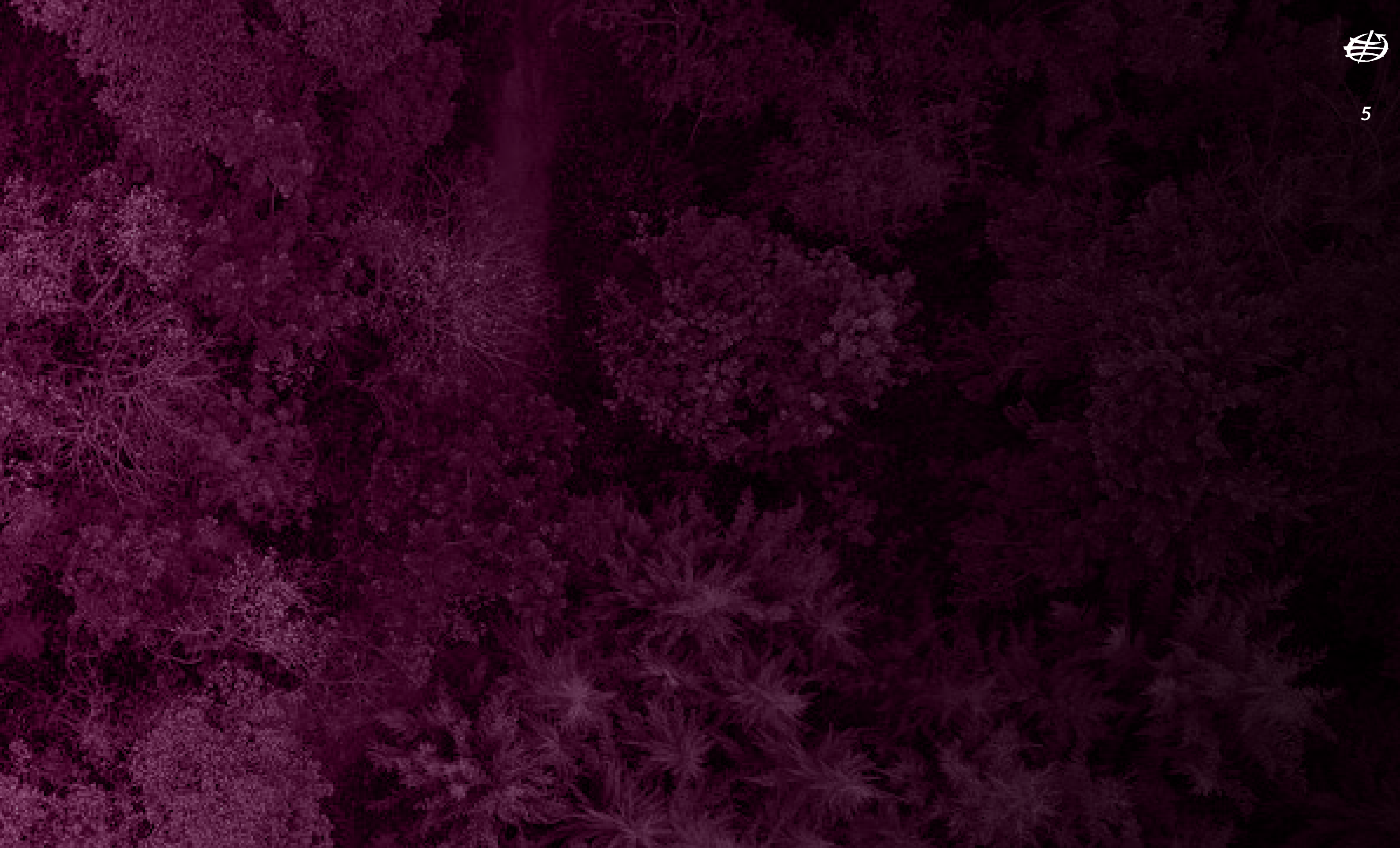
The sixth and final collection of essays is about the future: **What Might a Different Energy System Look Like?** This is where the impacts of carbon prices, climate change, long distance power lines and smaller distributed energy systems are considered.



01

CHAPTER ONE: KENYA'S ENERGY IN NUMBERS

TONY WATIMA



By way of backing up and illustrating the themes explored in the Compendium's articles, each section opens with statistical graphs to illustrate Kenya's energy situation today. Most of the data comes from the Kenya National Bureau of Statistics, compiled by author, Tony Watima.

- **Introduction:** Graphs of "Where does the energy come from & how is it used? An overview of energy supply and demand"
- **Energy in People's Lives:** Graphs of "Energy use in Kenya's counties"
- **Energy Policy and the Dilemmas of Fossil Fuels:** Graphs of "Fossil fuels: what is their role in Kenya's energy system today?"
- **Biomass Energy:** Graphs of "Renewable, but is it sustainable?"
- **Grid Electricity:** Graphs of "Renewable, but is it affordable?"
- **What Might a Different Energy System Look Like?:** Graphs of "Kenya's Renewable Energy Compared to Other African Countries."

The statistics back up the overall story coming out of the Compendium, that Kenya is facing an energy transition on several fronts: the challenge of replacing biomass with cleaner energy for domestic use in cities and rural areas; the need to make electricity both affordable and accessible; and the daunting task of creating an energy system that reduces climate change risks for all.

To begin, the following introductory graphs show the basic facts of Kenya's energy supplies, demand and uses.

KENYA'S ENERGY SUPPLY; WHERE DOES THE ENERGY COME FROM?

The pie chart in Figure 1 is a representation of the different sources of primary energy in Kenya. Biomass leads with 52% of supply, mostly used in households, followed by modern renewable energy, geothermal, hydropower, wind, and solar, which generate electricity.

Petroleum products are third, providing 20% of Kenya's energy, and are largely used in transport. Coal and coke providing the remaining small portion. Most of Kenya's energy is produced in Kenya, with fossil fuels largely imported.

The chart shows that Kenya still relies heavily on biomass, largely because it is currently cheaper, but not sustainable due to biomass depletion. The 2018 figures for biomass use are even higher – with biomass providing over 70% of Kenya's energy. A major challenge in Kenya is to help households make the transition from biomass to clean energy.

KENYA ENERGY DEMAND; WHAT TYPES OF ENERGY ARE BEING USED IN KENYA?

This pie chart looks at how Kenyans use energy. Over half of the energy used in Kenya (55%) comes from biomass used directly, usually as firewood for cooking. It is followed by electricity, at more than 30% of all energy, which is largely powered by modern renewable sources. Fossil fuels meet 15% of energy demand, much of it for transport.

Figure 2 below, with only 20% of energy use coming from electricity, shows that Kenya is not an electrified economy as often assumed.

The Figure 2 bar graph shows again that biomass is far and away the most used fuel, followed by electricity and then fossil fuels.

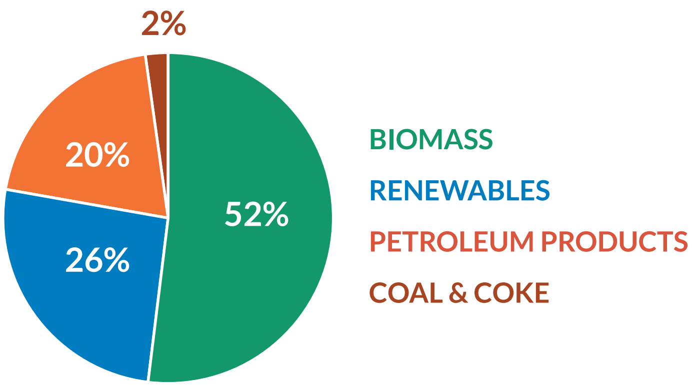


Figure 1: Primary energy supply. Source: KNBS Economic Survey 2020

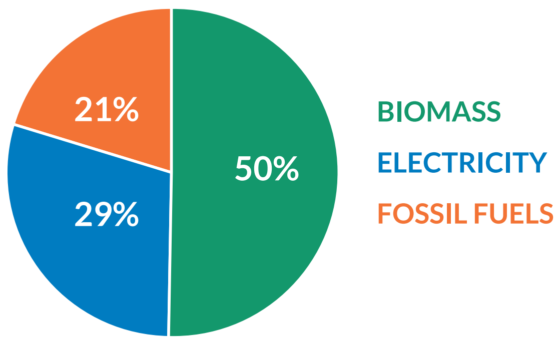


Figure 2: Main types of energy Kenyans use. Source: KNBS Economic Survey 2020

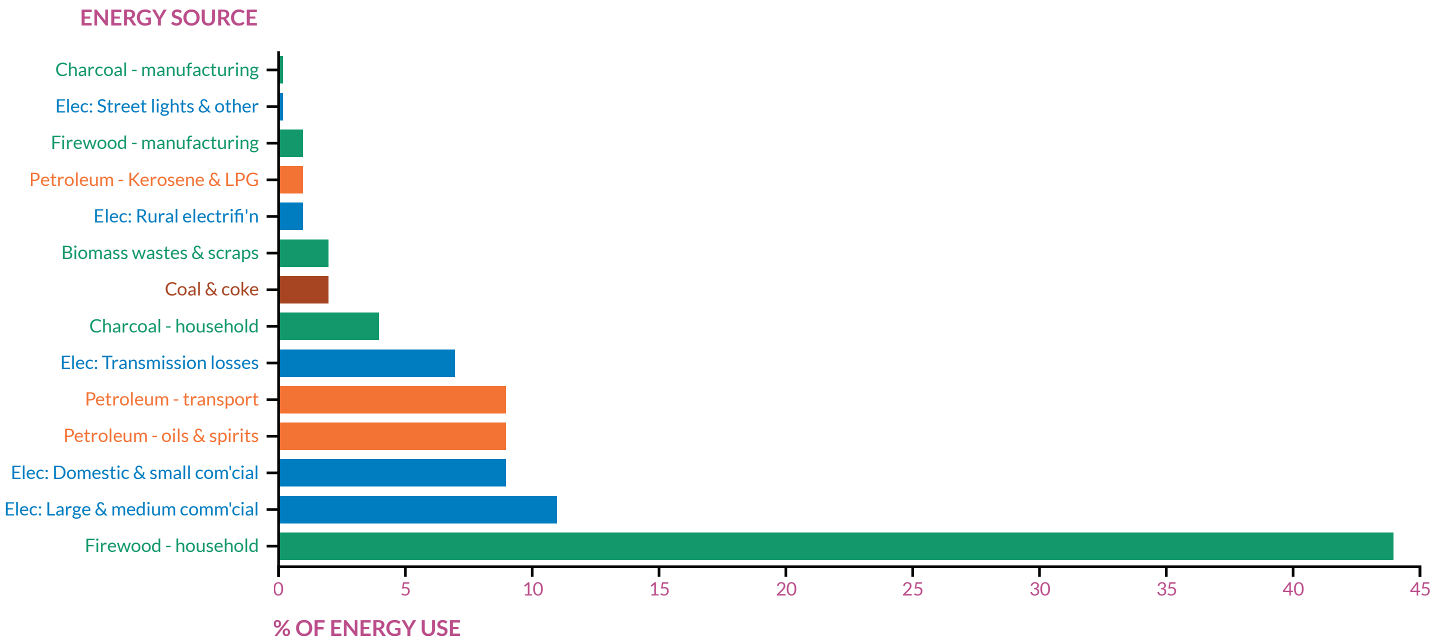


Figure 3: This graph shows how different types of energy were used in Kenya, & the huge role of firewood,in 2019. Source: KNBS Economic Survey 2020

Figure 3 shows that, looking across these categories, households burning firewood are the biggest energy users of all, consuming almost half of all energy used in Kenya. Large and medium commercial customers are the next largest energy users but consumed little more than 10% of the total.

They are followed by electricity use from domestic and small commercial customers, which are at a level similar to petroleum used for transport and various kinds of oil and spirits. Charcoal use by household follows next, which shows how little charcoal is used compared to firewood.

The most surprising energy 'use' is electricity transmission losses. These are quite high, bearing in mind that the cost of transmission losses is carried by customers, even though they are not responsible for the transmission infrastructure.

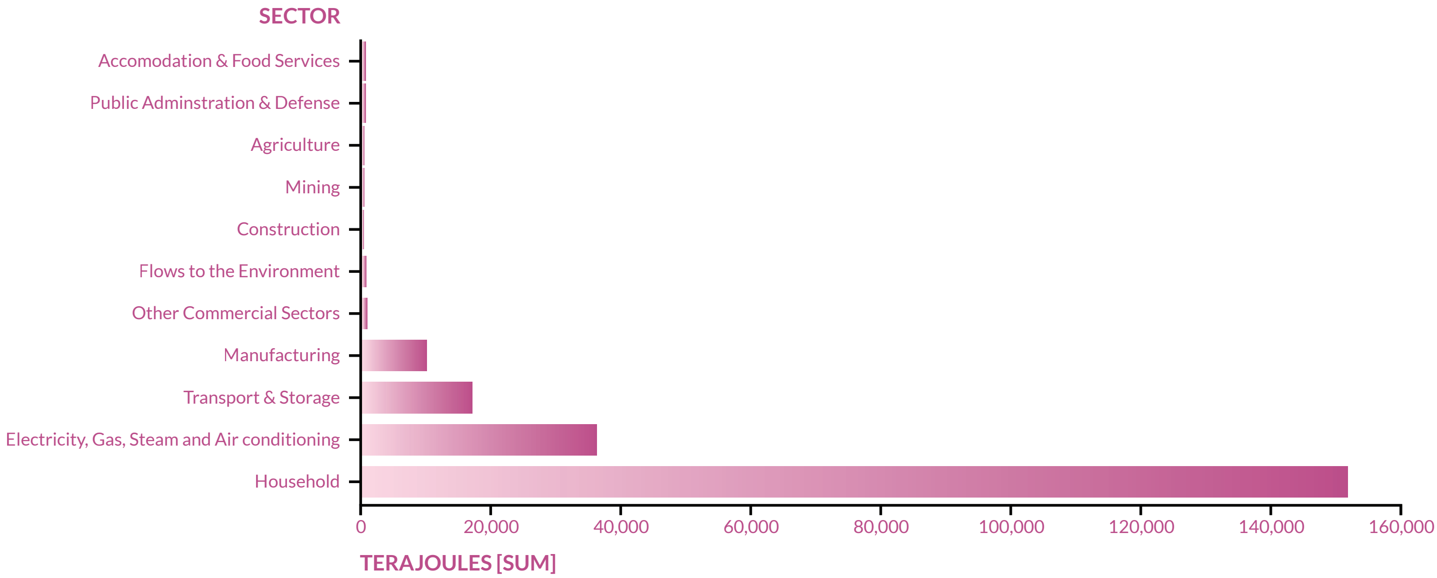


Figure 4: Energy use by economic sector, 2019. Households accounted for 70% of Kenya's energy use. Source: KNBS Economic Survey, 2020.

Figure 4 shows physical energy use by economic sectors in 2019. In this graph, household use is twice as large as all other energy uses combined (70% of total), followed by electricity, gas, steam and air, then transport and storage sectors.

Manufacturing also consumes considerable energy, while mining consumption is low because it is still a nascent industry in Kenya. Agriculture is also low because much of it is practiced traditionally in rural areas with little of the mechanization that would lead to the consumption of more energy.

Figure 4 illustrates that Kenya's economy is not very diversified, as the bulk of Kenya's energy use still comes from households. These are mostly in rural areas where the majority of Kenyans still live and rely on firewood for cooking.

BOX 1

WHERE IS THE ENERGY DATA?

TONY WATIMA

It has not always been easy to track down reliable and consistent data from Kenyan sources about energy use and supplies in Kenya. These few observations below reflect the experience of describing Kenya's energy system in numbers.

In the last ten years, going back to the 2010 census, the Kenya National Bureau of Statistics has greatly improved its capture of energy data at national and county levels, allowing for better policy making and analysis. A decade ago, the devolved system of government that brought in the counties was not in existence; now county data is being collected.

It is worth noting the heavy bias towards collecting electricity data at the expense of other energy sources, probably because it is easier to aggregate information from power producers and Kenya Power. However, despite the latest data showing a big transition by households towards more use of solar energy, there is notably little or no reliable data painting the picture of off-grid solar access across the country.

Another observation is that there is no explanation for why the data show biomass use shrinking by more than half between the years 2018 and 2019. Why did biomass use drop from 192,915.1 Terajoules in 2018 to 73,090.7 Terajoules in 2019? Neither the KNBS Economic Survey of 2019 nor the 2020 Survey addresses this occurrence. In fact, KNBS has only put up the highlights of the Economic Survey 2019 on its website. The whole report has not been uploaded. Some essays in this collection rely on 2018 data for biomass, others use 2019 data.

There is still considerable weakness around energy data for the counties. The Kenya Energy Act requires all counties to develop a three-year County Energy Plan, however, very few counties have these energy plans. Among those that have such plans, their plans are not accessible online.

The KNBS also releases Statistical Abstracts for individual counties which contain more detailed data including how many primary schools are connected to the grid, primary schools on solar, secondary schools connected to the grid and health facilities connected to the grid.

Unfortunately, the release of these county Statistical Abstracts has been slow. In 2020, the only county Statistical Abstract published by KNBS was for Laikipia County in 2020, whilst for the other counties the available Statistical Abstracts are for 2017. This lack of recent data may be the reason why counties have not been able to come up with County Energy plans.

Lastly, there are discrepancies on renewable energy data provided by KNBS and International Renewable Energy Agency. The differences do not change the broad outlines of Kenya's energy mix, but this is a discrepancy that merits an explanation.

ENERGY IN PEOPLE'S LIVES

INSIDE

The SID 2018 scenario booklet, Energy for Whom, has an important focus on issues of energy access and energy poverty. The Compendium shares that preoccupation which is why the Compendium looks here at the role of energy in people's lives.

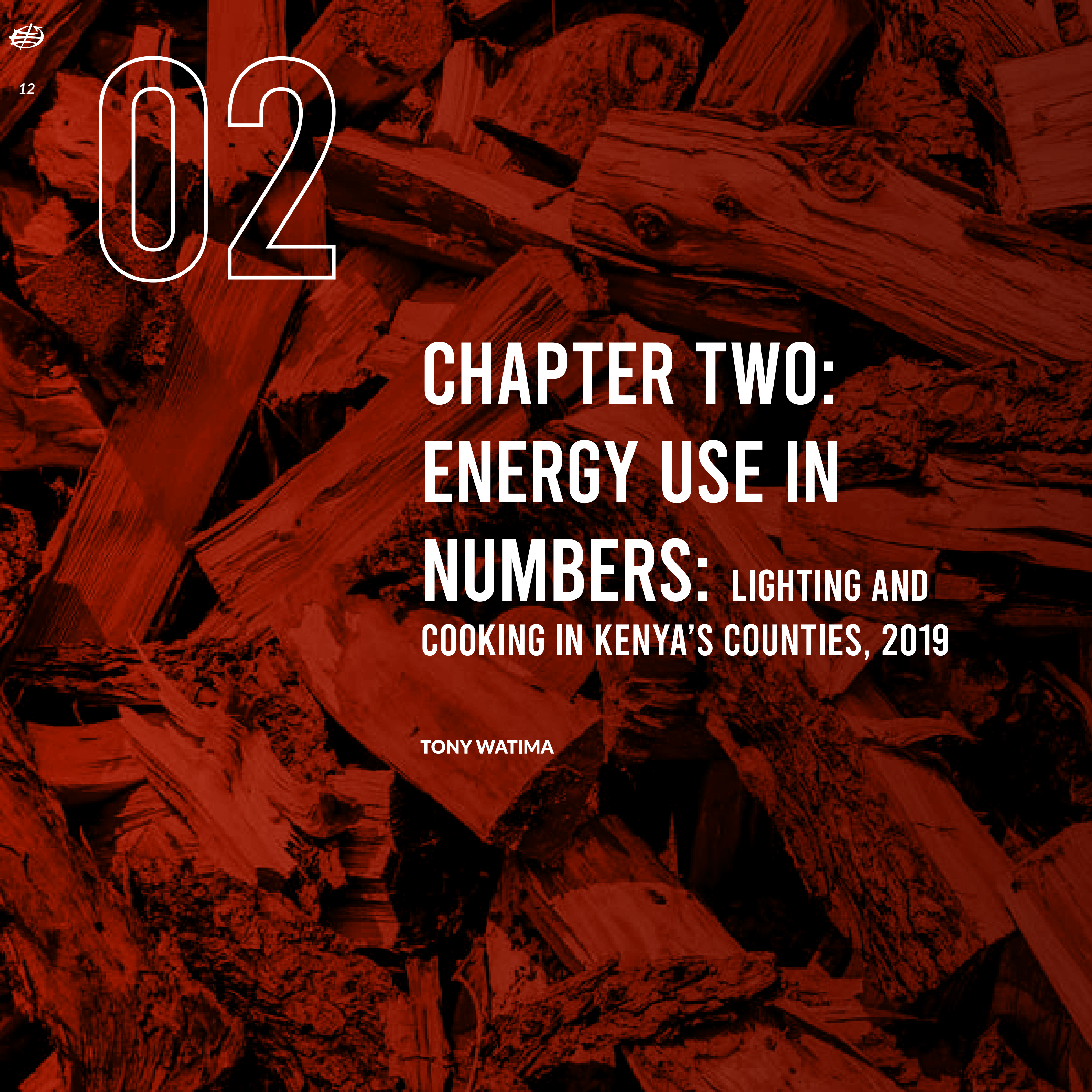
Tony Watima's statistical graphs on energy use for lighting and cooking in Kenya's counties (Figure 5, next page) shows the enormous disparities between different geographic areas of the county.

David Maina's article then explores what shapes energy choices in rural and urban households.

Passy Amayo's article reports on an SID workshop in the Nairobi neighbourhood of Kibra (Kibera), which sought to increase popular knowledge of energy issues in a poor section of town.

Samuel Oltetia has a different preoccupation: he describes what happens to people's lives and livelihoods when a new renewable energy project is built in their area of the country.

Finally, Sarah Odera and Professor Izael da Silva propose a different style of education for energy professionals that goes beyond engineering to consider the many social factors that are also important.



02

CHAPTER TWO: ENERGY USE IN NUMBERS: LIGHTING AND COOKING IN KENYA'S COUNTIES, 2019

TONY WATIMA

The following graphs use numbers from KNBS and show the different types of energy being used across Kenya's counties. for lighting and cooking. They are excellent illustrations of the variety of energy systems currently in use in the country.

Figure 5: Paraffin used for lighting, by counties in Kenya, 2019

Figure 5 above shows that counties in the western part of Kenya are largely the main consumers of paraffin use for lighting. Paraffin (kerosene) for lighting is used in three categories: the paraffin tin lamp is the type most used, followed by the paraffin lantern then the paraffin pressure lamp.

Eleven counties in the top 25 counties that use paraffin for lighting are from the western part of Kenya. Counties that come from the northern part of Kenya, which is arid, are the least likely to use paraffin for lighting, together with Nairobi County.

In northern Kenya, the lack of paraffin use may be due to poor distribution, while in Nairobi county, electricity has largely replaced paraffin for lighting, as shown in Figure 6.

The graph looks at households' use of electricity for lighting across counties. It shows that counties with high urbanization are the leading users of electricity for lighting, with counties with the least urbanization lagging behind. This can be a good indicator to gauge the rate of urbanization across counties.

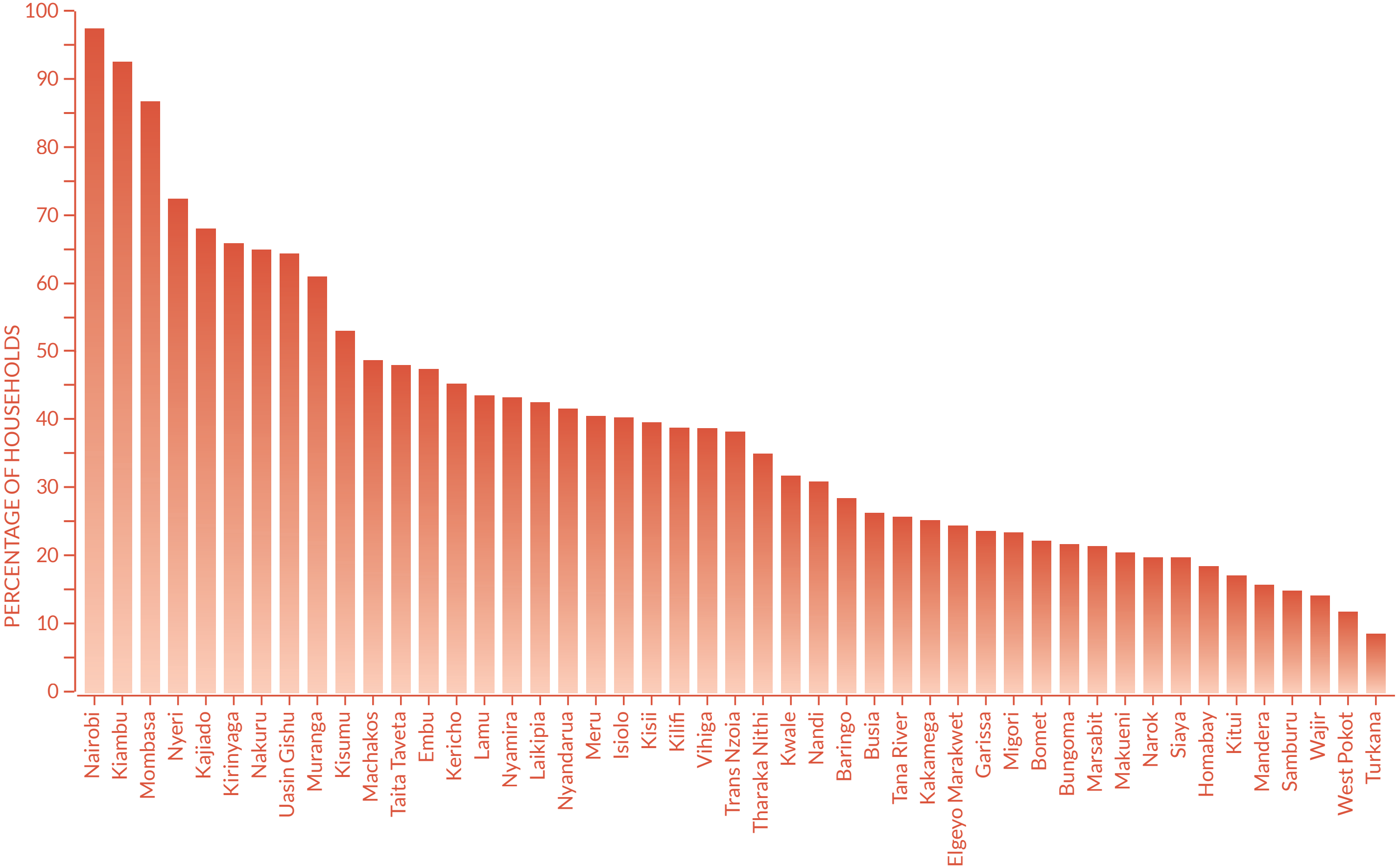


Figure 6: Use of electricity for lighting, 2019

Figure 7 looks at households' use of firewood for lighting across counties. It shows that counties in arid areas lead in the use of firewood for lighting. More than half of counties do not use firewood for lighting.

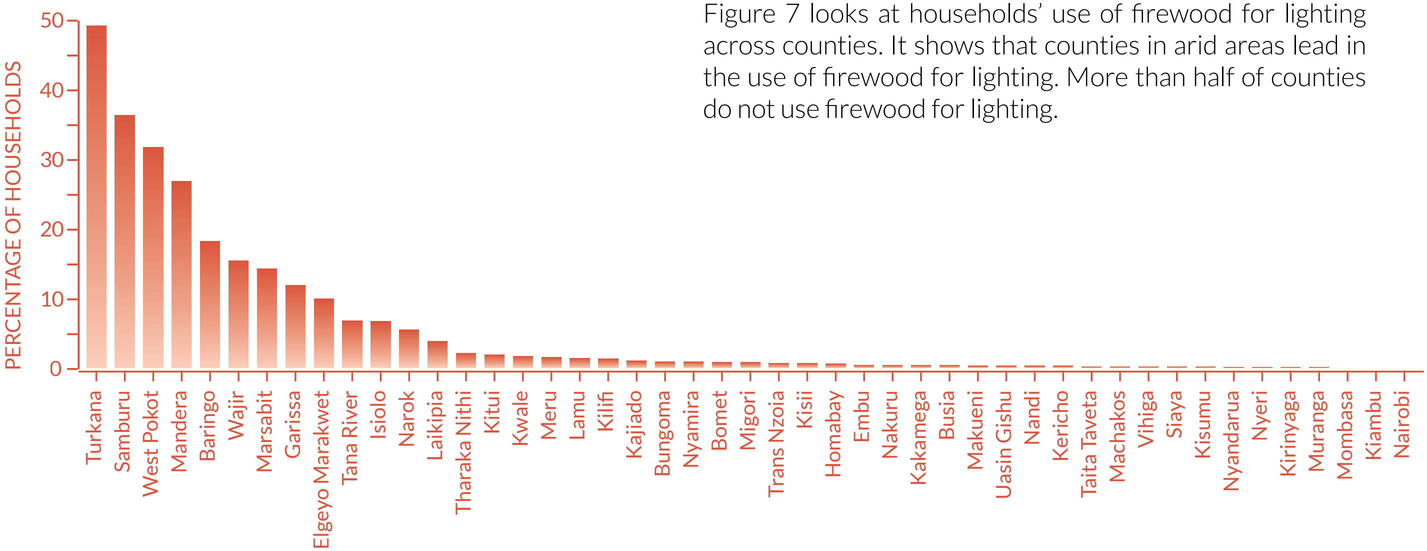


Figure 7: Firewood is still used for lighting in about a third of counties, 2019; elsewhere firewood for lighting is rare.

Figure 8 looks at households' use of solar as a source for lighting across counties. There is a proportionate use of solar across the counties, meaning solar penetration is spreading. The three urban counties–Nairobi, Kiambu and Mombasa – have the least solar use, largely due to good access to grid electricity.

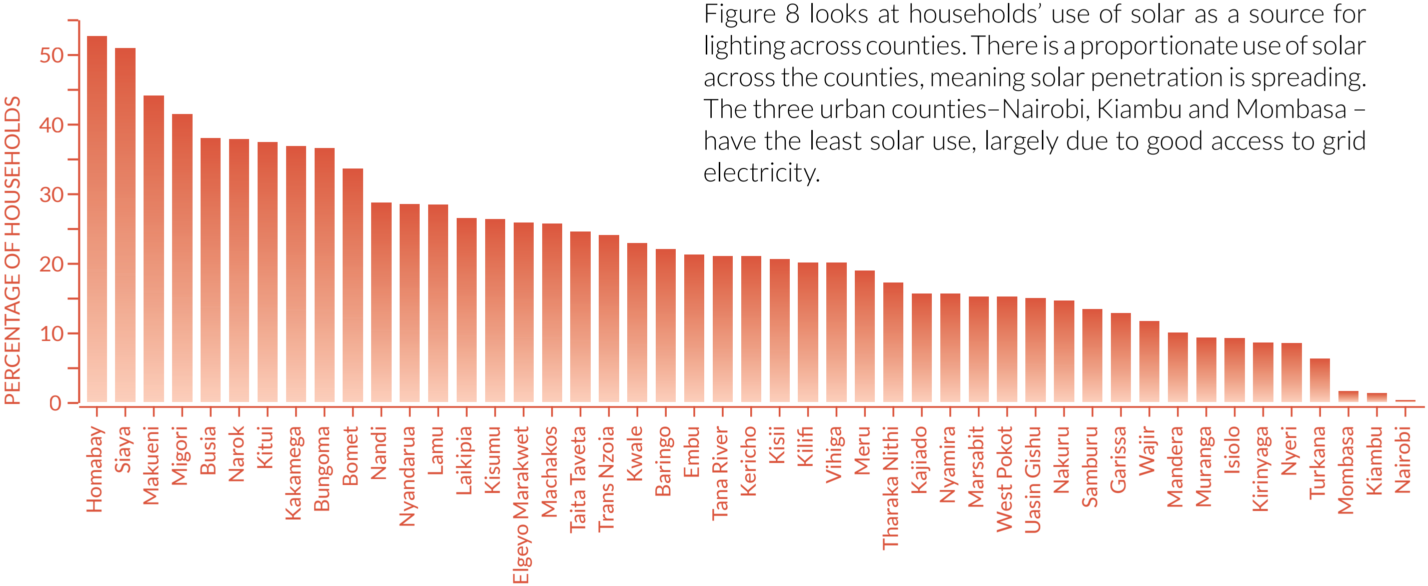


Figure 8: Solar power used in lighting in counties, 2019.

Figure 9 looks at households' use of paraffin, also known as kerosene, for cooking across counties. Counties with high urbanization lead in the use of paraffin for cooking. These are largely the urban poor households who use paraffin for cooking because it is the cheapest source available for them.

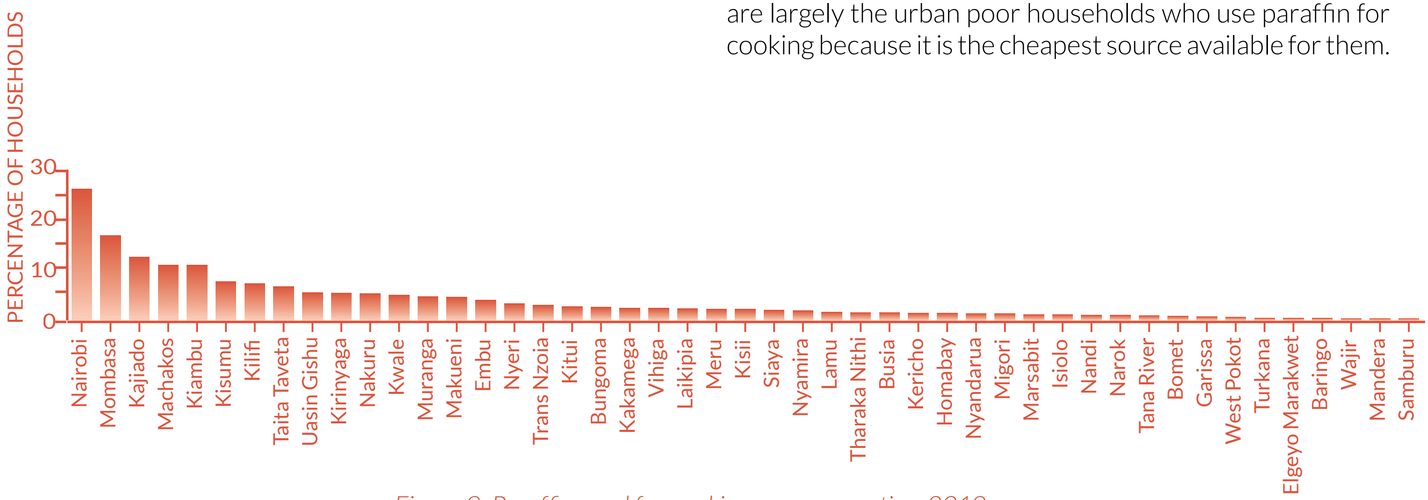


Figure 9: Paraffin used for cooking across counties, 2019.

Figure 10 looks at households' use of Liquefied Petroleum Gas (LPG) for cooking across counties. Counties with the highest use are those with high urban populations. More households are using LPG as it has become a more affordable clean source of energy, and it can now be bought in smaller canisters than previously.

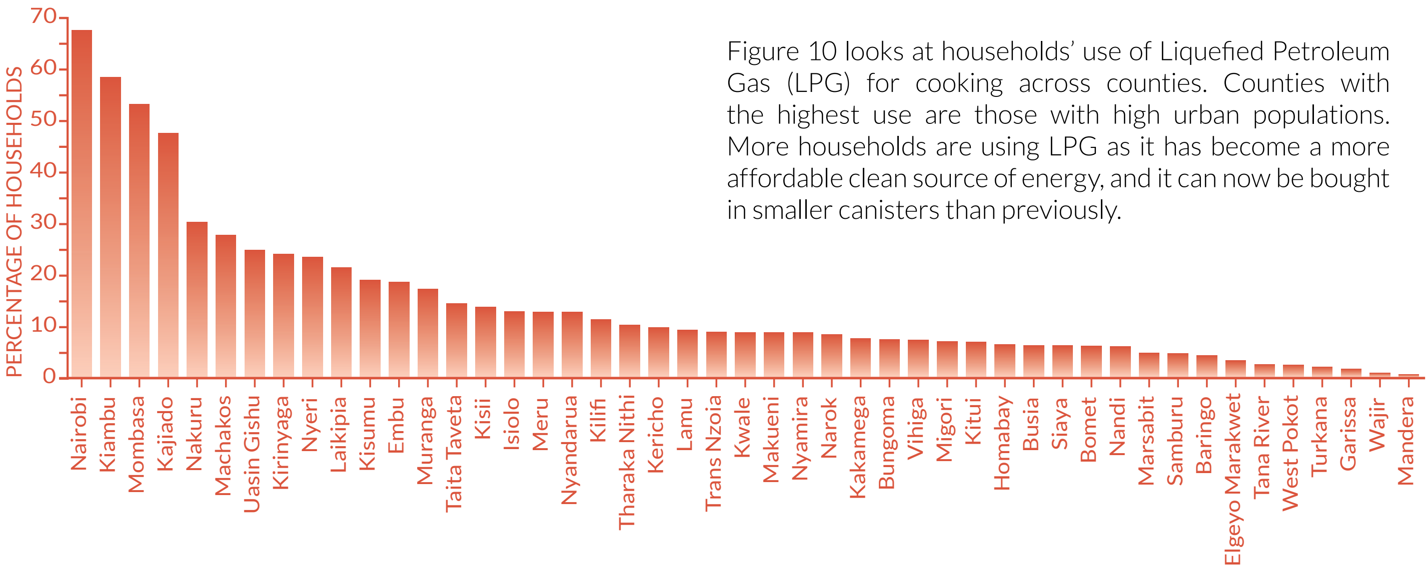


Figure 10: Use of LPG - Liquefied Petroleum Gas - in cooking, 2019.

Figure 11 looks at households' use of firewood for cooking across counties. Counties in arid and semi-arid areas lead in the use of firewood for cooking, though counties from the North Rift like Bomet and Nandi, which are agriculturally rich, also have heavy use of firewood. Counties with high urbanization are the ones that uses the firewood the least.

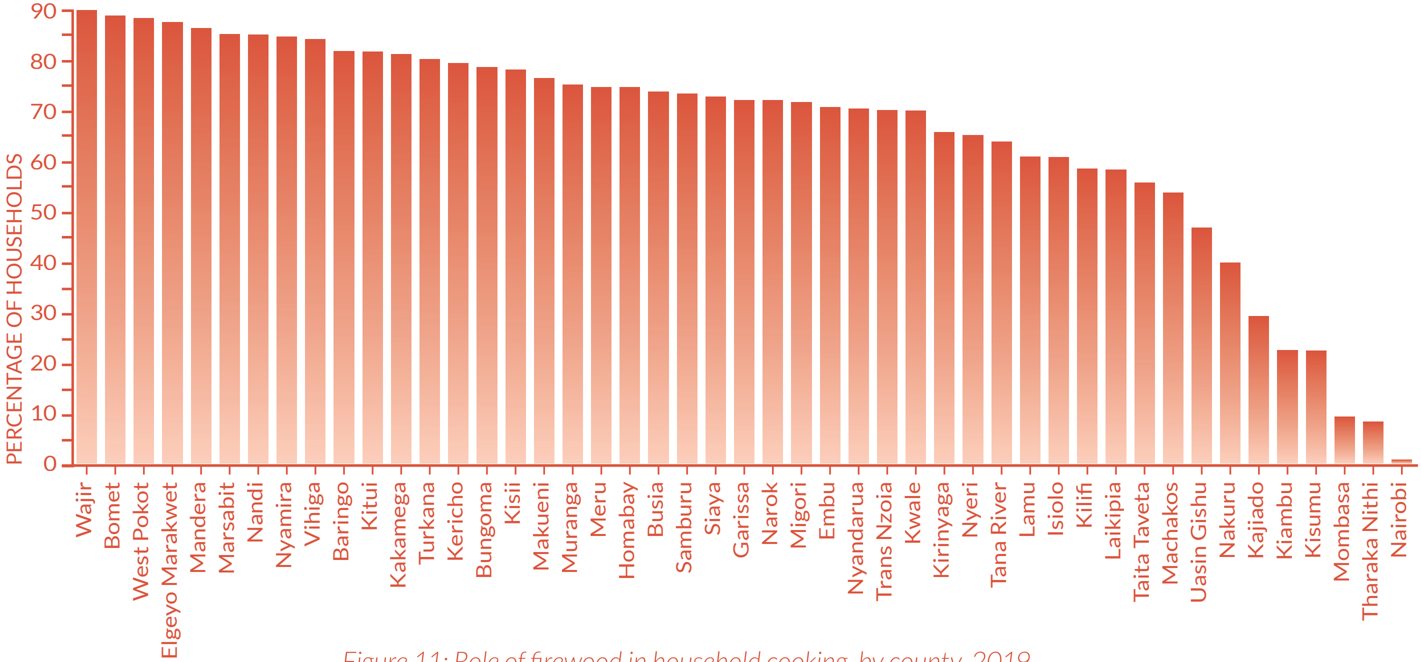


Figure 11: Role of firewood in household cooking, by county, 2019.

Figure 12 looks at households' use of charcoal for cooking across counties. Charcoal is used in all counties, urban and rural, with some rural counties (Like Tana River, Lamu and Isiolo) having the highest charcoal usage.

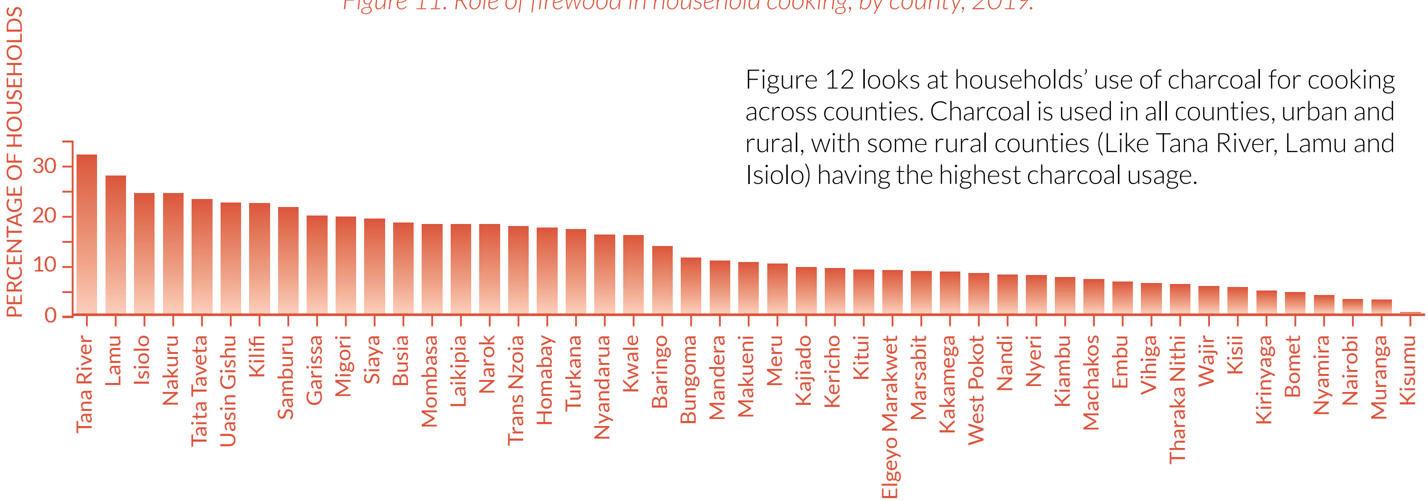
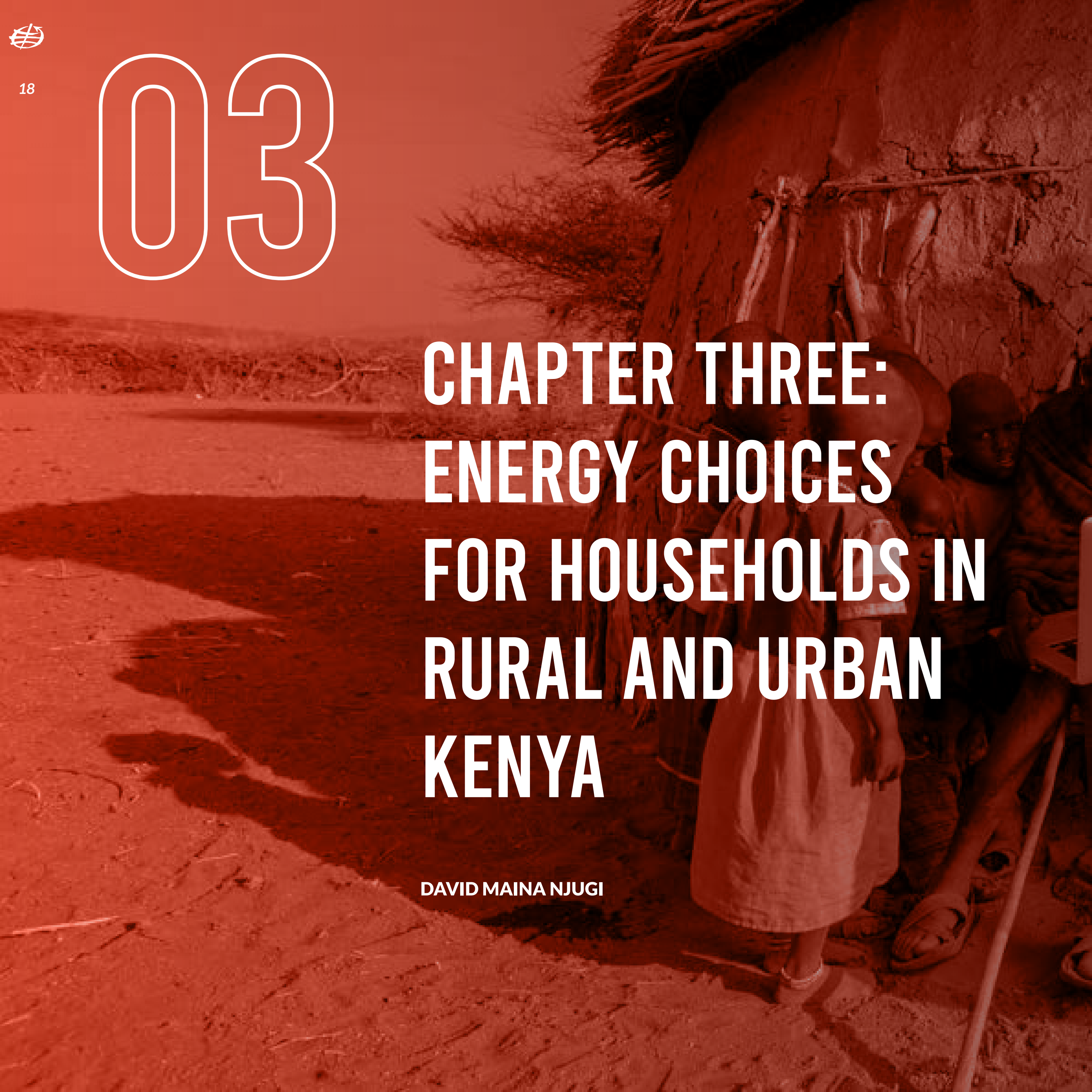


Figure 12: Role of charcoal in cooking, by county, 2019.



03

CHAPTER THREE: ENERGY CHOICES FOR HOUSEHOLDS IN RURAL AND URBAN KENYA

DAVID MAINA NJUGI

EXECUTIVE SUMMARY

Kenya has achieved a lot in its journey toward increasing electricity access to its population. A survey carried out by the World Bank found out that about 75% of the population of Kenya are close enough to connect to the electricity grid or to an off-grid system, as of early February 2020. This degree of access puts Kenya well on its way to achieving universal electricity access ahead of the Sustainable Energy for All (SEforALL) goal of universal access by 2030.

More ambitiously, the Kenya National Electrification Strategy (KNES) provides a road map to achieve this target by 2022 by including the role of mini-grids and off-grid solutions. Access, however, is not enough. The next challenge is to make electricity affordable and of good quality.

The government has also ramped up its support to the clean cooking sector to help it scale up, providing various incentives to the clean cooking sector. This paper answers a simple question: why do most households still use dirty and polluting stoves and fuels for their cooking, and how can they be assisted to easily transition to cleaner fuels?

INTRODUCTION

Millions of people in Kenya have no access to modern energy services. Without electricity or other modern energy, poor households struggle. Without light, children struggle to do their homework. Without clean energy, women cook with dirty fuels such as charcoal and firewood that affect their health and that of their children. Without reliable energy, households cannot create new economic activities that might improve the quality of their lives. This is why Kenya has set the goal of achieving Sustainable Development Goal 7 (SDG7), universal energy access, by 2030.

The technical solutions to the energy access challenge exist in the form of solar home systems, grid electricity, solar lanterns for electricity, and improved biomass stoves, biogas, ethanol, LPG and electricity for cooking. So where is the problem?

It is worth noting that clean cooking receives 1% of required funding globally from both private and public funding while off-grid electricity access receives 1.3% of required funding. By comparison, the investment going into large-scale renewable power projects is much greater and enjoys more consistent government support. Does this affect the choices facing Kenyan households? Of course it does.

KENYA HOUSEHOLD ENERGY FACTS AND ANALYSIS

Access to grid electricity

Kenya launched the Kenya National Electrification Strategy (KNES) in December 2018. This strategy provides a roadmap towards achieving universal electricity access by 2022 and has achieved impressive results.

According to the World Bank's Multi-Tier Framework (MTF)* energy access diagnostics report for Kenya, 75% of households had electricity access in 2018, meaning they were close enough to connect to a source of electrical power.

Some 53.5% had access through the national grid, while 21.5% use off-grid solutions. A project is well underway to provide electricity access to 14 underserved counties through grid, mini-grid and off-grid options. This is far ahead of the Sustainable Energy for All goal of universal access by 2030.

This strategy appreciates that access will be achieved through a myriad of means, including the national grid, mini-grids, and off-grid options.

Separately, the Kenya Integrated Household Survey by the KNBS (2015/2016), noted an impressive increase in households using solar energy. Only 1.6% were using solar power in 2005, but that rose to 14.1% by the time of the survey.

The report also indicated a significant decline in the number of households using paraffin for lighting, dropping from 76.4% to slightly more than a third over the same period. This shows a significant increase in households using cleaner fuels for lighting.

However, quality and reliability of the electricity supply remain major constraints, with more than half the grid-connected households experiencing more than three outages a week. To cope with this challenge, households use paraffin and wood for back-up lighting (23.7% and 4.3% of households respectively) as well as off-grid solar (KNBS 2019).

Overall, according to 2018 data from Kenya Power, main grid electricity only supplied 50% of lighting in Kenyan households, with wide variation between urban and rural homes. While 88 % of urban dwellers used mains electricity for lighting, only 26% of rural households did so.

The MTF (Multi-Tier Framework) for cooking is a multidimensional, tiered approach to measuring household access to cooking solutions across six technical and contextual attributes – convenience, affordability, safety, fuel availability, exposure, and efficiency – ranging from Tier 0 (no access) to Tier 5 (full access). A household is considered to have access to modern energy cooking services (MECS) when their cooking practices meet the MTF Tier 4 or above. A household whose cooking practices meet MTF Tier 2 or 3 is considered as being in transition with access to improved cooking services.

Conventional households		Type of lighting fuel (%)										
		Grid electricity	Paraffin pressure lamp	Paraffin lantern	Paraffin lamp	Gas lamp	Wood	Solar	Solar charged torch	Candle	Battery (car)	Generator (diesel/ petrol)
Kenya	12,043,016	50.4	0.3	6.6	9.6	0.2	2.8	19.3	5.2	1.3	0.4	0.1
Rural	7,379,282	26.3	0.4	9.4	13.9	0.2	4.3	29.9	8.1	1.0	0.6	0.1
Urban	4,663,734	88.4	0.2	2.2	2.8	0.1	0.3	2.4	0.7	1.8	0.1	0.0

Table 1: Percentage Distribution of Conventional Households by main type of lighting. Source KNBS 2019

Sustainable electricity

Importantly, by increasing the use of grid electricity, energy use becomes more sustainable. In 2018, 87.23% of the national grid's power was generated from renewable sources such as hydro, geothermal, wind and solar, as indicated in the chart below.**

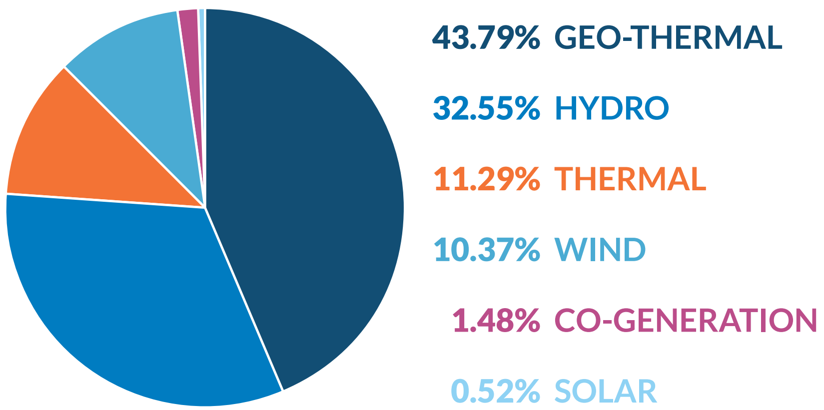


Figure 13: Renewable contributions to grid electricity in Kenya 2018/19

** *Kenya Power Annual Report, 2019*

Access to off-grid electricity

Where grid electricity is unavailable, households use off-grid solar devices and rechargeable batteries to bridge the gap. The main constraints they face are the capacity of the systems and the availability of solar power.

The importance of off-grid energy cannot be over-stated. Kenya has always been a global leader in the adoption of off-grid technologies. According to Lighting Africa*, nearly 10 million Kenyans are currently relying on off-grid solutions for lighting. This has been made possible by innovative and vibrant private sector players that offer these products and services.

The roll out of innovative payment models like pay-as-you-go and efficient supply channels for cash sales have driven the success. These solutions are mostly used in rural areas and mostly serve poor households.

Government could encourage more off-grid solutions but the recent reintroduction of VAT on solar products increases their cost and will greatly reduce the growth, investment and adoption of the off-grid solutions.

Consumers of off-grid solutions also face challenges around the high cost of initial investment and maintenance, as well as the limited capacity of power provided and the low quality of light. Once again, households are forced to use paraffin as backup lighting, further increasing the cost of household energy for lighting.

* *Lighting Africa is part of the World Bank Group's contribution to Sustainable Energy for All (SEforALL). It is implemented in partnership with the Energy Sector Management Assistance Program (ESMAP). https://www.lightingafrica.org/about*

Access to clean cooking globally and in Africa

When Kenya's access to clean energy is compared to others in the world, the record is poor. Worldwide, four billion people still lack access to clean, efficient, convenient, safe, reliable, and affordable cooking energy, according to a recent report (World Bank 2020).

The report, produced by the World Bank's Energy Sector Management Assistance Program (ESMAP), in collaboration with Loughborough University and the Clean Cooking Alliance, shows that 1.25 billion people globally are considered in transition with access to improved cooking services.

It also suggests that approximately 2.8 billion people globally still cook with traditional polluting fuels and technologies which have severe impacts on health, gender inequality, economic, environmental, and climate outcomes.

As shown in Figure 14, Kenyan households have better access to modern energy for cooking than Sub-Saharan Africa as a whole, but are behind other parts of the world.

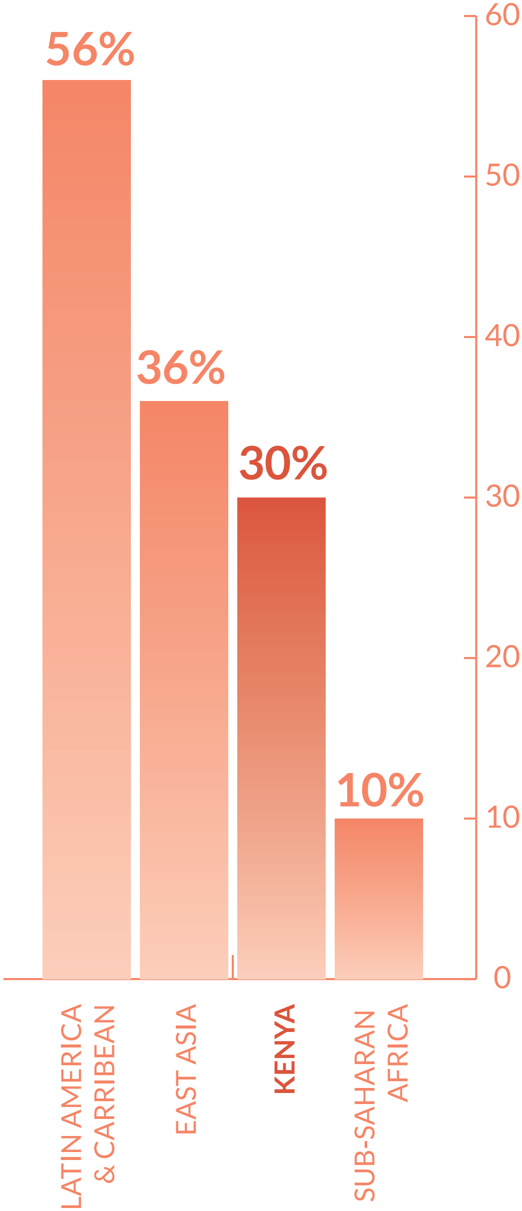


*Figure 14: Kenyans access to clean cooking, compared globally. Source: World Bank 2020. The State of Access to Modern Energy Cooking Services (ESMAP, WB, MECS**)*

** *MECS stands for Modern Energy Cooking Services*

Status of clean cooking in Kenya

Conventional households		Percentage distribution of conventional households by main type of cooking fuel						
		Electricity	Paraffin	Gas (LPG)	Biogas	Firewood	Charcoal	Solar
Kenya	12,043,016	0.9	7.8	23.9	0.5	55.1	11.6	0.2
Rural	7,379,282	0.4	1.6	5.6	0.3	84.1	7.7	0.2
Urban	4,663,734	1.7	17.7	52.9	0.7	9.2	17.7	0.0

Table 2: Percentage distribution of conventional hosuehelds by main type of cooking fuel. Source: KNBS 2019 KPHC*

Cooking fuels

A recent study carried out by the Ministry of Energy and the Clean Cooking Association of Kenya found out that 59% of households in Kenya still use the Three Stone Open Fire (TSOF) traditional method of cooking using firewood. The report found out that 64.7% of households in Kenya still use wood as their primary cooking fuel, followed by LPG at 19% and charcoal at 10%.

Following various policy interventions to reduce the cost of LPG, the number of households using LPG has increased about six times from 0.6 million to 3.7 million.

This data is corroborated by the 2019 Kenya Housing and Population Census report. This found that firewood is still the most commonly used cooking fuel, as reported by 55.1 % of households, followed by Liquefied Petroleum Gas (LPG) at 23.9% (See Table 2 above).

The 2019 Kenya Household Cooking Sector Study puts the number of households using firewood at 53 % while those using LPG is at 30 %, with 19% reporting using LPG as their primary fuel for cooking and charcoal at 10.3%.

The study also found out that 14% of households still use kerosene for cooking, used by 27.7% and 3.2 % of urban and rural populations, respectively. Only 3% of households own an electric cooking appliance such as an integrated LPG and electric cooker, electric coil or microwave.

According to the 2019 census report by the KNBS, biogas for cooking is used by 0.5 % of the population. The cooking sector study by the Ministry of Energy noted that only 17,900 biogas systems had been installed in Kenya by 2018.

* *Kenya National Bureau of Statistics, KNBS*

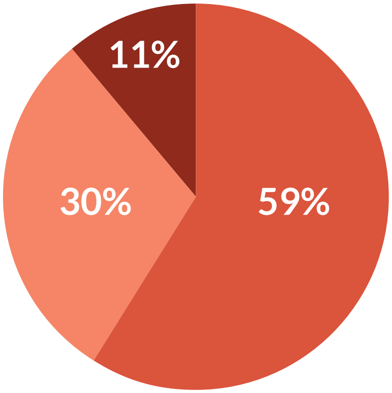
Cooking stoves

The question then becomes, why are Kenya households choosing to use dirty cooking fuels and stoves, as shown in Figure 15?

Figure 15 shows that more than two-thirds of Kenyan households still rely on traditional biomass stoves for their cooking needs. Of these, 59.8% use the three stone open fire (TSOF) stove, and the rest use traditional charcoal stoves.

Overall, 30% of households use clean cooking solutions, many in urban areas where 41.6% use LPG or electric stoves for cooking. Kerosene is still used for cooking by 27.7% of urban households in Kenya, with improved charcoal and wood stoves used by 11% of all households. Traditional biomass stoves are more common in rural areas with clean fuel stove users mainly in urban areas.

Photo by affini4 from shutterstock.com



TRADITIONAL COOKING SOLUTIONS
TSOF (Three Stone Open Fire), Metallic Charcoal Stoves and Kerosene Wick Stoves

CLEAN COOKING SOLUTIONS
LPG, Biogas, Biofuels and Electricity

IMPROVED (BIOMASS) COOKING SOLUTIONS
Improved Charcoal & Wood stoves

*Figure 15: Percent of households using different cooking solutions. Source: 2019 Kenya Household Cooking Sector Study***

** *A national study carried out by the Ministry of Energy and the Clean Cooking Association of Kenya.*

Household energy costs

The choice of cooking or lighting fuels and technologies among Kenyan households is a composite of various factors. One of the most important factors is the high cost of technologies and fuels.

Cost of electricity

While the aggressive grid expansion to cover off-grid areas through the rural electrification programme rolled out by the government has seen electricity access increase significantly over the years, consumption or productive use of this energy has been hampered by rising costs of electricity.

The unit charge, or what is commonly called the energy charge, increased by 23.9% from 12.75 to 15.8 KSh/kWh in the last tariff review in 2018. This does not factor in the connection fees that vary depending on how far a household is from the main grid. It can range from KES 35,000 where a new transformer is not needed, to more than KES 1,000,000 where one is needed, as shown in Table 3. In addition, according to the 2018 tariffs gazetted by the Energy and Petroleum Regulatory Authority (EPRA), households with consumption between 0 and 10 units (kWh) fall under a lifeline tariff band paying KES 2.50 per unit and are exempt from paying fixed charges of KES 150. It is estimated by the authority that 3.5 million customers are eligible for this more affordable price.

The energy costs of isolated mini grids is 70-83 KES/kWh according to a study carried out by the World Bank. This cost is higher than the grid and does not encourage productive use of energy and further limits its adoption.

A 2019 study carried out by GOGLA and HYSTRA analysed the cost of off-grid solar systems and found out that quality solar lanterns range in cost from KES 700-1,350, and that of quality solar home systems based on a pay-as-you-go model at KES 56,000-95,000. This is far too expensive for most Kenyans. For those earning a salary in 2020, the average wage was about 34,000 KES/month[*], but many earn much less than that.

According to Dalberg–GLPGP (2013), lower-income households have an income of less than KES 10,000/month; middle-income households, between KES 10,000 and 40,000; upper-income households, more than KES 40,000/month. The high costs of quality solar have also created a market for non-quality solar systems. Where these dominate the market they affect consumer confidence, leading to lower adoption and stunted growth for the sector.

From the above cost analysis, and considering the income levels of most households[**], it can be concluded that the cost of electricity sources for Kenyan households is very high. This definitely affects the accessibility of the service to most households, and slows progress towards the government's goal of universal access by 2022.

* *See Salary Explorer for Kenyan wages in 2020: https://www.salaryexplorer.com/salary-survey.php?loc=111&loctype=1 . Accessed 29 December 2020*

** *According to Dalberg–GLPGP (2013), lower-income households have an income of less than KSh 10,000/month; middle-income households, between KSh 10,000 and 40,000; upper-income households, more than KSh 40,000/month. US$1≈KSh 100.*

Evolution of Tariffs, Isolated and Connected Mini grids (2015)		
Source of electricity	***Cost/kWh, in KES***	***Notes***
Isolated mini grids	KES/kWh 70-83	cost reflective
Connected mini grids	KES/kWh 21	same as national tariff
National grid	KES/KWh 15.8	Plus connection fees, price dependent on distance from grid KES 35,000 to 1,000,000

Table 3: Evolution of Tariffs, Isolated and Connected Mini grids, 2015; Source: World Bank, ESMAP. 2017 Mini grids in Kenya: A case study of a market at a turning point.

Cost of clean cooking stoves and fuels

As indicated above, the adoption of clean cooking technologies in Kenya is low at around 35%, including those using improved cook stoves. The cost of these products has been cited as one of the major barriers to adoption and is clearly illustrated in below.The cleanest cooking fuels and stoves currently are LPG and bio-ethanol. However, as shown in Table 4, the cost of these is higher than the dirty stoves and fuels. Most households are unable to afford the upfront cost of cleaner cooking technologies. This is made worse by the poor availability of these technologies.

For example, LPG users face the expense of transportation to have their cylinders refilled. Ethanol technologies are still not easily available to most consumers. Most bio-ethanol is imported and not always available in the market as there is currently no bulk storage facilities in the country.

Higher tier improved biomass stove manufacturers lack an effective distribution network that would ensure availability of these stoves to a lot more consumers.

The main reason for this is lack of investment in distribution businesses, as the sector is heavily underfunded and most financiers shy away from the sector. Lower-tier biomass stove production is dominated by small and medium-sized enterprises that face similar challenges in finding the investment needed to expand their businesses.

Firewood is largely free for most rural households, and charcoal has an elaborate distribution network and channels that make it readily available for most households. Charcoal is also available in smaller quantities that are more affordable than buying charcoal in bulk, as is the case for kerosene.

However, when compared to LPG, charcoal is still cheaper, as shown in the article above on energy costs in this Compendium.

Cost of Stoves and Fuels*		
Stove/fuel	***Cost in KES***	***Explanation***
Cost of Stoves		
Biogas system solutions	35,000 – 90,000	Cost depending on size and type
LPG multiple burner	12,000	
Electric pressure cooker	8,500	
LPG cylinder and gas	1,800 (3kg), 3,500 (6kg), 8,500 (13kgs)	Bought prefilled with LPG
Improved biomass cook stoves	3,500-5,000	Higher tier biomass stoves
Ethanol gel stove	2,300	One burner
Kenya ceramic jiko	700-2,500	Lower tier biomass stoves
Kerosene wick stove	400	
Cost of Fuels		
LPG	500 (3kg) 900 (6kg), 2000 (13kg)	
Kerosene	79-94	November/December prices
Charcoal per kg	80	
Bio-ethanol fuel	70/litre	
Briquettes per kg	50	
Ethanol stove	45	Two burner
Firewood	Free if collected	

Table 4: CCAK analysis of stoves and fuel costs in 2020

* *Clean cooking solutions include electricity, LPG, biogas and biofuels. Improved biomass cooking solutions include improved charcoal and wood stoves and the traditional dirty solutions include the Three Stone Open Fire (TSOF), metallic charcoal stoves and kerosene stoves.*

CONCLUSION

Kenya has made great strides towards universal access to electricity through various programmes such as the rural electrification programme, the Kenya Off-grid Solar Access Project (KOSAP) in 14 underserved counties.

However, there is still a lot more than needs to be done to achieve 100% electrification. There is a need to improve on the affordability, reliability and quality of power to households that are grid-connected. Service interruptions, power outages, high cost and voltage fluctuations are all key concerns that households face with grid power. Given these problems, households are forced to use dirty fuels such as paraffin or candles as backup lighting. Some people do not have any backup and stay in the dark until service resumes.

There is also a need to increase support for off-grid power systems suitable for remote rural areas. Support for the innovative businesses that are trying to meet this need would be valuable and could include training of staff in construction and maintenance, low cost loans, etc. In the absence of such support, energy users are forced to continue to rely on dirty energy.

Sustained efforts to transform the cooking sector from one that is highly dependent on traditional cooking solutions to one where most households have access to clean solutions has yielded mixed results. While the use of firewood and charcoal remains prevalent, the uptake of LPG has gone up mainly because of policy interventions, though more is needed to drive down the cost. Recent innovations being piloted such as the pay-as-you-go model for LPG could go a long way in increasing uptake.

Various studies have shown that access to cleaner technologies does not mean displacement of traditional forms of cooking, as households that use cleaner solutions often supplement their cooking with traditional sources. Therefore, emphasis should be placed not only on access but also in promoting use; incentives should be multi-pronged in nature. Although cost is the most important determinant of access and use, other critical factors such as ease of use, availability of fuels, distances to fuel sources, last mile distribution options, availability of long-term payment plans, nature and structure of cooking area, types of food, and number of households members all contribute to the hyper complex matrix of choice.

Overall, there is a need to look at the cooking sector market from the perspective of the users and what they require: lower prices, more reliability and easier access. A transformative programme with their needs in mind would help to build an energy sector that is cleaner, more sustainable and more profitable for investors.

POLICY RECOMMENDATIONS TO IMPROVE ENERGY ACCESS

Recommendations for electricity access

- Increase electricity access to those without electricity through:
  * *Extending low voltage lines of households near the grid*
  * *Offering payment plans to households not able to pay the connection fees*
  * *Promotion of off-grid solutions to households far from the grid*.
- Improve reliability of electricity for grid-connected households by building capacity and skills in building and maintaining grid and off-grid electricity systems. There is need for a comprehensive capacity and skills building programme for electricians and technicians to improve the quality of internal wiring and maintenance of grid infrastructure. Properly trained solar technicians and installers are critical in expanding and maintaining mini-grids and off-grid solutions.
- Improve access for off-grid households. Most households using off-grid solutions face capacity and availability challenges in the systems. Addressing these challenges would improve the experience of off-grid consumers as they will be able to power more appliances and even upgrade their systems to larger ones. Availability of affordable, quality solar systems and appliances, coupled with innovative financing solutions, would help address these challenges.
- Create awareness of alternative energy solutions. Many households are not aware of the benefits of electricity access and quality of off-grid solar products. Some households are not even aware of grid connection processes and the availability of new technologies. A sustained awareness campaign should be implemented to address these gaps.
- Monitor progress. The government should continuously monitor the progress and impacts of electricity access and measures already introduced such as reduced connection fees and a last mile connectivity programme.

Policy recommendations for access to clean cooking

- Help people make the transition from kerosene and traditional stoves to cleaner solutions such as LPG and bio-ethanol by providing innovative financing options and increasing public awareness about clean fuel stoves.
- Expand electricity access through mini-grids and other means in order to increase the uptake of electric cooking and the use of clean fuel stoves.
- Support businesses offering clean cooking solutions by providing access to finance for investment and business improvement, especially on distribution channels that allow their products to reach more people.
- Providing incentives to attract more investments in clean cooking businesses is key to achieving the goal of universal access.

Photo by Sopotnicki from shutterstock.com

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04

CHAPTER FOUR: POPULAR ENERGY KNOWLEDGE IN A POOR NAIROBI NEIGHBOURHOOD:

REPORT FROM KIBERA* JULY 2019

PASSY AMAYO OGOLLA

* *Kibera had recently been renamed as 'Kibra'. In this essay, the area is called Kibera, but both names are commonly used*

EXECUTIVE SUMMARY

In July 2019, the SID Energy Project Team, in collaboration with the Heinrich Boll Foundation, embarked on planning and implementing a two-day energy tour and discussion in Kibera, a poor Nairobi neighbourhood. The team was hosted by Slum Soka, a youth-started community-based organisation dedicated to empowering children in Kibera through sports.

On the first day, Slum Soka led the team on an energy tour of Kibera, then organised an energy dialogue for the second day. This dialogue was held with 50 Kibera residents, including women, men and youth. They met on the Slum Soka's football pitch where the youngest children could safely play while the adults talked.

KEY MESSAGES OF THE KIBRA ENERGY FORUM

During this Community Energy Forum in Kibera, two key messages stood out. First, although a majority of Kibera's residents live on under a dollar per day, about 70% of their weekly income goes into energy-related expenses, mainly cooking, lighting, heating and entertainment. Second, there is a rich diversity of knowledge, perspectives and ideas to be drawn from residents' experience and daily interaction with energy issues.

Despite this reality, too often civil society organisations working on the energy/climate nexus limit their research and advocacy to high-level engagements in fancy boardrooms where ordinary citizens have limited access. These citizens have little say on how to meet the challenges they face and rarely participate in finding workable responses to those challenges.

Instead, fears around security in Kibera and similar settlements mean that those most affected by energy poverty are left out of efforts to tackle their energy issues, ignoring the useful knowledge that exists in Kenya's informal settlements. As a result, we continue to see a mismatch between energy policies and peoples' needs*.

* *SID, 2018. 'Lessons Learnt' in Energy for Whom? Scenarios for Eastern Africa. Nairobi: Society for International Development, pp 4-5.*

MAKING ENERGY CHOICES IN KIBERA

To stimulate conversation, the SID Energy Team developed forms where participants were given 10 groundnuts (peanuts) representing a week's income. They were then asked to allocate their groundnuts to the energy they bought (See Form 1 on page 40.) This showed that about 70% of what people earned was spent on energy.

The discussion around this exercise demonstrated that Kibera residents were fully aware of the energy challenges they experienced. They spoke about the high costs of clean and safe energy choices and the hazards of affordable energy alternatives that affected their health and security. They had many ideas for addressing these challenges, and wanted to be represented at the decision-making tables.

"If we want our energy stories to be listened to, someone like the Member of Parliament must hear, so that he can take it to Parliament. It is in Parliament that they discuss and plan to implement issues taking into consideration the citizens needs and cries. We know some senior citizens here in Kibera who are always in Parliament. It is therefore up to us to come together with them to take our energy issues to Parliament so that they can see how to help us."

-Kibera Resident

Above: Energy-efficient jua-kali stove using waste woodchips to cook crisps sold by street vendors.

While dialogue with authorities was seen as important, there was also a fear that nothing would be done. Even if the authorities were successful and received funding for a local project, the resources more often than not benefitted only a few individuals.

There was also an unwillingness to engage directly with the national government as residents strongly believed the government was not interested in their well-being. One cannot dialogue, reason or collaborate with someone not seen as trustworthy or willing to implement change.

Furthermore, there was a belief that powerful cartels were working against clean and affordable forms of energy which might ruin their businesses, especially charcoal trading and illegal power connections.

The residents of Kibera believe that they have the power and willingness to transition into more sustainable forms of energy, but simply cannot afford them. Among the 50 participants, most were engaged in informal jobs that paid only daily or weekly wages. With low incomes and high rates of unemployment, solar panels and solar, LPG or energy-saving cookers were simply a dream too far.

Above: Women, men & youth participated in the Energy Dialogue on Day 2, held at the Slum Soka football pitch.

> *"People who are not sitting in offices are oppressed. We don't get to decide, the cartels decide. Take for example the disappearance of the Jiko Safi (Clean charcoal stoves), that has been done by the cartels."*
>
> -Kibera Resident

Above: Discussions at Slum Soka football pitch, Kibera

> *"During elections, our leaders are quick in throwing money our way for votes. But when it comes to our needs or challenges, we never see their hand of help. It's time for us to work on the change we want to see for ourselves."*
>
> -Kibera Resident

ENERGY NEEDS IN KIBERA

Residents of Kibera want and need three things:

1. **Access to clean energy**
2. **Affordable energy alternatives**
3. **More awareness of energy issues in the neighbourhood.**

Access to clean and reliable sources of energy

People cited health and respiratory illnesses as a major concern given their constant use of charcoal, firewood and sawdust as the cheapest, and most readily available cooking fuels. Given the crowded nature of the informal settlement, the majority of the residents are forced to prepare their meals indoors.

This increases the risks of respiratory problems and suffocation, as insufficient ventilation means indoor smoke cannot be vented efficiently.

Above: Charcoal was a widely used, affordable fuel, readily available in 2019.

Affordable energy alternatives are absent

People have opted to use cheaper, but unhealthy, energy because they don't have any alternatives. Cleaner electricity should be available because Kibera is well-connected through both legal and illegal power connections. The monthly power bill in 2019 was an affordable flat rate of 200 Kenya shillings, paid in cash and collected on foot by people identified by one resident as working for local power 'cartels.'

However, the power supply was extremely unreliable and dangerous. There were reported cases of electronic and electrical appliances blowing up due to power surges from the power source. People have also been electrocuted to death when they came in contact with unprotected live wires. Unreliable and dangerous power often outweighed the benefit of clean energy and a flat affordable rate.

Above: Electric wires, often illegal, are strung casually across the lanes of Kibera.

More awareness and capacity building in informal settlements

The conversations during the Kibera Energy Forum made participants aware of the need to share a better understanding of energy issues in their lives.

"Our number today is not so big, but what we have learnt today has definitely changed our lives. We have learned about energy and the challenges associated with some forms of electricity. Many of us have not gone to school, therefore this initiative has greatly taught us the benefits and risks associated with our energy choices now and in the future. However, informal settlements such as ours continue to be neglected by most if not all sectors. We are really grateful to your NGO and we hope this will continue into the future. Even the Bible says we perish for lack of knowledge. Don't forget to come back to give us more knowledge!"

-Kibera Resident

"We have been talking about people from Kenya Power too much, yet we as power consumers also have to look at ourselves. The Chinese people have brought to us 'fake' electronic appliances. This is why the power remains unreliable.

Many times, we have seen accidents that have taken place because the fake electronic appliances we have bought have exploded and burned down some of our homes. Kenya Power thus keeps the power off to keep us from killing ourselves. You would rather spend your money to buy something original, than spend little money buying something that might be life threatening. You would rather disconnect the power connection than burn your house down."

-Kibera Resident

Above: the Kibera Energy Forum team: SID, HBF & Slum Soka.

CONCLUSION

The Kibera Energy Forum in 2019 showed that we need to broaden the important discourse about sustainable energy choices and the future, moving beyond classrooms and boardrooms to include those most affected by energy poverty. For a truly wholesome transformation of our societies, we must engage the whole system, including those who have authority, resources, expertise, information and need.*

Instead, we often leave out citizens and businesses at the grassroots level, and ignore people living in informal settlements, even though they suffer the most from the impact of poverty and climate change in all their forms.

The format of the Kibera Energy Forum created a platform for residents to express themselves, their challenges, perspectives and ideas in their own languages. Kibera residents realised that they have a role to play in shaping a better energy future for themselves.

For us in the SID Energy Team, we witnessed the value of raising awareness and drawing on the popular knowledge of grassroots energy issues. We saw the value in spurring community level interest and action to address local struggles**.

It is time to break through the limitations of classrooms and boardrooms, so that we don't leave anyone behind. Only then will be able to achieve a truly sustainable energy future for current and future generations.

Above: Children playing on open ground next to the Kibera settlement.

* *Marvin Weisbord and Sandra Janoff (2007) Don't Just Do Something, Stand There!: Ten Principles for Leading Meetings That Matter. Oakland: Berrett-Koehler Publishers, INC, pp 28.*

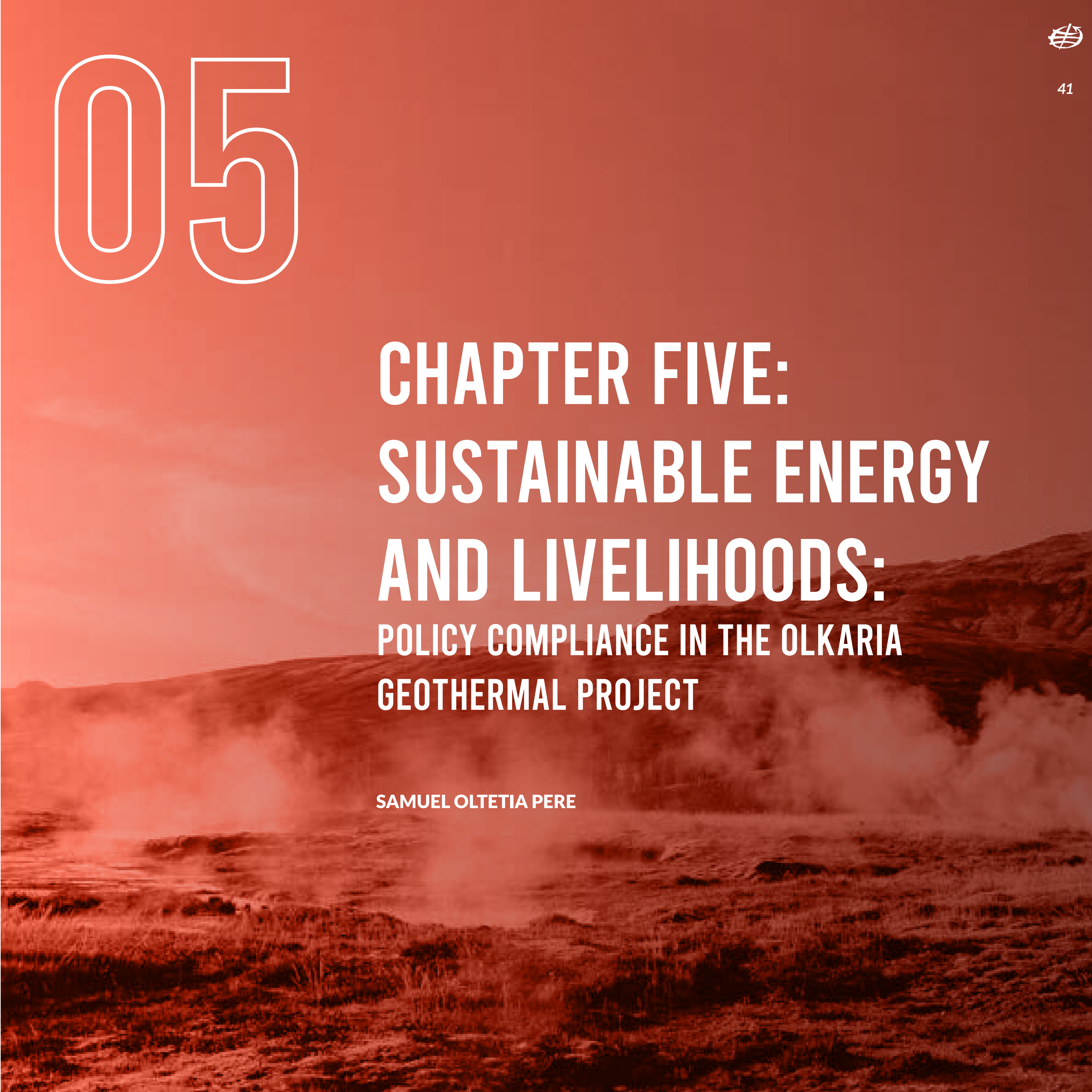
** *SID, (2018) Struggles in Energy for whom? Scenarios for Eastern Africa. Nairobi: Society for International Development (SID), pp.42-51.*

FORM #1: KIBRA HOUSEHOLD ENERGY BUDGET - JULY 2019 - INDIVIDUAL

Number of people in household ______________ *Name/Initials ______________________________*

Tick all boxes for how this type of energy is used						
Type of energy bought	*KSh/week spent LAST WEEK on energy type* *(Note: each person was given 10 groundnuts, representing a week's household income.)*	*Lighting*	*Cooking*	*Heating*	*Charging*	*Other (What?)*
Charcoal						
Electricity						
Firewood						
Gas						
Kerosene						
Solar						
Other						
TOTAL						
# groundnuts/10 spent on energy						

Table 5: Sample tool used to calculate energy budgets during Kibera engagement with Slum Soka community.



05

CHAPTER FIVE: SUSTAINABLE ENERGY AND LIVELIHOODS:

POLICY COMPLIANCE IN THE OLKARIA GEOTHERMAL PROJECT

SAMUEL OLTETIA PERE

EXECUTIVE SUMMARY

The global transition to clean energy is inevitable. Nonetheless, there is a need to look at clean energy with a wider lens to factor in the livelihoods of communities affected by sustainable energy development.

This article explores lessons from the Olkaria Geothermal Exploration and development in Kenya. Although it has been hailed as an avenue to clean energy use, there have been negative impacts on indigenous communities from geothermal exploration and securing sites for later exploitation.

Many of these impacts resulted from a failure to implement policies concerning consultation, resettlement, and restoration of community livelihoods. This pattern of ignoring local consultation on local needs has affected similar renewable energy developments elsewhere in Kenya, and needs to change.

OLKARIA GEOTHERMAL PROJECT AND LOCAL RESIDENTS

Clean energy has widespread acceptance because of its minimal negative impacts on the environment. However, any sustainable energy system – its technologies, appliances, processes and practices of resource exploitation – not only interacts with the environment, but also with the economic and social systems of society (Howells & Roehrl 2012).

This article looks at the Olkaria Geothermal Project in Kenya to understand how these other social and economic systems challenge the exploration of clean energy in Kenya.

The Olkaria Geothermal Project has experienced numerous conflicts with locals owing to their dissatisfaction with the ways in which the exploration has affected them. According to a 2019 report by the International Working Group for Indigenous Affairs, the government has readily given concessions for the exploration of the geothermal energy since 1984, hoping to satisfy the rising demand for low-carbon energy in the country (Renkens 2019).

As the Olkaria Project in Nakuru County developed, it brought resettlements and movement of populations, causing increasing concern. In the process, Koissaba notes there was a systemic failure to consult the local community, which resulted in skewed relocations and corrupt practices (Koissaba 2017). The ecological sustainability of geothermal energy seems to have overridden the socio-economic sustainability of the communities living around the project area.

Consultation with local communities should go beyond environmental impact assessments to include consideration of local community livelihoods, including the likely impact of the development on their economic practices, cultural values, and social structures. In the case of the Olkaria Project in Nakuru County, the community living within the project area is largely Maasai, who practice a pastoral economy based on moving livestock which informs their land use practices (Koissaba 2017).

In a pastoral economy, the benefits of a large-scale sustainable energy resource, like the Olkaria generation plant, do not reach their own socio-economic system founded on pastoralism. Such a mismatch increases inequalities not only between the affected community and their neighbours, but also within the community itself.

Maasai women and people with disabilities were often ignored during consultations, thus denying them the opportunity to participate on matters affecting their livelihoods during the Olkaria resettlement process.


Photo by Belikova Oksana from shutterstock.com

BEHIND THE FAILURE TO CONSULT

The European Investment Bank, the key financier of the Olkaria Geothermal Project, has very sound policies regarding indigenous communities and extractive industries. Under their policies, the Maasai qualified as an indigenous community affected by the geothermal development. They therefore required wider consultations on socio-economic and cultural issues in the initial phase of the project. The EIB's policy further provides a framework for complaints by the local communities (Abad & El Sabee 2015). Had these two policies been respected, it would have helped facilitate the identification of people to be resettled, improved the resettlement process, and provided a means to restructure the livelihoods of people forced to move. All of this would have been done in consultation with local people (Abad & El Sabee 2015).

Findings by the World Bank in 2015, however, paint a grim picture of the way things were actually handled. The World Bank's independent report compared the European Investment Bank policies to their implementation, centring on the compliance by the geothermal generating company and the government. The World Bank reviewed key areas like identification of the community as indigenous people requiring consideration of their cultural and physical resources, resettlement action plans, and the supervision and monitoring of the entire process (World Bank 2015).

According to the World Bank's report, there was good compliance on the policy areas concerned with cultural issues. However, compliance with policies on resettlement of people found numerous problems with identification of beneficiaries, consultation on the approaches to entitlement, and a major failure with the baseline evaluation that failed to analyse the viability of the resettlement area (World Bank 2015; Koissaba 2017). Women, orphans, people with disabilites and those living below the poverty line were worst affected.

In a statement to the Power Africa Summit, the community affirmed the World Bank findings through a statement which highlighted some of the challenges they had experienced under the implementing agency which was KenGen and the national government. They reported having received threats on voicing their concerns, raised issues on irregularities around titling of land, and noted the lack of a comprehensive economic recovery plan (Shaa, 2016). The community expressed fear of the loss of more land with the extension of the energy projects, and specifically pointed to a possible total annexation and displacement of the Keekonyokie clan of the Maasai (Shaa, 2016). It is thus clear that the activities of the energy agencies and the government have anatgonised the community against a would-be sustainable project.

In particular, although the Maasai community practices pastoralism, the resettlement disrupted the communal use of land and forced an immediate need to adjust to individualistic ownership of land, even though this is a relatively unproductive way to keep livestock in semi-arid landscapes.

It was also impractical to expect a pastoral community to shift immediately to settled farming without a timely readjustment and training plan. While the geothermal project appears to be sustainable due to its minimal ecological effects, its damaging impact on the surrounding community's livelihoods does not meet the sustainability criterion.

LAKE TURKANA WIND POWER PROJECT

The Lake Turkana Wind Power project has faced similar challenges where a wind farm totalling 150,000 acres has led to displacement of the local Laisamis constituency community. Like the people of Olkaria, this community submitted their grievances concerning irregular land acquisition and denial of indigenous community status (Achiba 2019).

However, the response from the government and implemening agencies was worrying. They argued that the land was "uninhabited" and located in "the middle of nowhere" (Achiba, 2019) which was patently not true.

This official reasoning meant that no compensation or understanding of local peoples' needs was considered. Nor did the consortium of financial backers challenge the government's conclusion. Instead, the Turkana story points to a pattern of failing to comply with policies that should guide clean energy projects' relationship to local communities, wherever such projects have been established in Kenya.

CONCLUSION

In Olkaria, the European Investment Bank's work served to trigger valuable development. However, the creation of a space for geothermal exploration in Olkaria required the communities to vacate the area. The economic and social care of the community to be resettled should have been better since they are key stakeholders. They should have been resettled in land that is equally productive, supports their economic activities, and factors in their social and cultural ways of living. Unfortunately, inconsistencies in implementing both the project and the donor's policies meant that vulnerable groups suffered because project managers ignored the complexity of restoring community livelihoods. This could have been avoided by working with the donor's sound policy. A similar dismissal of local peoples' needs has been seen at the Lake Turkana Wind Power Project.

Trends and patterns in the clean energy sector seen in the Olkaria and Turkana wind projects indicate deliberate undertakings to marginalize and "other" the vital interests of the communities in such exploration areas. It is thus essential that development is not disintegrated into aspects that deserve implementation and those that can be ignored. The Olkaria area has rich geothermal resources, while Turkana has valuable wind, but practices at the initial exploration stages can endanger scaling up of the work and subsequently place affected communities at risk of losing their livelihoods. Sustainable development is not just about green energy and the planet; it must also respect people, peace and prosperity. Some of the actions in the Olkaria area and others at Lake Turkana do not reflect these principles.

Photo byStanley Njihia from shutterstock.com

RECOMMENDATIONS

The following is recommended:

1. The consultation of the locals should be non-negotiable throughout the entire process for all energy exploration projects. Consultation should be simplified and understandable to the locals and include the use of the native languages.
2. There should be rigorous donor engagement and supervision of compliance with donor policies on consultation. The conflict mechanisms in the context of Olkaria would have worked, if the donor had insisted they be used.
3. Civil society should have an increased oversight role at all phases of project implementation to ensure the realization of sustainability, principled on people, prosperity, planet and peace. The involvement of local grass root organizations will provide an entry point for national and global civil society groups to assist.
4. There is need to strengthen policy provisions for consultation with vulnerable demographics like women and people with disabilities. The donors and the government should put in place specific guidelines on the engagement of women, youths and other vulnerable groups while acknowledging local cultural traditions that may disadvantage these groups. This could prevent deepening inequalities in the course of energy exploration.

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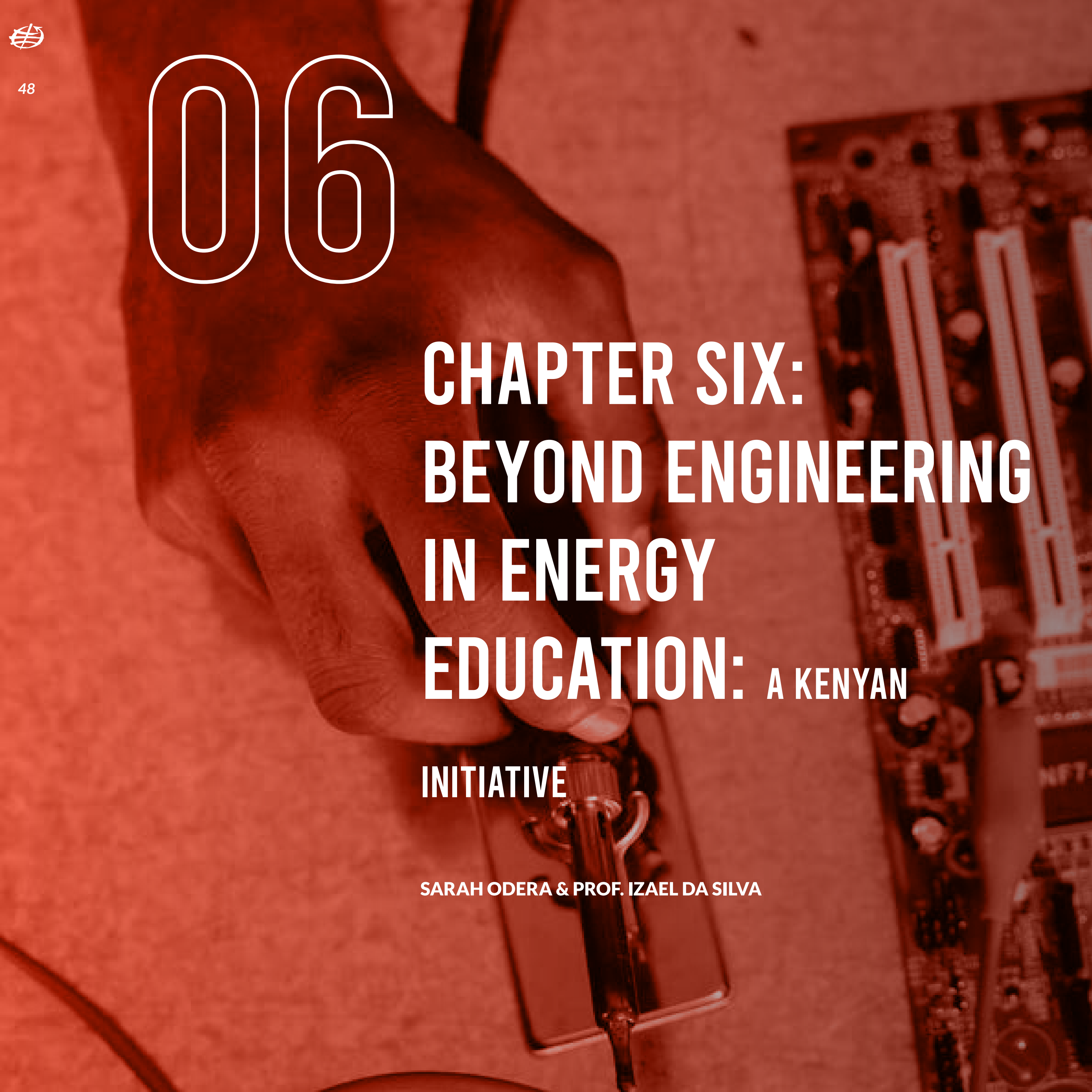
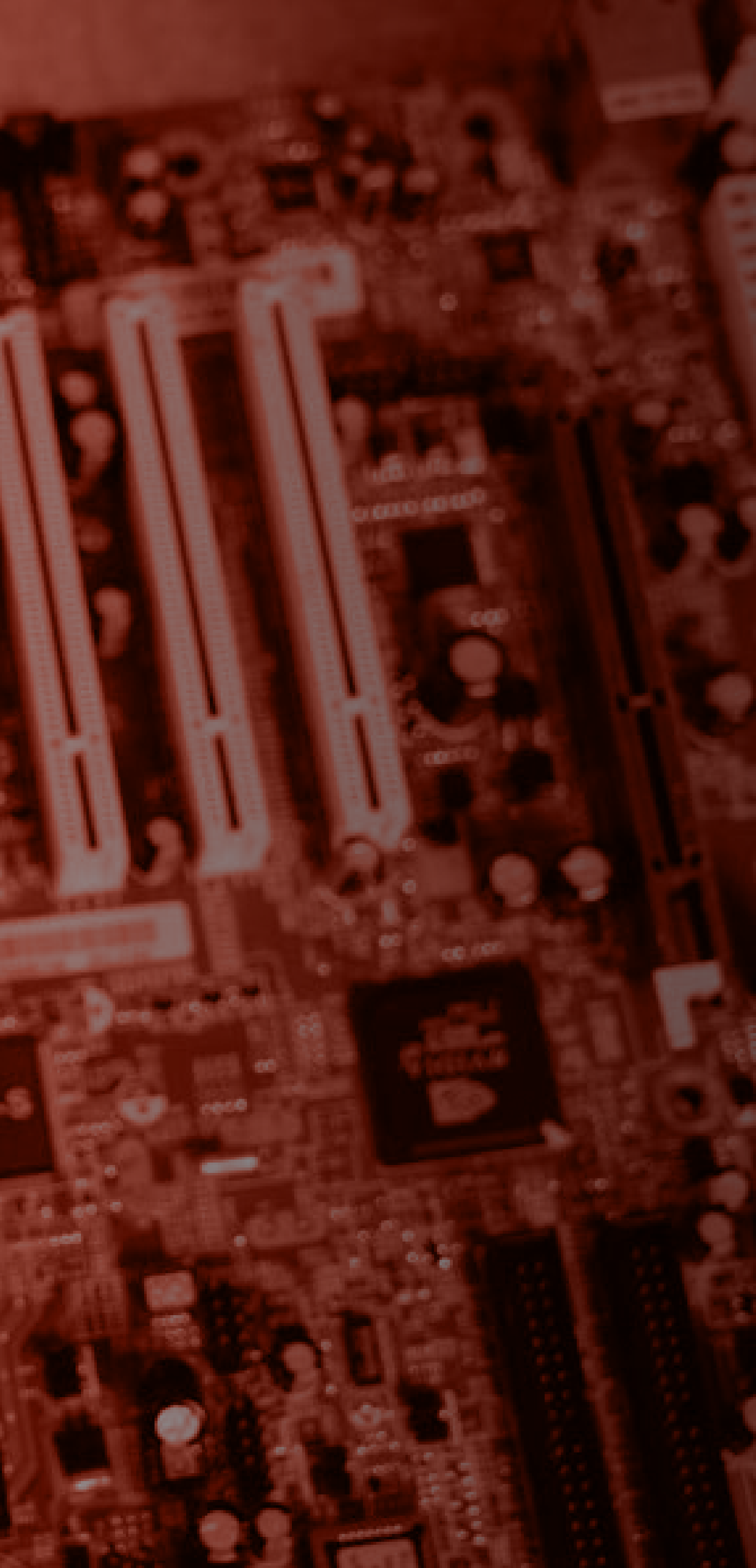


06

CHAPTER SIX: BEYOND ENGINEERING IN ENERGY EDUCATION: A KENYAN INITIATIVE

SARAH ODERA & PROF. IZAEL DA SILVA



The energy sector is commonly thought of as a technical field where engineers undertake design, installation, and maintenance. In fact, the energy sector is a multi-disciplinary field where individuals with various academic backgrounds including economics, finance, law, environment, IT, and others, gather together to provide goods and services to society.

To be successful, these actors need to work together to analyse multiple perspectives of the same problem. Only then will they understand the ecosystem within which they operate and develop appropriate solutions. This can be compared to a symphony where different musical instruments collaborate to make beautiful music. This collaboration cannot occur if professionals are not trained in a multi-disciplinary approach to solving societal problems.

Multi-disciplinary education has received its fair share of accolades and criticism in the recent past, with some arguing that it does not create a platform for learners to work collaboratively using theories and skills they have not yet fully mastered. Others have stated that multi-disciplinary education creates an opportunity to break down disciplinary silos and allows professionals to communicate and engage with each other to address complex societal problems.

In Africa, for example, a prevalent societal problem is access to modern types of energy which the World Energy Outlook defines as a "household having access to a minimum level of electricity and clean and sustainable cooking fuels." Using a multi-tier framework, the World Bank takes the definition of electricity access one step further by stating that the household must be able to use it for charging a mobile phone and have at least four hours per day of lighting.

A key threat to this is affordability. Countries like Kenya report that households, particularly in the rural areas, are unable to pay for the cost of grid connection despite heavy subsidies received from initiatives like the Last Mile Connectivity Project. Further, despite numerous projects being implemented to promote a transition to clean cooking fuels and technologies, the Stockholm Environment Institute indicates that 67,000 people in Africa die annually because of respiratory illnesses associated with indoor air pollution from 'dirty' fuels such as charcoal and firewood. Barriers to using clean cooking fuels and technologies in this case include affordability and the accessibility of better cooking stoves and fuels.

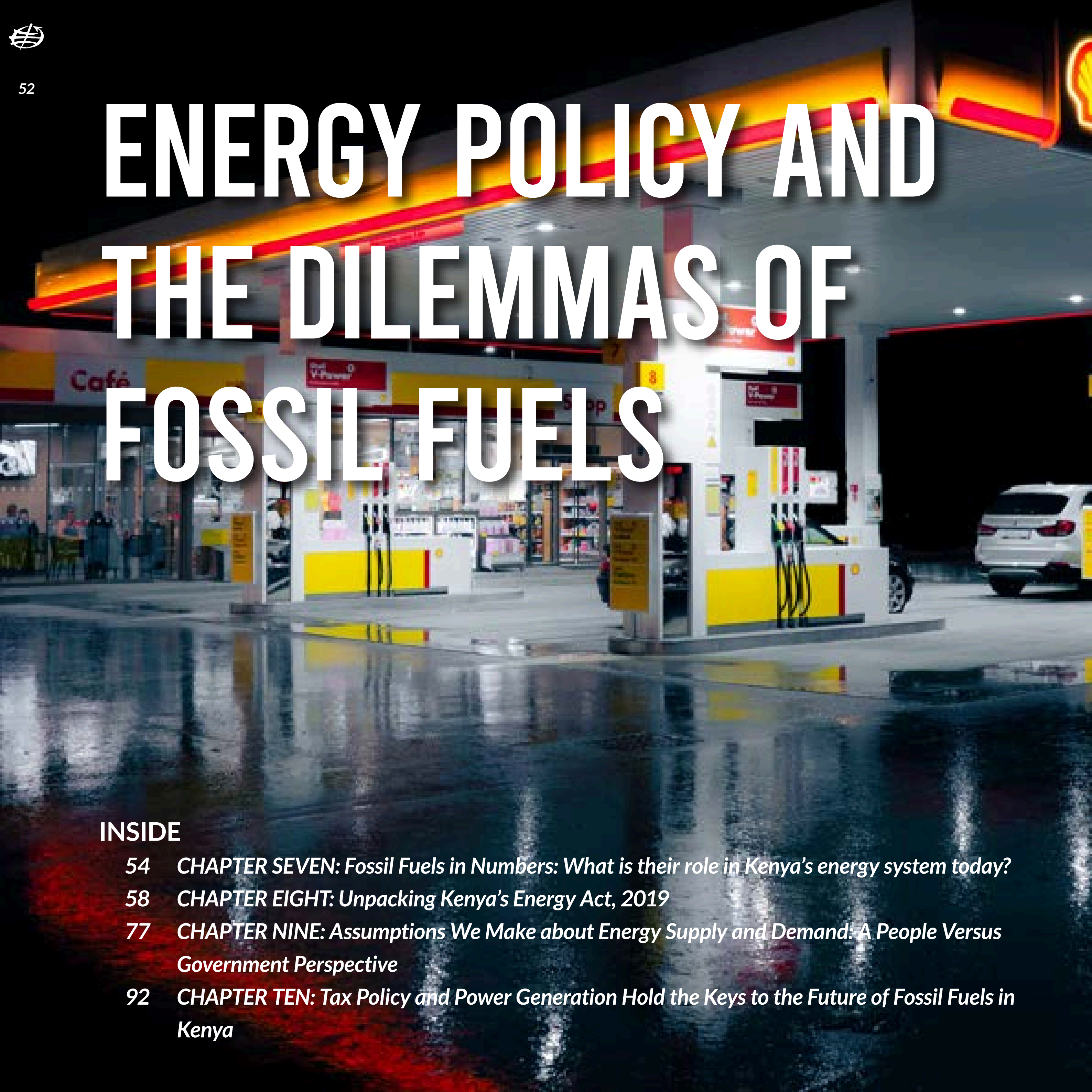
Engineering alone cannot solve these problems. For example, a study which the Strathmore Energy Research Centre undertook with Power for All found that people undertaking sales and distribution formed more than a third of the distributed renewable energy workforce while managers and business administrators were another 15% of the work force. This indicates the diversity of skills required in the energy sector that go beyond engineering.

Through our technical training at the Strathmore Energy Research Centre we have observed that engineers often lack basic knowledge of finance, economics, policy and management. We have also observed that financiers generally do not understand technologies and business models used in the energy sector and therefore are reluctant to finance it. This limits performance of the sector and causes sustainability to suffer.

Multi-disciplinary education is therefore needed to equip individuals and organisations with the understanding of core concepts contained in other disciplines. Such knowledge will enable them to improve their work, as it provides a foundational understanding of the ecosystem in which they operate. In turn, a better understanding will enable people to communicate and cooperate with other professionals from different academic backgrounds while sharing the goal of addressing complex societal challenges.

Having observed this gap in the education sector, Strathmore University, through funding from the UK's Department for International Development, DFID, has developed a multi-disciplinary Energy Masters degree launched in 2021. This two-year programme will initially focus on students with an engineering and IT backgrounds. It will then seek to equip them with the capacity to solve problems in the energy sector by refining their specific skill set while also providing them with knowledge outside their academic disciplines. Finally, the programme will work with students to develop key soft skills such as critical thinking and communication.

With a broader, multi-disciplinary understanding of the energy sector and its social economic context, we hope to train professionals who will manage Kenya's energy transition to a clean energy system that can benefit all of society.



ENERGY POLICY AND THE DILEMMAS OF FOSSIL FUELS

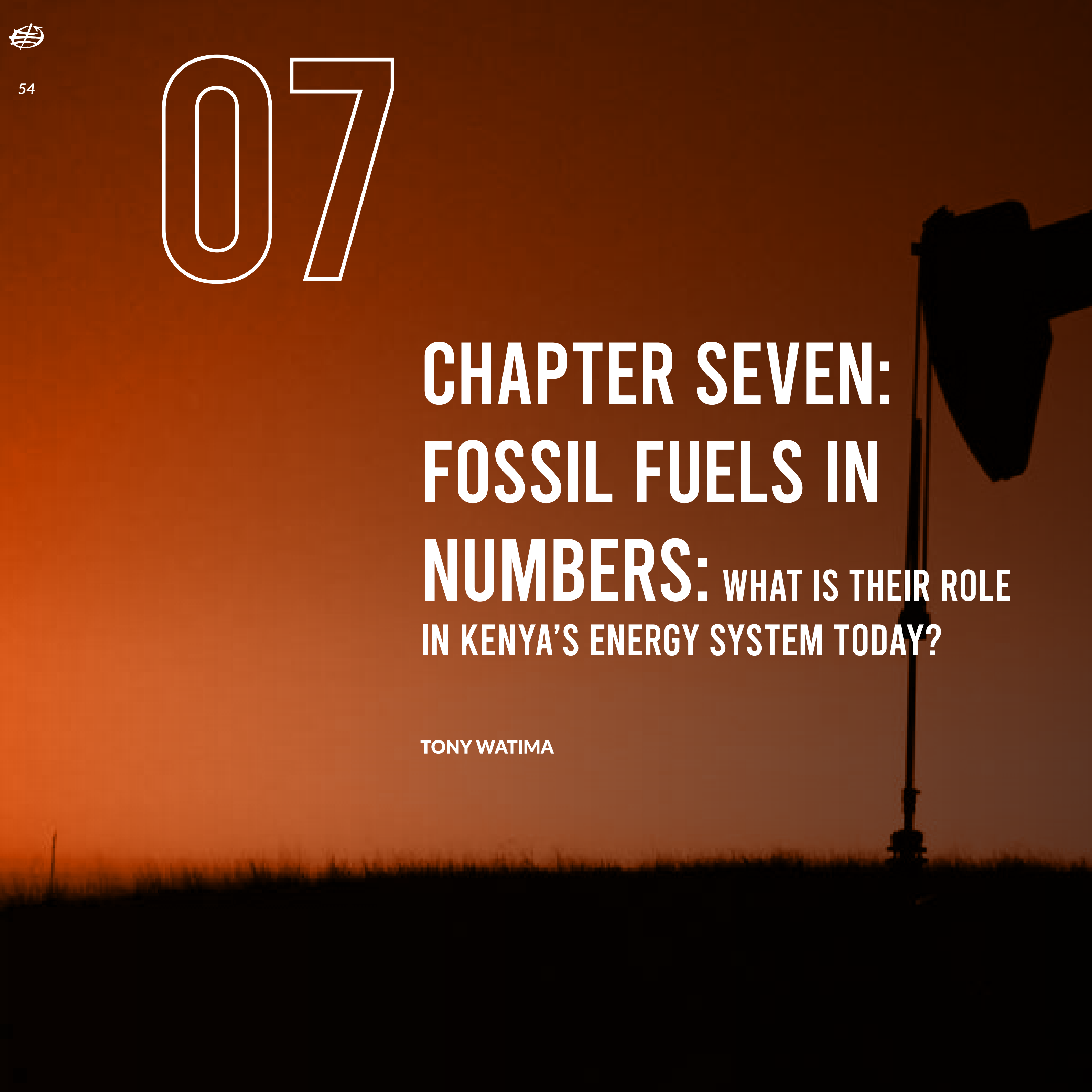
INSIDE

Kenya's leaders and planners have long assumed that development relies on the increased use of fossil fuels such as coal, oil and natural gas to generate electrical power and fuel transportation. In addition, if oil and other fossil fuels can be mined in Kenya, rather than imported, this could reduce costs or even produce an income if sold abroad.

This section of the Compendium begins with Tony Watima's statistics on the role of fossil fuels in Kenya's economy today, followed by Halima Hussein's detailed explanation of Kenya's 2019 Energy Act.

The Energy Act and other policies reflect assumptions being made about future energy supply and demand, the subject of the second essay written by Wilkista Akinya and Vane Aminga.

The concluding article from Charles Wanguhu looks at how tax policy and power generation are key to defining the future role of fossil fuels in Kenya.



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CHAPTER SEVEN: FOSSIL FUELS IN NUMBERS: WHAT IS THEIR ROLE IN KENYA'S ENERGY SYSTEM TODAY?

TONY WATIMA

While fossil fuels have declined in providing thermal power for electricity generation as well as illuminating kerosene for lighting, they still have a major role in road transport, and a growing role in providing clean cooking fuel through liquid petroleum gas, LPG.

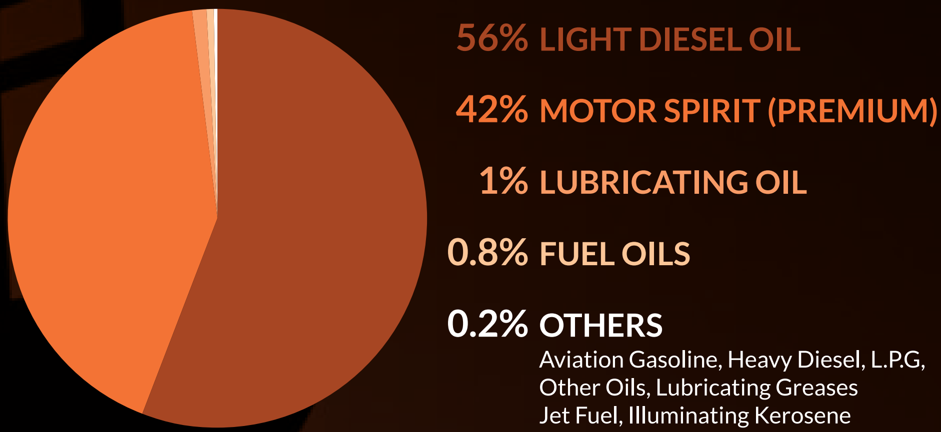


Figure 16: Road transport depends on fossil fuels, Source: KNBS Economic Survey 2020

This graph breaks down the various use of petroleum fuel in road transport. Light diesel oil leads in usage at 56%, followed by motor spirit. Together, these two make up 98% of road transport petroleum fuel use.

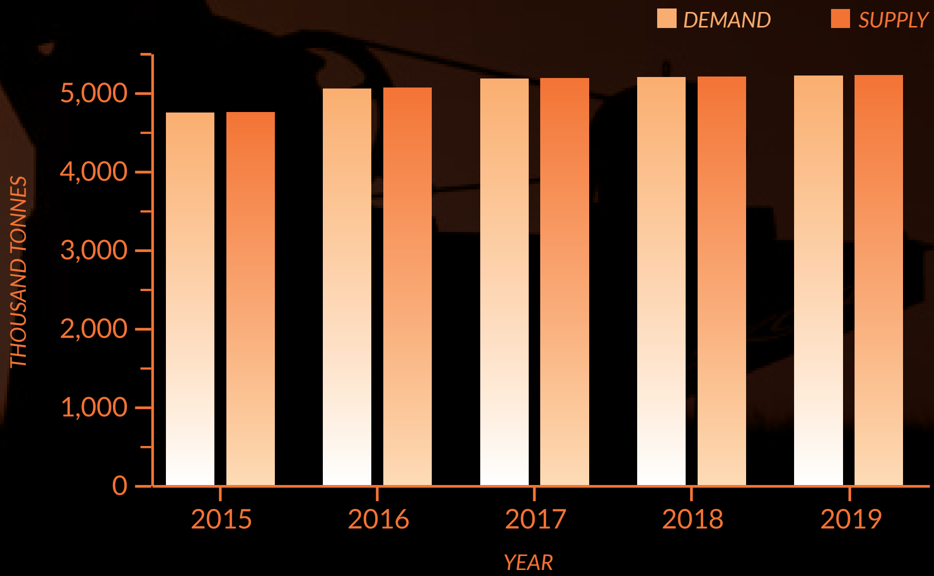


Figure 17: Use of petroleum fuels keeps rising, Source: KNBS Economic Survey 2020

The trend in Figure 17 shows that petroleum use in Kenya continues to increase despite the world talking about clean energy use in the transport industry. The demand for petroleum fuels continues to grow. That suggests that Kenya's motorized transport will still be powered by more and more petroleum fuel if this trend continues.

The number of illuminating kerosene sales from 2009 until 2014 shows that its use had been almost constant. Then there was a sharp increase in sales in 2017 which government attributed to a tax increase on diesel fuel that led unscrupulous oil traders to adulterate diesel with illuminating kerosene to improve their profit margins.

Government then imposed a 34% tax increase on kerosene in 2018. This sharp tax increase led to the significant drop of sales in 2019 as seen on the bar graph in Figure 19. This affected the use of kerosene for lighting while cutting its use as fuel.

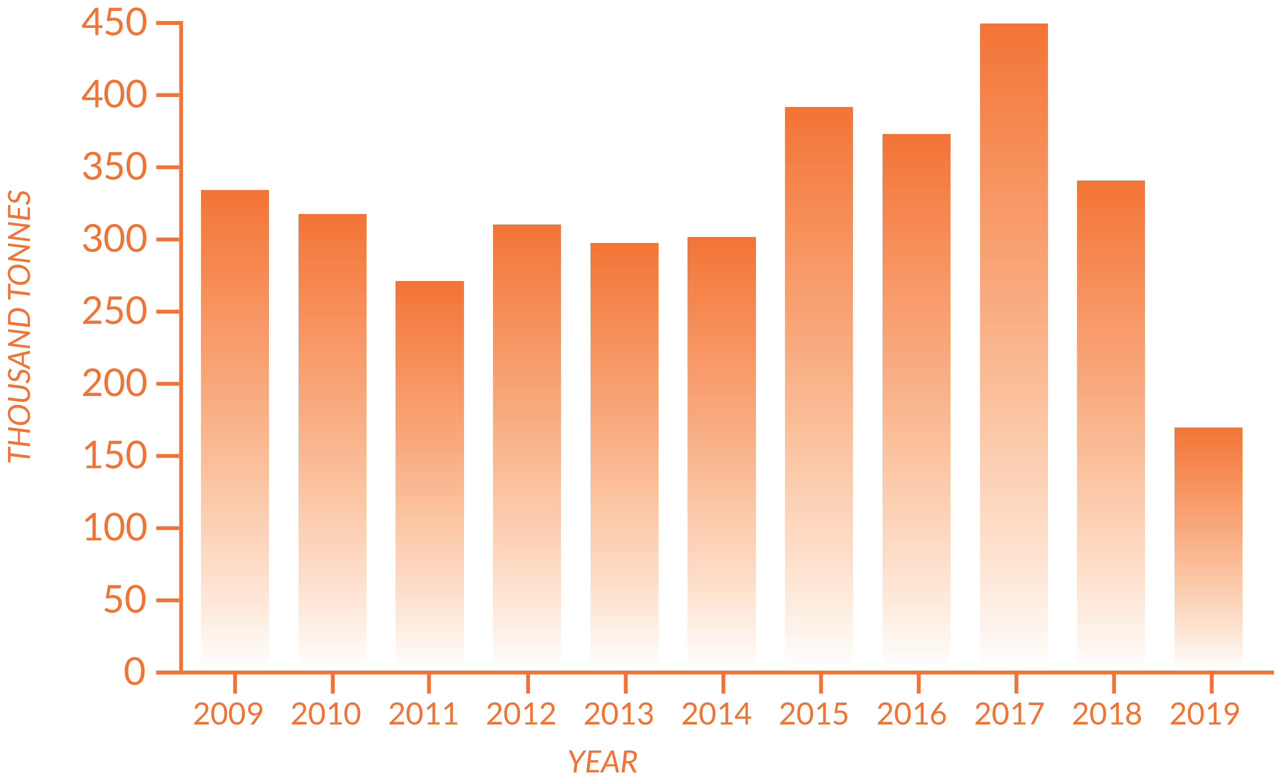


Figure 18: Illuminating kerosene sales - a history of taxes. Source: KNBS Statistical Abstract 2019 & Economic Survey 2020.

From Figure 19, it is evident there has been a constant increase in the use of LPG from 2009 to 2019. A sizeable number of households have been moving towards the use of LPG for cooking. A ban on logging increased the price of charcoal in 2018 (See article in this Compendium, "How Energy Prices Affect Energy Choices in Kenya"), while the introduction of smaller gas canisters and better distribution made LPG more affordable in urban areas.

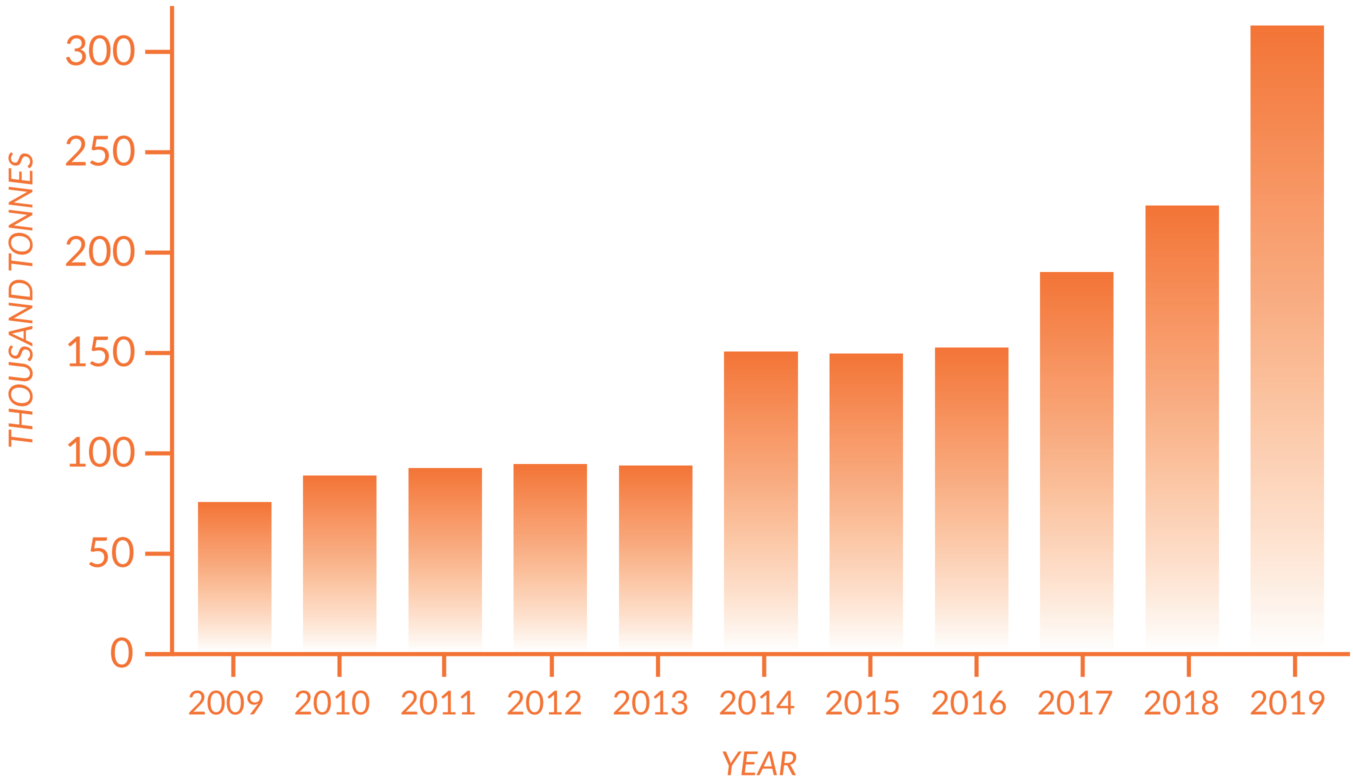
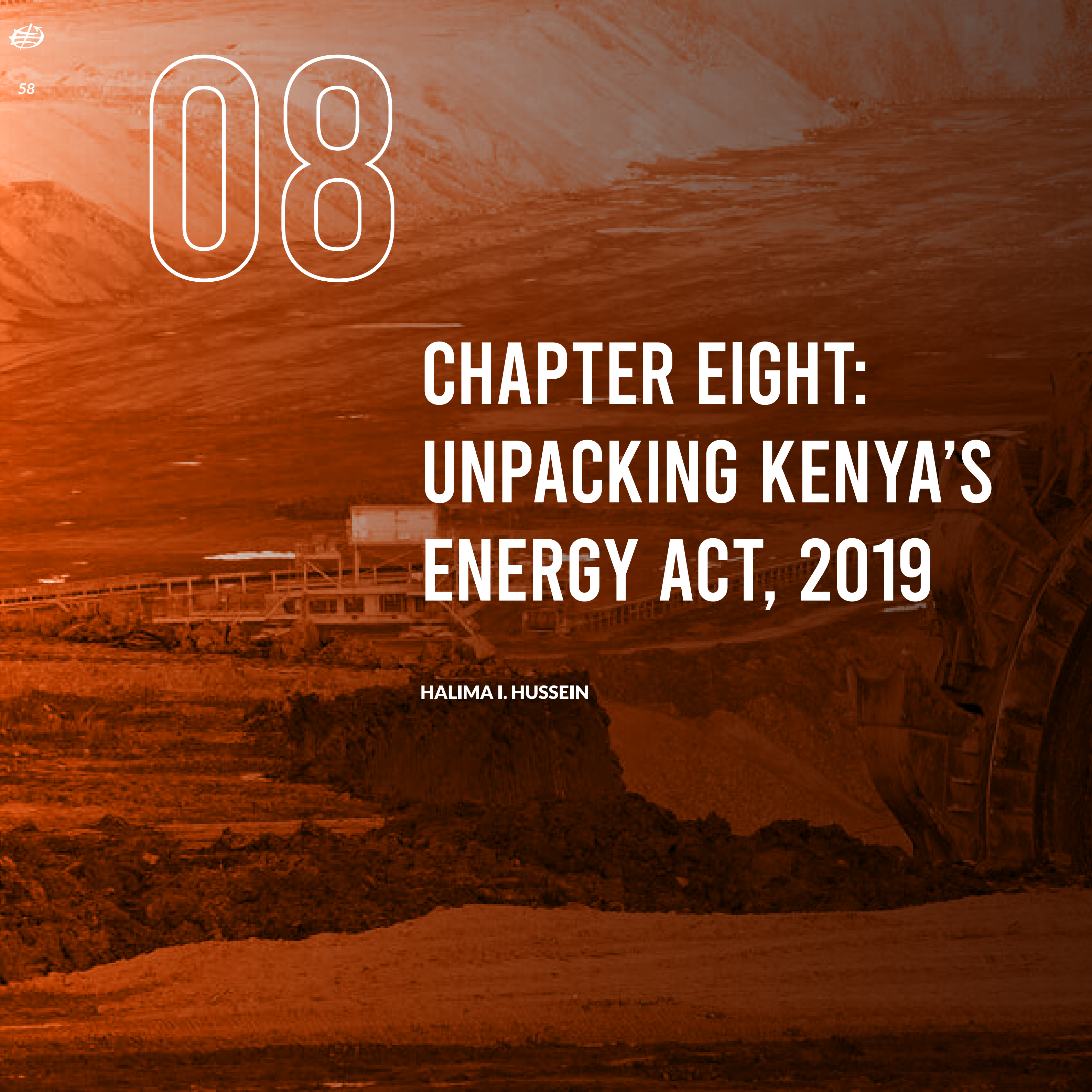


Figure 19: Rising LPG sales for clean cooking. Source: KNBS Statistical Abstract 2019 & Economic Survey 2020.



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CHAPTER EIGHT: UNPACKING KENYA'S ENERGY ACT, 2019

HALIMA I. HUSSEIN

EXECUTIVE SUMMARY

The Energy Act, 2019 heralds a new era in the planning, developing, reviewing and implementing an energy agenda that keeps up with the global trends in the sector. The Act with its sector institutions and principles, as well as its attempt to address the key issues of energy planning and land use, demonstrates laudable efforts by the government. The Act further expands the mandates of key sector institutions: the Energy and Petroleum Regulatory Authority; Energy and Petroleum Tribunal; Rural Electrification Renewable Energy Corporation; Renewable Energy Resource Advisory Committee; and Nuclear Power and Energy Agency. Unfortunately, it fails to ensure institutional autonomy in the discharge of their duties given that their boards are largely appointed by, and report directly to, the Ministry of Energy.

The Act, however, positively facilitates an enabling environment for renewable energy by vesting these rights in national government for better management and oversight. The law not only encourages renewables generation, but also promotes localized supply distribution networks by introducing benefit sharing provisions that provide 5% to local communities, 20% to the county government and 75% to the national government. It also cements the renewable energy feed-in tariff system in statute. What remains is to realise the promises of the Act. The Ministry of Energy and Petroleum should now take the lead in enacting and implementing subsidiary legislation necessary to operationalize the newly introduced provisions of the Act.

INTRODUCTION AND BACKGROUND

In the mid-1990s, Kenya embarked on a path to fundamentally reform fundamentally its energy sector. The Electric Power Act 1997, which was the prevailing law, and later the Energy Act 2006, changed the sector by separating the roles of generation of electricity from transmission and distribution. The reforms broke up long standing state corporations in the sector which were considered to be unsustainable monopolies. Reforms also led to the setting up of an industry regulator, the Energy Regulatory Commission, to monitor the institutions that were established by the new laws. It was anticipated that these changes would improve service delivery by providing quality and cost-effective services to Kenyans and would also stimulate investments in the sector.

However, these goals have not been met, as the cost of electricity remains prohibitively high for most Kenyans despite regulation. In addition, very few players have joined the sector as the capital costs are also prohibitive. Kengen is still the main producer of energy, while Kenya Power remains the sole distributor of electricity. The institutional and legal frameworks did not encourage liberalization in earnest, and neither did the inevitably uncoordinated enforcement by the new and different agencies. The energy institutions themselves were also weak technically or lacked support from political economic conditions to attract investors.

An overhaul of the sector laws was deemed necessary to promote energy supply security, sustainability and competitiveness in Kenya. The promulgation of the Constitution in 2010 gave added impetus to these reforms.

However, almost four years passed after the first draft was published without a new energy law. This is primarily due to political events such as the 2017 general election which delayed the process, as well as squabbles on the mode of sharing energy revenues between the national government, county governments and local communities.

On Tuesday 12th of March 2019, President Kenyatta finally assented to the Energy Act, 2019. It came into force 14 days later, repealing three earlier statutes: the Energy Act, 2006; the Kenya Nuclear Electricity Board Order No. 131 of 2012; and the Geothermal Resources Act, 1982. Together with the Petroleum Act, 2019, which seeks to regulate the upstream petroleum industry, these two acts of 2019 have fundamentally changed the energy landscape in the country. The Petroleum Act 2019 exclusively deals with petroleum fuel and replaces an old 1984 upstream petroleum law, while accommodating the downstream and mid-stream petroleum sub-sectors which were previously domiciled in the Energy Act 2006. This paper only discusses the Energy Act 2019.

As set out in its preamble, the Energy Act seeks to modernize and develop the energy sector by consolidating all laws relating to energy. The Act covers three key sources, and forms, of energy for the delivery of reliable energy services, at least cost, in Kenya: fossil fuels constituting coal and petroleum; renewable energy which includes solar, wind, biomass, biological waste, hydro, geothermal, ocean and tidal energy; and electricity. It promotes the generation and distribution of these sources of energy and regulates tariffs set by producers. It also regulates energy businesses, both large and small, and defines the differing responsibilities of national and county governments for managing energy issues. Inevitably, with such a broad remit, the Energy Act, 2019, is very long, running to 166 pages.

This paper briefly describes the goals the Act seeks to achieve, the principles upon which the Act is based, and the main institutions that should embody these principles to achieve these goals. The paper finishes with a discussion of the strengths and weaknesses of the Act and its implementation.

CONTEXTUAL GOALS OF THE ENERGY ACT

The Act was passed on the back of President Kenyatta's development agenda for his second term in office. This agenda was set out on Jamhuri day, 12th of December 2017 and called the "Big 4 Agenda" with four large goals to meet over the next four years to 2022: 1) achieve food security and nutrition; 2) build affordable housing; 3) enhance manufacturing; and 4) provide universal health coverage. These goals crop up time and again in every debate concerning national policy and the development agenda of the country.

Three of these goals aim to improve the lives of Kenyans, while the fourth "enhance manufacturing" seeks to diversify and strengthen the economy through industrial development. Because energy will be needed to meet each one of the goals, the Act offers an enabling environment to provide that energy.

PRINCIPLES OF THE ENERGY ACT

Five principles underlie the Energy Act of 2019:

1. *Devolution*
2. *National government is the custodian of renewable resources**
3. *Fair return for contributions to the national energy supply*
4. *Accountability*
5. *Climate change requires a low carbon energy system*

Sometimes these principles conflict, creating the need for the Act to find ways of resolving the conflict.

1. Devolution: national vs county rights and responsibilities

In Kenya's first constitution, devolution was included to protect the interests of marginalized regions and smaller tribes. After a period when devolution was removed by the ruling party, Kenya's constitution once again includes an emphasis on devolution. In keeping with the spirit of the constitution, the Energy Act assigns specific responsibilities to the national government and to the county governments.

Under the Act, the national government is the owner of all renewable energy* rights and is responsible for policy formulation and integrated national energy planning and regulation, under the Energy Petroleum and Regulatory Authority (EPRA). They are further empowered to regulate electricity, renewable energy, mid and downstream petroleum and coal activities, energy purchase contracts, set and review energy tariffs, resolve disputes and formulate national codes to promote energy efficiency.

County governments, on the other hand, are empowered to: aid the national government in formulating county energy plans to incorporate petroleum, renewable energy and electricity master plans; to plan for industrial parks and other energy consuming activities, and to regulate electricity and gas reticulation. They are also responsible for the regulation of biomass, biogas, and charcoal, and the distribution of retail coal and petroleum in the counties.

Also notable in the Act is the establishment of a Rural Electrification Programme Fund to accelerate electricity infrastructure in Kenya. Host community beneficiation and empowerment of local business is also emphasized by the Act. This is to be promoted by both national and county governments.

The Act also makes it mandatory for all energy companies to include locally-made components in their operations. Their plans to do so are to be submitted annually for approval by the EPRA.

Whilst proposing a few issues to be considered by all local plans, the Energy Act leaves a lot to subsidiary legislation to implement local content. This subsidiary legislation will take some time to go through the usual legislative cycles, national and county, until enactment scheduled for sometime in 2021.

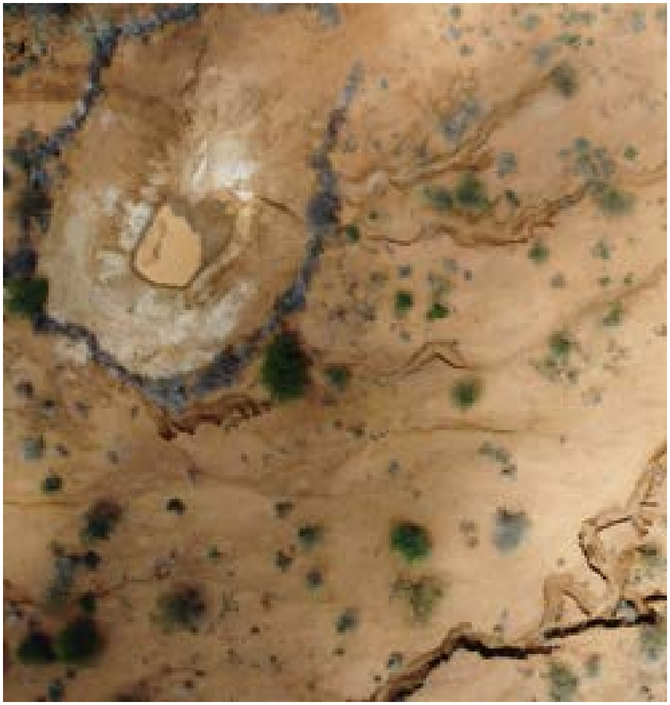
* *Other acts make the National Government owner and custodian of non-renewable resources like oil and coal.*

* *The Act defines renewable energy to mean all non-fossil sources including, but not limited to biomass, geothermal, small hydro-power, solar, wind, sewage treatment and plant gas.*

2. National Government as custodian of rights in all renewable energy

The second important principle arises from the fact that resources are not evenly distributed across the country. Therefore, it is in the best interests of all for the state to take these up and develop them for the benefit of all Kenyan people, not just the counties and communities where the resources are located.

Under this principle, the state owns all rights to unexploited or unextracted renewable energy* to use them in the best interests of all.



* *The National Government's rights to fossil fuels like petroleum and coal are assigned in the Petroleum Act and the Mining Act.*

3. A fair return for contributions to the national energy supply

Because resources are located in some areas of the country, but the rights to them are owned by the state, and because renewable energy can be generated on a household scale, a third principle underlying the Act is that contributions to the national energy supply should earn a fair return to those providing them. For that reason, there are provisions on royalties, net metering and a feed-in tariff.

a) Royalties

Although the national government owns both mineral rights and rights in renewable energy resources, county governments and communities will receive royalties from the national government for the extraction and development of resources in their territories. This applies to fossil fuels, geothermal resources and renewable resources like solar and wind.

The idea of royalties is a new concept in the revenue sharing agenda of the Energy Act. It emerged as a key issue during the public participation process of the Act. Royalty money is paid to the national government by those exploiting energy resources. Royalties are then shared between the national government, local communities and counties.

The tug-of-war over royalties revolved around three main stakeholders – communities, county governments and the national government. Whilst county governments requested almost half of royalties concerned, the Act settled for 5% for local communities; 20% for the county government and the remaining 75% to be taken by the national government. These royalties to county governments and communities are on top of the budgetary slice of the pie they receive from national government every year.

b) The Renewable Energy Feed-in-Tariff-System (FiT)

The principle of a fair return to those contributing to the national energy supply also underlies the Renewable Energy Feed in Tariff System. This is a key highlight of the Act and cements the 2008 'Feed-In-Tariffs Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity' (FiT Policy) developed by the Ministry of Energy.

In practical terms, the FiT is envisioned not only to encourage generation from renewables, but also to encourage localized supply distribution networks. More localised power generation is expected to reduce overloading the national transmission and distribution networks, minimise system losses from long distances in the network, and advance the country's commitment to reducing its emissions by innovating in renewable energy technology.

Subsidiary legislation is key to implementing the system as the Cabinet Secretary is directed to develop regulations to connect it to the grid and set out its tariffs.

c) Net-Metering

Net-metering is another example of the principle that those who supply energy deserve a fair return. Net-metering is a system where any consumer of electricity from the grid who installs a renewable energy system, like solar panels, for their own use is compensated for any surplus that is fed into the electricity grid.

The Energy Act is emphatic in its language that a licensed distributor or retailer must make available a net-metering service to a consumer upon their request. In practice, this faces a lot of push back from distributors and retailers, given the potential erosion of their revenues, but it should encourage more users to install renewable power.

In these three ways – royalties, feed-in tariffs and net metering – the principle of a fair return on contributions to the national energy supply is respected.

4. Accountability for consistency of power supply

Kenyans have long experienced interrupted power supplies, often occurring without warning and with no compensation for any resulting damage. The general sentiment has been that Kenya's main power supplier, and a state-owned company, the Kenya Power and Lighting Company (KPLC), enjoys a monopoly, and is thus free to take advantage of its consumers.

In response, the Energy Act seeks to promote confidence in supply by penalising electricity suppliers, including KPLC. The Act also obliges the supplier to compensate consumers for power outages as well as for irregular or poor-quality electricity. Outages and poor-quality electricity supplies often damage consumers' property, leading to financial losses and even loss of life. This provision is timely given the public's complaints regarding the frequent blackouts occasioned by the state supplier.

5. Climate change requires a low carbon energy system

In order to accelerate investment in renewable low carbon energy in Kenya, the Act laudably provides for the creation of an inventory and resource map of renewable energy resources. This Renewable Energy Resources Inventory and Resource Map will be produced by the government through the Ministry of Energy & Petroleum, and should considerably reduce the financial burden on investors. Under the old Act, investors were required to provide feasibility studies in support of their projects.

The cabinet secretary responsible for energy is mandated to, within one year of the commencement of the Act, carry out a countrywide survey and a resource assessment of all renewable energy resources. The findings will be critical, as they will be used to prepare the inventory and map which will set the stage for extensive exploitation of renewable resources to meet the country's energy demand.

Mapping renewable energy resources also helps to achieve the Act's goal of mitigating greenhouse gas emissions by promoting renewable energy and introducing carbon credit trading under the Clean Development Mechanism. This global mechanism for reducing greenhouse gases is described elsewhere in the Compendium and is anchored in global climate change protocols.

CONFLICTING GOALS: CLIMATE PROTECTION & COAL-FIRED POWER

Good legal drafters seek to reduce inconsistencies in a law. However, there are times when different goals of a law are in conflict with each other. In this case, the goal of promoting rapid industrial development in Kenya seems to conflict with the goal of building a low carbon energy system.

The best current example is the promotion of coal in the energy mix. Coal-fired power stations are seen by many as essential elements in an industrial economy. However, there is nothing clean, secure nor sustainable in regards to coal.

Moreover, the trend in divesting and decommissioning coal-fired plants globally indicates a steep price to be paid by Kenya's citizens when (and if) the country invests in this resource.

INSTITUTIONS OF THE ENERGY ACT

The goals and principles of the Energy Act are only likely to be effective if the institutions to implement the act are able to function to high professional standards without excessive political interference. So, what are the institutions established by the Energy Act and what are their strengths and weaknesses?

A brief history of energy institutions in Kenya

In discussing these new entities, it is important to revisit the history of Kenya's energy institutions, to determine whether they are likely to be more effective under the Energy Act of 2019 than their predecessors were.

Up until 1982, East Africa Power Lighting Company (EAPL) was a private company run professionally with the government as a minority shareholder. Its associated companies, Kenya Power (KPC) and Tana River Development Company (TRDC), both wholly owned by the government under the Ministry of Energy, were managed and financed by EAPL under a well-defined ascertained cost principle.

Two other state corporations, Tana & Athi River Development Authority (TARDA) and Kerio Valley Development Authority (KVDA), both under the jurisdiction of the Ministry of Regional Development, were assigned to generate electricity under a well-structured Power Purchase Agreement (PPA).

In 1983, following the 1982 coup attempt, EAPL was rebranded Kenya Power and Lighting Company (KPLC) with the government now the majority shareholder controlling the company's board.

TARDA and KVDA were also brought under the wing of the Ministry of Energy. In 1984, there was a major restructuring in KPLC Management. Julius Gecau, Ex-Chairman and CEO of the Company, was removed, and Sam Gichuru, then Company Secretary, was appointed managing director (MD) and CEO of KPLC. Mr. Gichuru, who was MD until 2003, is now wanted by Jersey Island for fraud and money laundering and is currently fighting an extradition case at the Kenyan Supreme Court.

Whilst the board was separated from the management of the company, the government took full control of KPLC including the appointment of its managing director, Chairman of the Board and the majority of its Board Members.

Before these events, the government and World Bank agreed in 1997 to restructure the sector and create only two companies: KPLC, to manage transmissions and distribution; and Kenya Generating Company Ltd (Kengen) to manage generation.

Further, all independent power producers (IPPs) would participate in all future generation projects in competition with Kengen. KPLC was responsible for negotiating and signing all PPAs with IPPs and with Kengen. These agreements would then be ratified by the regulator, Electricity Regulatory Board (ERB), renamed the ERC (Energy Regulatory Commission) under the Energy Act of 2006.

The 2006 Energy Act further introduced the Rural Electrification Authority to promote rural electrification in Kenya. In 2008, Geothermal Development Company was established as a state-owned company independent of Kengen, and Kenya Electricity Transmission Company Limited (Ketraco) as a state-owned company independent of Kenya Power. Finally, the Kenya Nuclear Energy Board was established in 2012 to develop nuclear energy.

Energy institutions under the Energy Law 2019

Under the new Energy Law 2019, many of the existing institutions were renamed, but their responsibilities and organisation have remained largely unchanged.

1. The Energy and Petroleum Regulatory Authority (EPRA)

(formerly the Energy Regulatory Commission (ERC)

EPRA is the successor to the Energy Regulatory Commission (ERC), and is still the primary regulator of the energy sector. The objects and functions of EPRA remain similar to those of the ERC, albeit with added mandates to license nuclear facilities and regulate downstream petroleum. In all other respects, all rights and obligations have simply been transferred to EPRA under the Energy Act of 2019.

2. The Energy and Petroleum Tribunal (EPT)

(Formerly the Energy Tribunal)

The Energy Tribunal was a quasi-judicial body mandated to hear appeals concerning rulings from the Energy Regulatory Commission under the 2006 Energy Act. The renamed Energy and Petroleum Tribunal (EPT) has an expanded mandate, as it may now hear and determine disputes arising under the Energy Act "and any other written laws."

The Act further provides a more detailed framework to guide EPT's conduct of its business particularly concerning its procedures. Unlike its predecessor, the EPT now has wide powers to grant equitable reliefs synonymous with Courts of Law in Kenya*, including injunctions, penalties, damages, specific performance with the power to review any relevant judgments and orders.

* *"Synonymous with the courts of law" means that the EPT's decisions have the same force as if they were made in a court of law.*

3. Rural Electrification and Renewable Energy Corporation (REREC)

(Formerly Rural Electrification Authority (REA)

While inheriting the rights and responsibilities of the Rural Electrification Authority (REA), the new REREC's extended mandate includes policy formulation, including the development and updating of Kenya's renewable energy master plan. REREC is also responsible for: establishing energy centres in the counties; developing, promoting and managing use of renewable energy (excluding geothermal); coordinating research of renewable energy; developing appropriate local capacity for renewable technologies; and offering clean development mechanisms such as carbon credit trading or similar policies.

Importantly, with this expanded role, REREC helps Kenya gain hard currency from selling carbon credits in the international arena whilst expanding renewable energy in the Olkaria geothermal fields in Naivasha. A key gain of the Act is the empowerment of REREC to develop, promote and manage the use of renewable energy in Kenya. Renewable energy includes biomass. The Act specifically describes what it means by biomass, including biodiesel, bio-ethanol, charcoal, fuel-wood, biogas and agro-waste. The Act also mandates REREC to provide an enabling framework for the efficient and sustainable production, conversion, distribution, marketing and utilization of biomass.

This function is further supported by the Cabinet Secretary's mandate to promote thedevelopment and use of renewable energy technologies, including but not limited to biomass, biodiesel, bio-ethanol, charcoal, fuel wood and municipal waste. The Act has further devolved biomass regulation to the counties. The recognition and promotion of biomass is a huge win for the Kenyan citizenry who rely on firewood and charcoal for their everyday needs. Indeed, according to the 2019 Kenya Population and Housing Census, 55.1% of Kenyan households use firewood for cooking, followed by 23.9% using LPG.

4. Nuclear Power and Energy Agency (NPEA)

(Formerly the Kenya Nuclear Electricity Board)

NPEA takes over the mandate to develop and implement Kenya's nuclear energy programme.

5. Renewable Energy Resource Advisory Committee (RERAC)

(This is a new institution.)

RERAC is an inter-ministerial committee whose mandate includes: to advise the Cabinet Secretary on matters concerning the allocation of renewable energy resources; the licensing of renewable energy resource areas; the management of water towers and catchment areas; the development of multi-purpose projects such as dams and reservoirs; and the management and development of renewable energy resources.

Critique of institutional arrangements

The hallmark of the Energy Act 2019 is its institutions. If the goals are to be reached and the principles respected, then the institutions mandated by the Energy Act need to function effectively. Unfortunately, there are several aspects of the institutional setup of the Act that work against effective implementation.

First, when taken as a whole, there is clear duplication of roles among the ones named here. If some of these entities were to merge, not only would it reduce the burden on the Exchequer, it would also reduce unhealthy competition and turf wars between different institutions.

Second, while the 2019 Energy Act has renamed and expanded the mandates of existing sector institutions to enable them to better discharge their functions under the Act, their boards are largely under the control of the Cabinet Secretary who hires their Managing Directors and appoints their Board Members. The only exception is the independent Chairperson for each board, who is appointed by the President, but upon the recommendation of the Cabinet Secretary.

This pattern of government's domination of the energy sector began in 1984 when the government, as majority shareholder, took full control of KPLC. That was the first time the government appointed the Managing Director, Chairman of the Board, and the majority of KPLC's Board Members. Arguably, institutional rot started to set in at this time. The fact that these practices continue to this day raises serious doubts about the level of independence in these institutions and their continued vulnerability to political interference. Such interference has been the architect of corruption in most state corporations in Kenya.

Third, between 2006 and 2012, the Government introduced four new agencies: for rural electrification; geothermal development; electricity transmission; and nuclear energy. Since then, these entities have not only added a financial burden to the Exchequer, they have become conduits of corruption with many appointments to these agencies made on a political basis. New projects to serve independent power producers (IPPs) often have needed political patronage to be developed. Whatever legitimate purposes these projects may have served are undermined by political appointments which do not advance the energy agenda or help to realize the long term goals of Vision 2030.

STRENGTHS, WEAKNESSES AND UNRESOLVED ISSUES IN THE ENERGY ACT 2019

Kenya has abundant renewable energy including geothermal, wind and solar energy. In many ways, the country is in a strong position to develop an energy sector that responds effectively to the dual challenges of climate change and economic development, but that potential may be hard to realise.

Strengths

It is worth noting that Kenya's resources buck the intermittent nature of renewable energy resources. Geothermal energy operates steadily at 0.8 capacity factor*, while the 310 megawatt (MW) Turkana wind farm, completed by June 2017, also enjoys relatively steadfast winds that enable it to operate at a constant of 0.5 capacity factor. Due to this reliability, the Turkana wind farm, can serve as a source of reliable base load power in the daily energy mix in addition to the Olkaria Geothermal Power plants.

International trends also signify that solar will become an accepted "base-load" supplier in the next five years, primarily fuelled by the advancement of battery storage technology scheduled to reach a high of 100 MW capacity. In this way, it will be feasible to use solar given that daytime generated capacity may be stored for use during peak evening hours. However, Kenya must prioritize this development now to stay ahead of the curve.

Photo by Belikova Oksana from shutterstock.com

* *Capacity factor is the ratio of geothermal's annual power production to the power it could have produced if it ran at 100 per cent capacity every day of the year. It is crucial in determining a power source's ability to operate at its full potential and analyse how best to maximize the investments sunk into it.*

Weaknesses

The most important weaknesses in the Energy Act 2019 are political. First, there is the bottleneck that comes from placing so much decision-making authority with the Cabinet Secretary. Second, there is the high risk of political interference in institutional decision-making when so many key appointments are politically-determined.

For example, given Kenya's advantageous renewable energy resources, the government should fast track their development by giving them priority and protecting them from imported energy competition. The Act attempts to tick this checkbox by mandating the Cabinet Secretary to create an enabling environment to promote these clean renewable energy resources. Unfortunately, the language is largely general and not emphatic.

Taking another example, the Act is forward thinking in providing for nuclear energy, a clean source of electricity. However, nuclear power has high capital costs and requires expensive waste management. It is not, therefore, realistic given Kenya's current economic set up. Coal-fired power generation is another option for the government, but that is highly polluting and could become uneconomic when carbon pricing is introduced. A prudent government, therefore, would avoid sinking resources into nuclear or coal generation at the expense of geothermal, solar and wind.

However, because so much institutional power is in the hands of the government, this kind of prudent calculation risks being overturned by decisions that are more immediately advantageous. The Act calls for progressive energy plans to be developed by the Cabinet Secretary with relevant stakeholders. In practise, cartels and investors have long captured the sector and continue to mar energy planning in the country. A meaningful review and overhaul of the institutions is needed to eliminate cartels from the picture, but the Energy Act of 2019 has not done that.

A third weakness of the Act comes from the expectation that the executive will implement its provisions by developing the necessary regulations and rules. However, most of these have not been enacted, allowing institutions, existing tariffs and current licences to carry on under the old Act to ensure continuity. The Cabinet Secretary must not waste time in enacting these. For instance, the Cabinet Secretary responsible for energy was mandated to, within one year of the commencement of the Act, carry out a countrywide survey and a resource assessment of all renewable energy resources. As of the time of writing, September 2020, this has still not been done.

A final weakness of the Act comes from an over-reliance on the assumption that rapid economic growth will require rapid growth in electricity supply. A corollary assumption was that adding new generation sources and capacity to the grid would have international investors flocking to Kenya in order to take up the flagship projects identified under Vision 2030*. Both assumptions have proven to be wrong.

Over-estimation of national electricity demand has resulted in surplus production that is paid for by consumers. Lahmeyer International, an independent consultant commissioned by the Ministry of Energy and Petroleum, released a report in 2016 that revealed that the average growth in electricity demand for the previous 10 years (between 2006 and 2016) had been only 6%, and not 15%**.

* *Kenya's national long-term development policy aims to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment. See Government of Kenya, Kenya Vision 2030: The Popular Version, (GoK, 2007) Available at http://www.vision2030.go.ke/about-vision-2030/ Accessed on January 25, 2020*

** *Lahmeyer International. 2016. 'Development of a Power Generation and Transmission Master Plan, Kenya, 2015-2035'.Lahmeyer International GmbH, October 2016.*

In 2007, Vision 2030 forecast future growth in electricity demand at an average of 8% over the following 15 years, resulting in a projected peak demand of 4,700 MW by 2030*.

GDP growth rate has also been lower than predicted. This has averaged 5.5% from 2004 until 2017 and slowed down to 5.1% by the 3rd quarter of 2019**. This rubbishes claims that the annual GDP growth rate would increase to 10%. In fact, the Standard Gauge Railway is the only major flagship project that has been fully completed since 2009, and even so will only be upgraded to an electric railway in four years.

The Lamu Port, another flagship project, only completed the first of its 30 berths in October 2019. The envisioned steel smelting and rolling mills as well as Konza City Technopolis, among others, remain draft plans for now. In short, the energy demand expected to be created by increased industrial development has not yet been seen.

While the impact of political interference is a clear weakness of the Energy Act, as is the lack of implementing rules and regulations, the poor projections of growth and energy demand are different issues. One interpretation is that it is the lack of energy that has held back industry and the economy. Alternatively, the projections are sound, but badly timed. Increased demand for electricity will follow, but not at the time expected. The weakness of the Energy law was to assume too much growth rather than planning a more flexible and affordable strategy to develop electricity and energy resources for Kenya's development.

* *Ibid*

** *Trading Economics,. 2020. 'Kenya GDP Annual Growth Rate' available at https://tradingeconomics.com/kenya/gdp-growth-annual , accessed on January 26, 2020.*

Unresolved issues

Perhaps the single most important issue not resolved by the Energy Act of 2019 is the issue of land rights. The government has advanced many energy projects to support its development agenda. However, most projects – Turkana Wind Power Plant, Kinangop Wind Farm, Olkaria Geothermal Power Plants – have hit snags when it came to resolving disputes over land use and ownership. The Act repeatedly failed to propose ways to resolve the disputes that arise when energy plans collide with existing land use, owners and custodians.

Nor does the Act give credence to the thorn affecting both communities and investors when land is compulsorily acquired to make way for these new projects. Given that most project sites are located in rural areas, this inevitably means that most are agricultural use lands which require Land Control Board consent. Before granting consent, the Board considers whether the application comes from a non-citizen or a private company having any non-citizen shareholder. This of course raises a challenge given that most energy projects are capital-intensive and often require foreign investment. Whilst it provides for presidential exemptions, the procedural snags in obtaining these make the country an unattractive investment location.

The other issue which has led to the failure of projects such as Kinangop Wind Power Project is community disputes over poor compensation for land. The government must ensure that an agreed community management plan is safeguarded and implemented by all stakeholders. Stakeholders include those very communities who accept agreed compensation and includes project developers who must sufficiently and meaningfully engage with communities to acquire the "social license to operate." Only then can developers proceed to acquire formal licenses.

Such consultations are inevitably very slow. The Cabinet Secretary may need to enact regulations to ensure that land acquisition is not a disincentive for investors in this space in Kenya, while also reassuring local people that their interests will be respected.

CONCLUSION & RECOMMENDATIONS

The Energy Act, 2019 held great promise for revamping the energy sector and keeping up with modern trends and technologies in this space. It has achieved its promise to some extent. With the promotion of renewable energy, given Kenya's abundant renewable energy resources, it provides a degree of both energy security and environmental sustainability of the sector. In addition, with its acknowledgment and active promotion of biomass, including charcoal and biogas, as well as the devolution of biomass regulation, the Act stands to change the Kenyan rural map and provide solutions to lift millions out of poverty who have been constrained from accessing clean and affordable energy for their daily needs.

Given that biomass production and distribution is within the purview of county governments, county employees need to be trained and empowered to develop frameworks to promote and regulate these sources of energy to improve the lives of rural Kenyans.

Overall, however, the status quo has not really changed. Sector institutions have simply been rebranded with different names and given a few further responsibilities, many of which are duplicated by other institutions. What is most concerning is the fact that sector boards and chairpersons are appointed only with the approval or recommendation of the Cabinet Secretary. In addition, the Permanent Secretary to the Ministry is required to sit in every entity.

With the Executive still retaining its hand in the running of these institutions, the sector may never evolve to be independent or autonomous, nor able to run a competitive and merit-based system of awarding tenders, the basis for any successful energy system. The Act needs to be amended to promote merit-based appointments and transparency in appointing members to its entities.

In addition, subsidiary legislation must be enacted in order to fully operationalize the Act. Given the outside role of the Cabinet Secretary, there is a lot for this person to take up. For instance, the Act compels Kenya Power to provide non-discriminatory open access to its distribution system for use by any company, However, the Act fails to set prices for this service while the regulation providing the structure for these prices is yet to be developed. Consequently, there are still no competitors to Kenya Power. The delayed enactment of regulations may be an indication that the government is not willing to have competitors to Kenya Power, which defeats the point of the Act.

Finally, the Act needs to reflect deeply on the issues and concerns it sought to answer at the onset. Energy planning, which is the foundation of the sector, needs concise and detailed regulations to avoid the dreaded lobby capture and to ensure that at the very outset plans are inclusive, reasonable and impartial. Such plans should take the country's and its citizens' best interests into account to propel this nation to become a middle income and sustainable country by 2030.

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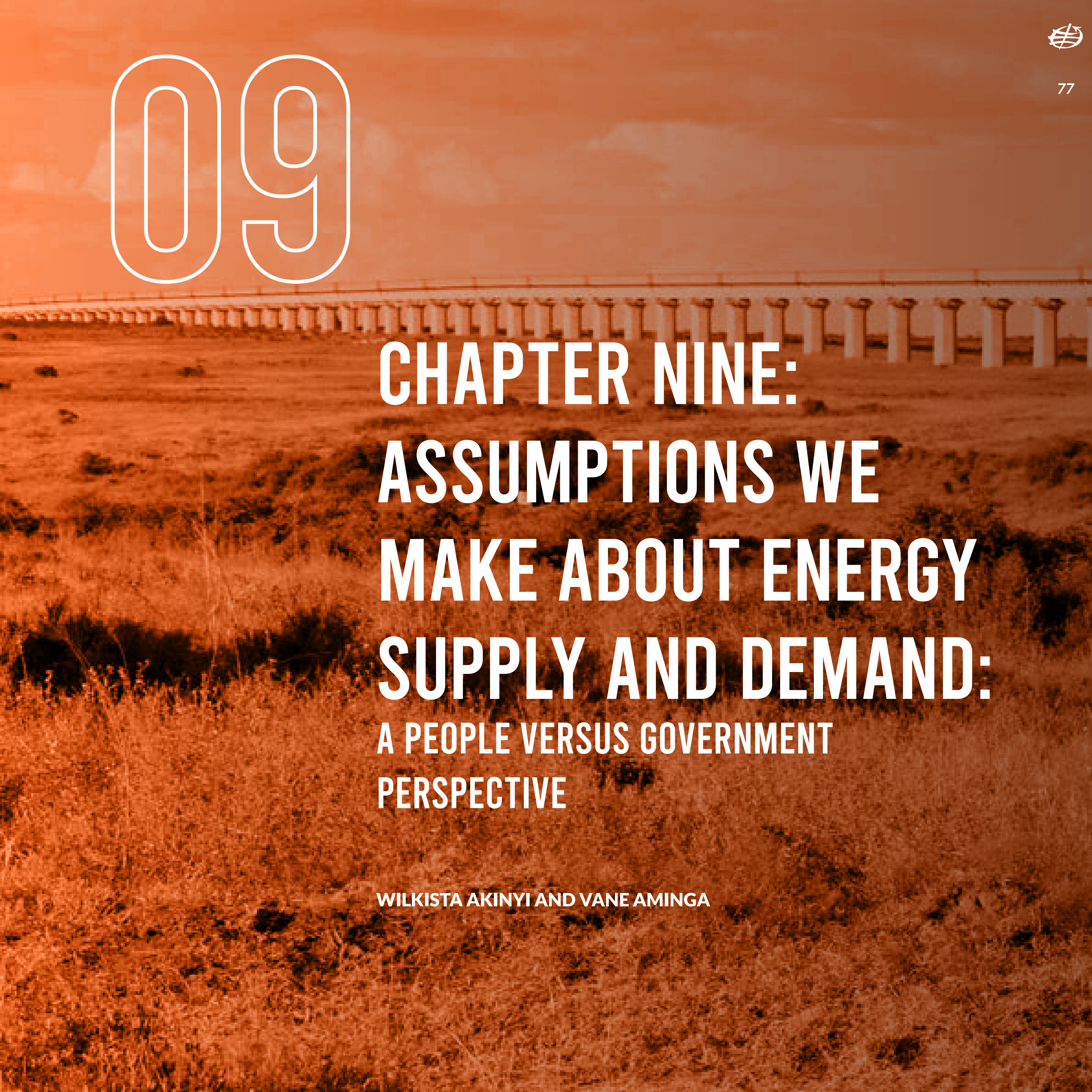

09

CHAPTER NINE: ASSUMPTIONS WE MAKE ABOUT ENERGY SUPPLY AND DEMAND:

A PEOPLE VERSUS GOVERNMENT PERSPECTIVE

WILKISTA AKINYI AND VANE AMINGA

EXECUTIVE SUMMARY

This paper reviews some of the assumptions underlying Kenya's current policy making on the future of energy. Overall, there exist critical divergences between the people's perspective on energy needs and the Government of Kenya's commitments for energy security up to 2050.

The varying outlooks are especially evident in indicators such as: strategies on energy planning and prioritization of projects; views on the role of the country's new fossil resources in any future energy system; the role of centralized power distribution vs decentralization; the underlying complexity in attaining 100% clean cooking; and limiting the emissions of greenhouse gases to slow down climate change.

The paper illuminates the need for energy policymaking to carefully put the people's perspective centre stage when designing energy interventions, in order to encourage a sustainable and just energy transition for all.

INTRODUCTION

When it comes to energy, there are three big goals that Kenya wants to achieve by 2030. First, transform Kenya into a newly industrializing, middle-income country that provides a high quality of life for all its citizens in a clean and secure environment. To achieve that goal, Kenya is committed to becoming a leading example of the sustainable energy transition by increasing investments and policy support for renewable energy projects. A second big goal is to provide 100% access to electricity and clean cooking by 2022 and 2028 respectively, as most people still don't have access to reliable, affordable, modern energy. Third, under the Paris Climate Accord, Kenya has pledged that by 2030 it will have reduced its volume of greenhouse gas emissions by 30% relative to expected emissions under a business-as-usual scenario of 143 $MtCO_2e$ per annum in 2030 (Ministry of Environment and Natural Resources 2015).

Like many countries globally, these laudable goals present serious technical, social, economic and environmental challenges, forcing Kenya to face many complex dilemmas around its energy choices*. For example, pressure from the country's rapidly growing population and increasing wealth is intensifying the demand for fossil fuels, especially for transport. That demand comes as oil and coal discoveries in Kenya could meet the demand, but only by increasing greenhouse gas emissions. More people also means more use of biomass for cooking which could lead to greater environmental degradation.

Given these dilemmas, what assumptions about the future of energy are being made as energy policies are being developed? How might they influence the energy transition to a low carbon economy? Are the assumptions justified or is there a need for differentiated views that take into consideration a people perspective? According to Boudet (2019), it is important to test policy assumptions using the lens of public perceptions, including the level of public knowledge, needs and reactions to proposed policies. These might challenge policymakers' views of the conditions people face on a daily basis.

This paper is organized as follows. Section I presents an overview of Kenya's current energy system – both supply and demand – and compares it to the government's stated ambitions and the polices to achieve them. This is followed by Section II, which presents policies and their underlying projections of the country's future energy system. Section III gives an analysis of the key assumptions about the country's future energy system contained in both the projections and energy policies. The assumptions will be analysed by comparing the perspectives of the government to those of the people. The paper concludes with a summary of the findings, and highlights insights that could strengthen policy makers' ability to question their own assumptions to ensure their plans match their ambition for Kenya's future energy pathways.

* *Kenya Vision 2030, https://vision2030.go.ke, accessed 19 November 2020; Mwangola and Society for International Development, 2018*

KENYA'S CURRENT ENERGY STATUS

Energy supply

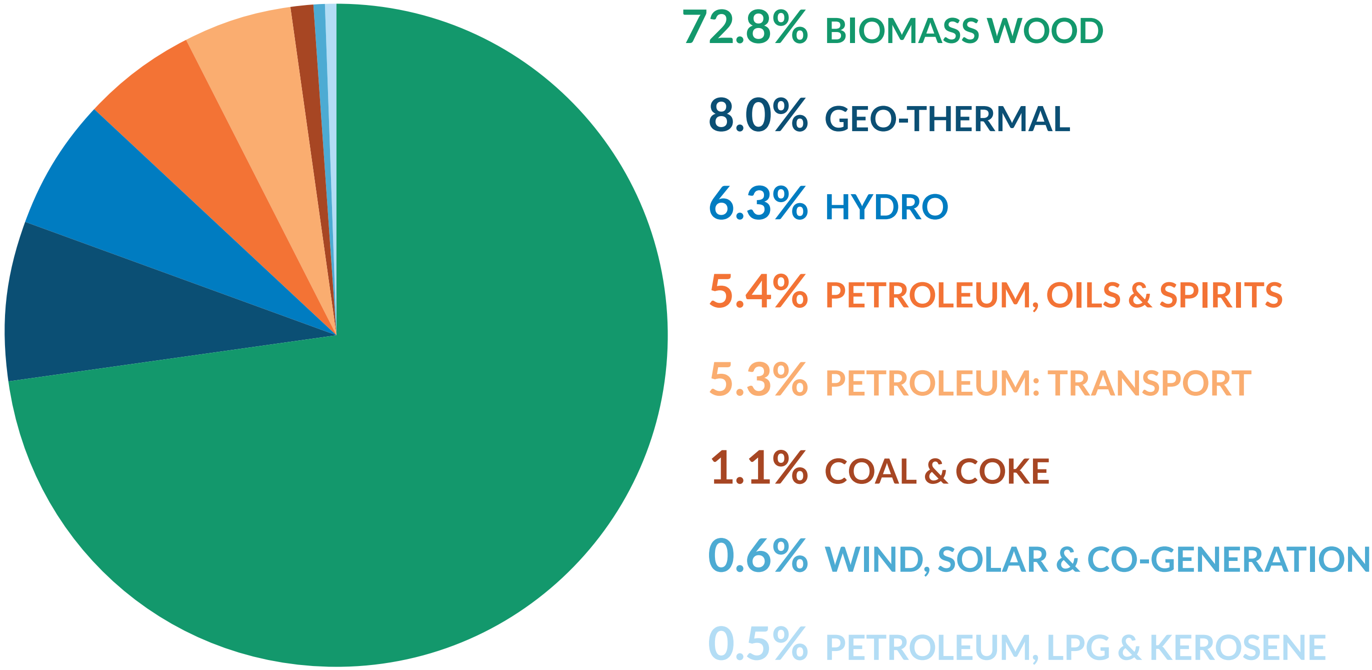

Figure 20: Primary energy supply in Kenya. Source of data - KNBS Economic Survey 2019, Table 9.11 (b). Total 2018 Energy Supply in gigawatts = 63,722.7

The Kenyan statistics on energy for 2018 published in the Kenya National Bureau of Statistics (KNBS) ***Economic Survey of 2019****[*] show that over 70% of the primary energy supply in Kenya came from biomass, with the balance coming from fossil fuels and renewable sources used to generate electricity.

* *Kenya National Bureau of Statistics (KNBS), Economic Survey, 2019, using 2018 data. These data are used because they are the most reliable of the recent figures we have.*

Energy use

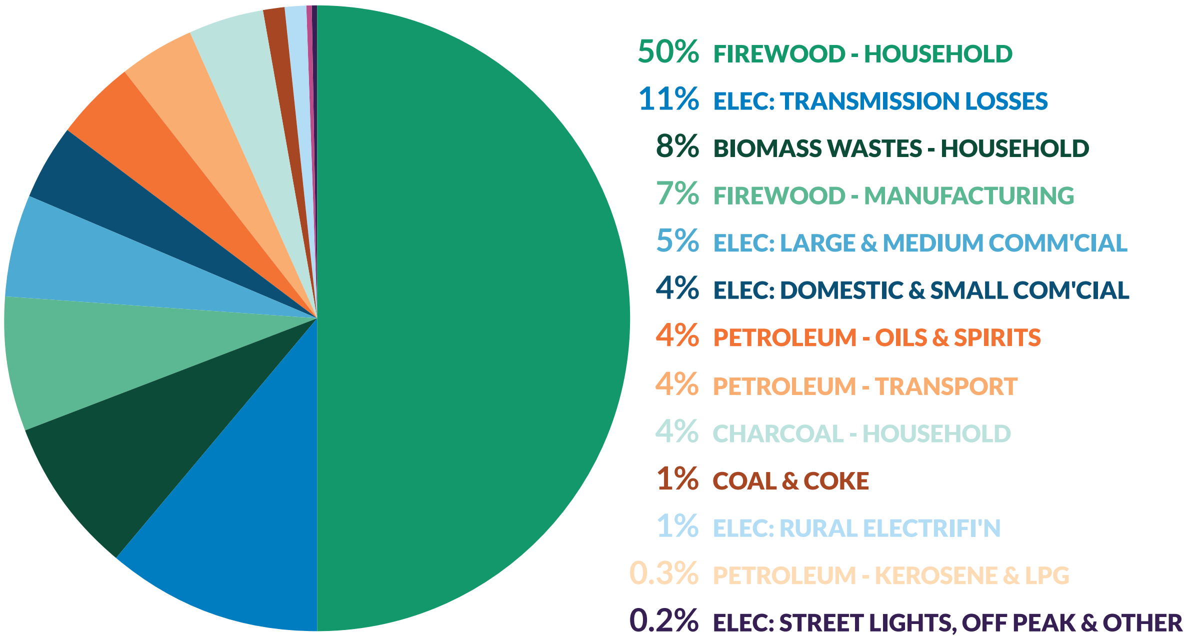

Figure 21: Uses of primary energy, 2018. Source of data KNBS Economic Survey 2019. Total Energy Used in 2018 = 86,125.3GWH*

The 2018 statistics on energy use differ slightly from supply, but biomass still accounts for 69% of energy use in Kenya, especially in rural areas where 70% of Kenyans still live**. About a fifth of energy used in 2018 came from electricity, but much of that (11% of total energy use) was lost in transmission. Large and small businesses were major users of electricity, while fossil fuel in 2018 accounted for 9% of energy use; most of this was petroleum products such as transport fuels or a variety of oils and spirits.

Most energy use (62% of the total) came from households burning biomass (firewood, wastes or charcoal), with a small share of coming from household use of electricity – around 5% of total energy used in Kenya in 2018. Coke and coal were a small part of the mix, as were kerosene and liquid petroleum gas, LPG. Household use of electricity and fossil fuels was less common in 2018, although it has increased since then.

* *In the KNBS Economic Survey of 2020, it is hard to clarify what numbers describe the supply of primary energy available, versus numbers describing what primary energy was consumed in Kenya. That may be why the primary energy supply noted in Figure 27, is smaller than the energy used noted in Figure 28.*

** *World Bank data reported in https://www.theglobaleconomy.com/Kenya/rural_population_percent/ accessed 21 October 2020.*

POLICIES AND PROJECTIONS OF KENYA'S FUTURE ENERGY SYSTEM

Summing up: Kenya's energy supply & demand

Despite the modernisation of Kenya's economy, the energy system still relies on biomass, especially wood fuel used in rural households and agricultural industries. Urban households also use biomass, especially charcoal, while energy in the form of electricity is largely used by businesses and urban consumers. Both LPG and kerosene were relatively small contributors to energy use in Kenya in 2018.

The principal driver of this reliance on biomass comes from domestic cooking, as only an estimated 10% of the population have access to clean cooking energy. As access to electricity is defined as living within connecting distance of an electricity supply, 75% of Kenya's population had access to electricity in 2018 after significant growth over the previous decade (SDG 7 tracking report). However, household use of electricity only accounted for 4% of household and small business energy consumption in 2018. The significantly lower percentage of people who use electricity, compared to those who have access, is partly explained by the definition of access as the presence of a line to which a household can be connected. Even with access, electricity may have been too expensive and/or unreliable to be used for cooking or anything else beyond simple lighting. Even lighting was not that widespread. While over 40% of urban and peri-urban households rely on electricity for lighting, 87% of the rural population still relied on kerosene for their lighting needs in 2018.

Summing up, in spite of the ambition to achieve universal access to reliable, affordable, modern energy for lighting and cooking by 2022 and 2028 respectively, there is still a long way to go to achieve these targets.

Policy targets seek to increase access to clean energy

With most Kenyan households still relying on biomass fuel, the government set a target to attain 100% electricity access by 2022 and 100% access to clean cooking energy by 2028. In addition, Kenya wants to create an energy system that will produce 30% less carbon in the atmosphere compared to a business-as-usual scenario for 2030*. This low-carbon energy policy will be adopted across energy-reliant sectors such as transport, households, agriculture, buildings and the manufacturing sector.

How does the government expect to meet these targets? To answer that question, we analysed various existing energy policy documents from the government as well as related studies and reports**. Table 6 below provides a summary of the analysis.

* *The business-as-usual scenario assumes that by 2030 Kenya would producing up to 143 MtCO2e per annum of greenhouse gases, up from 78.86 MtCO2e in 2016, most of which came from agriculture and land use changes. See data at World Resource Institute: https://www.wri.org/blog/2020/02/greenhouse-gas-emissions-by-country-sector*

** *The main analysis is based on: Kenya's Vision 2030 (https://vision2030.go.ke/, accessed 19 November 2020); SEforAll Action Agenda, Kenya's Green Economy Strategy and Implementation Plan (GESIP) Strategy 2016-2020 (Government of Kenya, 2019); the updated Least Cost Power Development Plan (LCPDP) 2017 -2037 (Republic of Kenya, 2018); Kenya National Electrification Strategy (KNES) 2018 (Ministry of Energy, 2018a); Kenya National Energy Efficiency and Conservation Strategy (NEEC) 2020 (Ministry of Energy, 2020a); National Bioenergy Strategy 2020, Energy for Whom? (Mwangola and Society for International Development, 2018); IEA Kenya Energy Outlook 2019 (IEA, 2019), among others.*

Government goals and expectations			
	2030	**2040**	**2050**
Policy Goals	• 100% electricity access for all • 30% emissions reduction relative to BAU of 143 $MtCO_2e$ per annum • Auction markets defined but not mature	• Energy policy focus on efficiency and conservation • Emphasis on net-zero emissions • Auction markets dictate cost of electricity	• No stated policy goals, but focus may still be on efficiency and conservation (if preceding decades global targets are not met)
Energy & technology: expected achievements	• Over 80% of electricity from renewables. 15% coal share in total final electricity consumption • Bioenergy dominant cooking energy source in households • Electricity supply exceeds demand by 23% • Existence of both centralized and decentralized electricity systems • Commercial and industrial (C&I) dominant electricity consumers • E-mobility increases gradually • Digitalization increase in industry operations threatening human labour	• Mainly renewable generation • Coal plants still operational • Drop in oil demand except in some sectors. i.e. transport • Charcoal demand drops due to supply deficit • Both centralized and decentralized electricity systems • C&I remain dominant electricity consumers • E-mobility becomes cheaper • Digitalization and automations surge in industries resulting in human labour phase out	• Mainly renewable generation • No clear projections on future of coal and oil • Increased uptake of synthetic fuels in the transport sector • No clear projection on expected emergent technologies • No clear projection on reliance on charcoal to meet households cooking energy needs

Table 6: Kenya's 2030, 2040 and 2050 Energy supply and demand goals & expectations

WHAT ARE THE ASSUMPTIONS GOVERNMENT IS MAKING ABOUT KENYA'S ENERGY FUTURE?

The plans and ambitions outlined in Table 5 reveal a number of assumptions being made by the government. They also show that Kenya's future energy pathway will involve a trade-off between centralized vs decentralized energy solutions, and between renewable energy and fossil fuel resources (Johnson et al 2017b ; Escudero et al 2017).* Below are a few examples of assumptions underlying long term plans for energy in Kenya.

Increased manufacturing will drive energy demand and employment

As per the government policies we analysed, priority energy projects are mainly for electricity generation in on-grid centralised systems targeting bulk demand. Relatively lower financial resources are dedicated to off-grid systems. The emphasis on a centralised electricity grid energy system backs up Kenya's Big Four Agenda.

That Agenda targets the manufacturing sector as one of the four priority areas which will drive the economy and create employment opportunities, but needs additional electricity generating capacity to enable the sector.

In his 2020 State of the Nation address, Kenya's president reiterated the need to shift from "a country of net consumers to a country of net producers" and the significant role of energy investments in this journey (The Presidency, 2020).

There are two important assumptions here: first, manufacturing will drive the economy and create employment. Second, a growing number of commercial and industrial customers will need increased amounts of energy which can be met by increasing electricity generation.

Critique: While increasing Kenya's manufacturing potential is projected to increase the demand for energy, the current slow growth in the sector has been associated with the prohibitive nature of Kenya's expensive and unreliable power. This raises the question of what should come first, bringing the chicken and egg analogy to mind.

The manufacturing sector is also facing other challenges such as the lack of technical expertise, cheaper imported products in the market and a heavy taxation burden (ITWeb 2019; Kangethe 2018).

For manufacturing to unlock the success of the other development pillars in the Big Four Agenda, there is a need for a comprehensive plan to ensure cross-sectoral coordination to improve the chances of achieving all four goals. Only once the manufacturing industry has reached its peak potential will it be able to drive energy demand and create job opportunities.

** The Energy Act 2019 has devolved some energy functions to the county governments while some remain a function of national government through relevant state agencies.*

Electricity can meet the bulk of energy demand

The emphasis on electricity is evident in most of the government's energy planning and prioritization, which revolves around increasing the number of connections and megawatts in order to bring electricity to all households (The Presidency 2017).

These plans reflect another assumption: that all the energy needs of both industry and the population can be met with electricity provided by clean renewable technologies.

Critique: When looked at from a people's perspective, many of these plans do not adequately represent the energy needs as people perceive them, especially the poor living in rural off-grid communities or informal settlement within peri-urban and urban areas (Practical Action 2016).

A survey on public support for national energy policies showed only 19% supported policies to increase electrification of households. Thirty-three percent supported frameworks aimed at lowering electricity prices and 40% prioritised policies to stimulate investments in renewable energy (Oluoch et al. 2020).

This low support for increased electrification tests the assumption that electrification for all is possible and is a goal shared by the wider public.

A centralised electricity grid is a better investment

A third assumption is that the increased electricity needed in manufacturing is best supplied to business users through a centralised electricity grid.

The government is involved in decentralised electricity systems in rural areas, but there are signs of ambivalence. The Kenya Off-grid Solar Access Project (KOSAP) is a 150-million USD flagship project by the Ministry of Energy in partnership with state energy agencies Kenya Power and the Rural Electrification and Renewable Energy Corporation (REREC). The project demonstrates a commitment to decentralised, off-grid systems for the hard-to-reach last mile communities. This is in addition to KOSAP's release of five million USD in October 2020 to the private sector to enable the sale of quality solar and clean cooking products in off-grid areas (Ministry of Energy 2020b). However, the implementation of the KOSAP project remains slow since the official launch in 2017, and its success in increasing energy access is yet to be seen. This reinforces the perception of a tacit preference for a centralised grid.

Critique: The most important challenge to this assumption is coming from commercial and industrial energy consumers. In 2020, there has been a growing shift as heavy-consuming industrialists pursue reliable and cheaper energy supplies from their own solar power systems, something first noted by Kenya Power in 2019 (Business Daily 2020).

Kenya Power revealed in its 2019 annual report:

Kenya Power operated in a challenging environment over the financial year under review, where demand growth at 3.7 percent remained below the projected level of five percent. The dampened demand growth is further compounded with the increased threats of grid defection by the industrial category as decentralised renewable energy options are becoming more available and cheaper (KPLC 2019).

While there are more decentralised energy projects designed to meet rural demand, Kenya Power is worrying about business customers who are generating their own decentralised power. This business response to unreliable grid electricity challenges the assumption that commercial and industrial customers will be the key users of grid electricity. If they are not the main users, who will buy grid electricity in the future?

Fossil fuels, coal and oil should be used if available

Although Kenya may want to achieve a 100% transition to renewable energy, it is not guaranteed that the country will choose to rely on low carbon energy solutions in the future (Johnson et al. 2017a). With the recent discovery of oil and coal in Kenya, the government believes the country should fully benefit from these resources and is creating the enabling framework for their exploration and development (Ministry of Energy 2018b). The National Energy Policy outlines the prospects of providing 2,000 MW of electricity generation from coal by 2030 and assumes there will be safeguards in place to promote the efficient use of coal resources with minimal environmental impacts. It is also assumed that coal will be a cheap and reliable primary energy.

Critique: It is not clear that either assumption is justified. If the proposed Lamu coal power plant commenced operation in the year 2024, it would increase the share of fossil fuels and greenhouse gases in the energy mix. Additionally, a clean energy transition report has shown that the levelized cost of electricity from coal would be up to seven times higher than what is currently estimated. If energy demand does not grow as projected, this difference could create a supply-demand imbalance and raise the cost of electricity, according to the updated Least Cost Power Development Plan. In that case, existing customers would be asked to cover the cost of investing in expensive coal-fired power generation that is rarely used.

Civil society organisations, often backed by the public, are strongly opposed to using power from coal and nuclear energy, a move that has been described as "ten steps backwards on Kenya's energy future," (Langat 2016; Save Lamu 2020; Dena 2019). The Lamu coal-fired power plant proposal has been a flash point, provoking both local opposition and objections from the United Nations Educational, Scientific and Cultural Organization (UNESCO) which asked the Kenyan government to reassess its impact on Lamu old town, a World Heritage Site.

The continued use of petrol and diesel for transport seems to have wide agreement, both in the public and government thinking. Reliance on, and investment in, petrol and diesel vehicles continues with little expectation the technology with change. This could be a misplaced assumption, if the transition to electric vehicles takes places more quickly than elsewhere.

Biomass and the transition to clean cooking

There is a tacit assumption that alternative fuels and technologies, coupled with increased public awareness and greater household wealth with industrial development, will enable a paradigm shift away from Kenya's use of biomass for cooking. There are also projects which promote user-centric design based on realities of energy-poor people and their needs. This is expected to encourage the use of modern cooking technologies, especially in rural communities where culture influences energy choices (Practical Action 2016; Ministry of Energy 2019). Clean alternatives to wood fuel and charcoal are also being promoted, including solar, briquettes, LPG, and biogas, in both national and county policies.

Critique: Despite these initiatives, biomass use continues. The assumption of a paradigm shift away from bioenergy may not hold water. Underlying socio-cultural influences on consumer behaviour and product preferences are a major barrier, as are the higher prices for alternative fuels as discussed elsewhere in this Compendium. Projections from the International Energy Agency (IEA) in its Kenya Energy Outlook 2019 assume biomass will continue to dominate primary energy demand over the next two decades. By 2032, they believe the demand for charcoal will exceed its supply by at least one per cent, resulting in a shortage and higher prices. This would signal a failure to meet Kenya's goals for access to clean energy (IEA 2020b), but might force a shift to cleaner alternatives.

CONCLUSION

The aim of this chapter was to review policy documents, strategies and plans and analyse some of the key assumptions by policy makers about Kenya's future energy system. Overall, the findings reflect significant variations between the critiques coming from a people's perspective of what they need, and the government's energy plans. For instance, the government assumes that increasing the number of electricity connections and megawatts will improve energy access for all, without understanding why people don't use the electricity. From the people's perspective, energy access means they can reach a power line and afford to use that electricity.

Secondly, Kenya's clean energy transition is undermined by plans to tap into the country's new fossil fuel resources. The government's policy assumption is that the resources can and will be harnessed without an impact on greenhouse gas emissions and other environmental damage. Numerous public contestations to these plans highlight the damage fossil fuels can do, and are doing, to the environment and climate.

Thirdly, a strategy to transition to clean cooking assumes that the mere introduction of alternative fuels and technologies for clean cooking will reduce overreliance on biomass at the household level. However, the public perception of renewable energy technologies indicates a need to consider existing socio-cultural preferences and behaviours for this to be achieved.

Fourth, an analysis of the assumptions underlying the adoption of centralised versus decentralised energy systems reveals that the manufacturing industry is expected to need bulk energy from a centralised electricity grid. This has justified investments in grid-connected projects designed to meet increased demand from commercial and industrial customers. However, some large industries are shifting towards their own decentralised renewable generation to cut down on costs, increase reliability and potentially offset their carbon emissions.

Overall, there is a mismatch between policy and both business and popular energy needs. This could lead to a future energy system that is bound to worsen rather than resolve the most pressing socio-economic challenges, environmental degradation and climate change impacts. The result would be an energy system that prides itself on achieving 100% access (albeit loosely defined) while also meeting emissions targets, but fails to do so. In reality, Kenya's energy system is more likely to continue to entrench vulnerabilities among the energy poor without providing businesses with the energy reliability they need.

In conclusion, the study illuminates that energy policy making has to carefully put the perspectives of all its users - households and industries - centre stage when designing energy access interventions to ensure a sustainable and just transition for all.

POLICY RECOMMENDATIONS

1. The Ministry of Energy should help county governments understand energy issues by providing training and capacity development to achieve the enabling role that energy plays across sectors in a bottom-up approach.
2. Both the Ministry and county governments should regularly revise and update existing energy plans, strategies, and targets to factor in the changing social economic dynamics and climate change effects.
3. Dialogue is needed between the decision makers and the public to ensure a mutual understanding of policies and energy transition pathways, organised by government offices or independent organisations.
4. Greater local and central government awareness and support for community projects that adopt renewable energy technologies would also be valuable.

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10

CHAPTER TEN: TAX POLICY AND POWER GENERATION HOLD THE KEYS TO THE FUTURE OF FOSSIL FUELS IN KENYA

CHARLES WANGUHU

EXECUTIVE SUMMARY

The future of fossil fuels in Kenya is dependent on key factors, among them: Kenya decarbonization policy; tax policy; power generation; and Kenya's aspiration to become an oil and gas producer. The view of the future of fossil fuels in Kenya, and whether it is bleak or bright, is also dependent on which level of industry is considered, whether it is upstream exploration and production, midstream processing or downstream use of fossil fuels.

Downstream, the government had initially put in place frameworks related to price controls that encouraged the uptake of clean sources of fuel among the population. In illustration, the taxation of fuel is a huge earner for the Treasury, with over 40% of the retail price of super petrol and diesel currently going to taxes, levies and funds to the Exchequer. However, recent changes to tax policy, particularly in relation to liquified petroleum gas (LPG) may reverse this process.

An increase in the price of LPG may lead to people reverting to dirtier fuels like wood, kerosene and charcoal. Midstream, the government is enhancing the efficiency of pipeline services to cater to regional demands for fossil fuels.

Upstream, tax changes may have partially resulted in halting operations in Kenya's most advanced oil and gas exploration and production project in Turkana.

This mixed picture is complicated by Kenya's power generation and consumption which is dominated by renewable sources of sometimes unreliable energy, such as climate sensitive hydropower. To compensate, the country currently relies on power from fossil fuels, but also wants to reduce reliance on such thermal power. Kenya is also impacted by the global conversation on decarbonisation, and continues to commit to reducing its carbon emissions.


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CONTEXT

The study of fossil fuels requires an interesting cross-disciplinary approach spanning legal, economic, scientific and social sub-sectors. At every point in the last decades since their use became mainstream, a key narrative has driven the discussion. The "peak oil" narrative was previously a key driver of action in the sector, the idea being that at some point the world could run out of oil (Holahan, 2020). This theory was developed in 1956 and then rehashed over the decades. It became most relevant when the price of oil hit a high of $100 a barrel. A high price led to the expansion of production to include difficult-to-extract oil like the oil sands in Alberta, Canada, and led to innovations in the fracking industry in the US and other places.

New technology like fracking has had an impact on the assumptions behind the idea of "peak oil." Two economic crises have also affected the discussion around energy use, first linked to the 2008 financial crisis, and now the COVID-19 pandemic. The two crises had an impact on both demand and supply of fossil fuels and continue to impact the analysis of fossil fuels in the energy sector.

In the most recent turn of events, the dominating discussion in fossil fuels is around climate change and the need for an energy transition. The Paris Agreement of 2015 on climate change is an international treaty, legally binding to Kenya under the Constitution of Kenya Article 2(5). To achieve the goals set out in the agreement, the world use of fossil fuels must be curtailed in order to limit global warming by reducing greenhouse gas emissions; fossil fuel use is the biggest contributor to global emissions (United States Environmental Protection Agency, 2019).

The energy transition debate flips peak oil on its head to a "stranded assets" conversation. As the world reduces its use of fossil fuels, fossil fuel assets may not be exploited, leaving their owners with significant debts and assets that are unlikely to get to market, making it harder to pay off those debts. According to newspaper reports, Tullow Oil and its joint venture partners have spent over 180 billion shillings ($1.6 billion) its Kenya project. The cost recovery process requires that Tullow start recovering the costs upon commencement of full field development and the sale of Kenya's oil in international markets. If Tullow does not get the oil to market, it would have to absorb the entire costs. In its 2019 full results, Tullow globally had to write off approximately two billion dollars in exploration, demonstrating that a decline in the oil price outlook is a reality of the sector (Tullow Oil PLC, 2020)

Cumulatively, fossil fuels accounted for 84% of the world's primary energy consumption in 2019 (BP, 2020). The US Energy Information Administration (EIA) in 2016 ranked Kenya 76th in the world in the consumption of petroleum and other liquid consumption. Kenya's fossil fuel use at 120,000 barrels of oil per day (BOPD) dwarfs its neighbours, with Uganda currently consuming

33,000 BOPD and Tanzania 55,000 BOPD.* Climate activists and most scientists want rapid decarbonisation, but the energy transition is likely to be a long-term process and will not occur overnight. To effectively analyse the future of fossil fuels in Kenya, one needs to segregate the different levels of use: upstream (exploration, development and production of oil and gas); midstream (pipelines/transportation); and downstream (including power generation as well as consumers and end users). The key thread that links the upstream and downstream is tax policy which directly influences developments at all levels.

In 2020, while celebrating the fifth anniversary of the Paris Climate agreement, world leaders upgraded their commitments. President Kenyatta indicated that Kenya had commenced the process of developing its long-term decarbonisation strategy.

* *These figures do not take account of other fossil fuel use including coal in use in heavy industry in the region or proposed new plants.*

DOWNSTREAM – USE OF FOSSIL FUELS

The majority of transport in Kenya is fossil fuel driven. More specifically, petroleum consumption, sale to retail pump outlets, and road transport accounted for 72% of domestic petroleum fuel sales in 2019 (KNBS, 2020). This could continue for some time, as progress towards the transition to electric vehicles has been slow. Kenya had only about 350 electric vehicles by December 2018, and updated data in the area remains scarce. The upsurge of investment in electric vehicles by key players such as Nopia Ride, Solar E-Cycles, and Omnibus among others necessitated the development and adoption of standards by the Kenya National Bureau of Standards that apply to vehicles imported into the country. The State Department of Transport is also creating the necessary policy and regulatory environment for uptake of e-mobility (State Department for Transport; GIZ, 2019). The Kenya Bureau of Standards has issued a standard for vehicle conversions to use liquefied petroleum (LPG) and compressed natural gases as engine fuels for internal combustion engines, opening the door to a transition to cleaner fuels. Notwithstanding these developments, progress in this space remains minimal.

Taxation on fuels is a huge income generator for the Kenyan government. The Tax Laws (Amendment) Act, 2020 which came into force on 25th April 2020 included taxes and levies as part of the VAT-able base for petroleum products. Upon its enforcement there was an increase in VAT and the contribution of taxes and levies immediately increased by 7.8% for super petrol, 9.1% for diesel and 1.7% for kerosene.

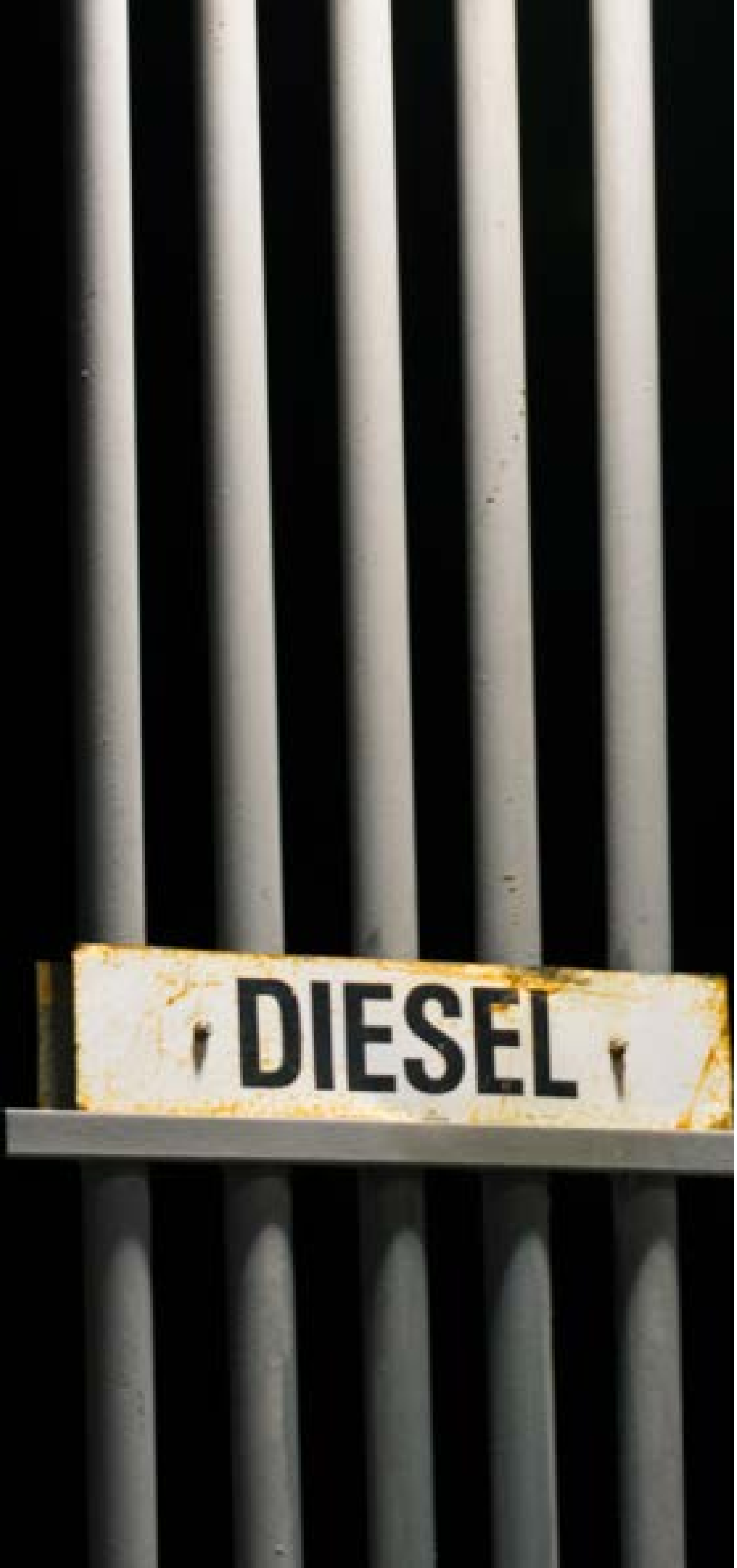
In July 2020, the government increased the petroleum development levy from Kshs 0.5 to Kshs 5.40. While pump prices in the year 2019 were generally higher due to the cost of international crude oil, the contribution of taxes and levies to the pump price has increased significantly for super petrol, kerosene and diesel since. For instance, for the period April/May to August/September in 2019, the government's average share of the retail price for the period stood at 34% for super petrol; and 35.2% for diesel. For the same period in 2020, super petrol taxes were 52.3%of the retail price, and 44.7% for diesel.

A significant reduction in global oil prices has not been felt at the pump, as government has consistently increased taxes. At the consumption level, therefore, Kenya has a reverse problem to most natural resource rich countries. Instead of subsidies for consumption, Kenya already taxes fuel consumption at a punitive rate. The latter places Kenya in good stead for the energy transition conversation.

The Ministry of Energy's goal of "affordable quality energy for all Kenyans" has led it to implement policies that have impacted the use of fossil fuels in country. The tax exemption of LPG in the Finance Act of 2016 and the increase in tax in response to fuel adulteration affecting kerosene in part contributed to the improvement in access to LPG as a primary cooking fuel for households from 13.4% in 2015/16 to 23.9% in 2019 (KNBS, 2018; KNBS, 2020). The Finance Act, 2020, passed in June 2020, took into account recommendations made by the International Monetary Fund to reduce the number of tax exempt goods as a means to meet the government's revenue targets. The tax exemption previously applied to LPG was lifted and it is now subject to 14% VAT, rising to 16% upon lifting of COVID-19 tax relief in January 2021. This could reduce the use of cleaner LPG for cooking as the price rises again.

Despite initiatives put in place by the government to increase the uptake of clean energy sources, dirty sources of fuel remain a primary fuel for majority of the households in the country. According to the Kenya Population and Housing Census (KPHC), 2019 the use of dirty fuels* in Kenya currently stands at 74.5% with kerosene accounting for 7.8% of all fuels used for cooking (approximately 10.5% of the dirty fuels used). However, there are disparities in access between urban and rural areas, with kerosene use standing at 1.6% and 17.7%, respectively (KNBS, 2020).

* *Mainly types of cooking fuel. In this context, dirty fuels considered are paraffin, firewood, and charcoal.*



MIDSTREAM – MOVING FOSSIL FUELS

At the midstream level the transportation of fuels is seen as a strategic industry for the Kenya government. The Kenya Pipeline Company is a government agency that has been identified as a strategic agency for the government. It has now been brought under the umbrella of Kenya Transport and Logistics Network (KTLN), together with Kenya Ports Authority and Kenya Railways. Strategically, it seeks to maintain Kenya's dominance in transportation and logistics in relation to its landlocked neighbours.

Uganda currently imports approximately 85 million litres of fuel, with demand growing at on average 7% per annum. Ninety-two percent of these imports are imported through the Mombasa port in Kenya, while only 8% is imported through Tanzania's Dar es Salaam port (Mwita, 2020). With the consolidation of the three agencies, landed costs of imported fuel could be greatly reduced by removing risks that have caused Kenya to lose to its neighbours, namely corruption on the highways and the adulteration of fuels.

The construction of a pipeline from Lokichar to Lamu is crucial to the commercialization of Kenya's own oil reserves. It is estimated that it shall be the longest buried, heated and underground pipeline in the world. The estimate of the cost of construction for the pipeline is prohibitive and currently stands at roughly 1.1 billion US dollars. In addition to the cost of the pipeline, other related infrastructure including access roads are estimated at 1.9 billion US dollars (Kiplagat, Kuloba, Tibaldesch, Abdallah, Mohamed, & Muturi, 2019) .

UPSTREAM – OIL EXPLORATION, DEVELOPMENT AND PRODUCTION

The global oil sector is in crisis as result of the COVID-19 pandemic. Lockdowns and the reduction in international travel have led to a collapse in the demand for oil and a crash in oil prices. At one point the US oil prices were in negative territory, as there was a shortage of spaces to store oil for which there was no market, forcing traders to pay buyers to take their oil. Kenya is considered a frontier country for oil and gas as it is yet to commercially export its 2012 oil discoveries. A pilot scheme christened Early Oil Pilot Scheme (EOPS) intended to test its reservoirs. It achieved a 2,000 barrels of oil per day production rate and resulted in the exportation of 240,000 barrels. However, after trucking the oil from the Turkana oil fields to the Mombasa port, the profits were so slim the project was not commercially viable and was put on hold. The full project envisages an initial 80,000 barrels of oil per day and the building of a pipeline from Lokichar in Turkana to the new Lamu port, a distance of over 800 kilometres.

Kenyan oil could have a bigger role in the future of the economy due to its potential in earning foreign exchange (forex). Traditional horticulture and tourism that dominated the forex contributions are declining due to high costs, competition and the COVID-19 pandemic. Long-term effects on these sectors are yet to be determined. Coupled with Kenya's huge publicly guaranteed debt of Khs 6.69 trillion in June 2020, compared to Kshs 5.81 trillion in June 2019 (National Treasury and Planning, 2020), any additional foreign exchange earner would take a central role in Kenya's economy.

However, Kenya's oil sector has suffered some setbacks, as its first project in the Lokichar basin faced challenges over the last year. Even before COVID-19 struck, its operator in the fields, Tullow Oil, had sought to find a buyer for its stake in the project. The company needed to balance its books, following a disastrous run of months when its CEO and head of exploration stepped down and they needed to restructure the business. Tullow and its partner would later go on to declare force majeure* on the project under the guise of COVID-19 and tax changes. Tax changes put forward under the Tax (Amendment) Act, 2020 related to upstream oil and gas included increasing corporate tax on machinery used for exploration operations from 20% to 50% in the first year, and 25% thereafter. Similarly, previously tax-exempt supplies for operations were now subject to standard taxation. Later Tullow Oil removed the force majeure and has now received an extension to its licenses to the end of 2021 (Tullow Oil PLC, 2020). However, that period only extends exploration, not the commencement of any production of oil at the Turkana site.

The force majeure notice following a proposed increase on VAT shows the continued challenge of maximizing benefits while attempting to not impede development. It also illustrates that Kenya's ability to exploit its oil finds is intrinsically linked to its taxation policy, especially as its oil finds are not as large as in neighbouring countries. The exit of several high-profile funds and multilateral organizations, including the World Bank and International Finance Corporation, (IFC, a member of the World Bank group) from funding fossil fuel projects poses a challenge for frontier countries trying to commercialize their finds. The countries are left to raise capital from a limited pool of funding sources who do not adhere to principles such as the performance standards of the IFC.

* ***Force majeure*** *is a legal term used in contracts whenever underlying conditions beyond anyone's control have changed so dramatically that the contract's terms cannot be met.*

An ever-present challenge attached to working with smaller exploration companies, like Tullow, is that without deep pockets small companies need super normal profits to stay in business. The need for high returns ensures that the money needed for such capital-intensive projects goes to the prospect with the highest return. That, in turn, forces countries to disadvantage themselves in competing with other natural resource rich countries. In a private conversation, an oil executive argued that Kenya needs to "sweeten" its project by giving more incentives to ensure it goes ahead. At some point, the "sweeteners" a country offers destroy the benefits the project was meant to bring.

Companies are aware of the backlash coming from resource-rich countries which are no longer keen to bend to corporate bidding after years of exploitation. Rather than influence national decisions publicly, companies are working privately through their home country missions; in addition, they maintain memberships in local lobby groups that are vocally opposed to any attempts at ensuring countries get a better deal. This corporate approach undermines the ongoing work of the Africa Mining Vision, which focuses on reducing illicit and sometimes legal but unfair financial flows out of resource-rich countries. Civil society organizations like the Tax Justice Network Africa (TJNA) have been at the forefront of ensuring fairer taxation systems and sealing loopholes that have traditionally been exploited by extractive sector companies. The fossil fuel sector and the broader extractive sector companies are both considered high-risk for illicit financial flows with their use of low tax jurisdictions and tax havens.

The stranded assets conversation has also led to a shift in the power balance during negotiations with countries keen to attract investment. Huge commodity firms unencumbered by pressure groups and civil society are likely to fill the funding gaps, which could simply lead to a second round of disenfranchisement of countries rich in natural resources. In this, Kenya's experience is not any different from its regional neighbours. Uganda recently held a bidding round for oil blocks that only attracted six bidders, forcing it to extend the deadline on the bidding round which resulted in no new applications.

In summary, Kenya's dream of becoming an oil producer is in a precarious state. The balance of tax policy to encourage development, attract new exploration of its unexplored basins while maximizing gains from the sector, is crucial. The gas finds in Wajir and offshore Lamu basin also require additional exploration if they are indeed to join the energy mix as a transition fuel, but may prove to be both expensive and risky propositions.

ELECTRICITY GENERATION – THE BASE LOAD CHALLENGE?

The EIA's definition of base load is "the minimum amount of electric power delivered or required over a given period of time at a steady rate." In a rather ironic twist of fate, the majority of renewable energy sources, be it hydro, wind or solar, are impacted by climate change and are therefore not reliable as a base load in an electricity grid. During their peak, renewables can supply excess; however their power cannot currently be easily stored. Therefore, two of the challenges of the energy transition are: first, the issue of having base load that can supply uninterrupted power to the grid; second, the storage of power produced by intermittent renewable energy. Geothermal energy could provide that kind of base load, but at present is not sufficient to do so.

Kenya has positioned itself as a leader in renewable energies with approximately 86% of electricity generated within the country being obtained from renewable sources. The particular contributions of geothermal, hydro, wind to electricity generated within the country is 45%, 28 %, and 13 %, respectively (KNBS, 2020). This supply has been found to be adequate to meet current local demand.

Historically, Kenya's electricity generation was dominated by renewable energy and was initially limited to hydropower. In 1995, 77% of Kenya's power was hydropower (Sugimoto, 2005). However, that period coincided with frequent blackouts and unreliability in the supply of power. More recent policy, while seeking to increase the quantity of power generated by renewable energy sources, seeks to reduce dependency on hydroelectricity to 5% by 2021. In seeking to diversify its energy pool, Kenya invited public-private partnerships to increase the thermal production of electricity using heavy fuels and industrial diesel.

Diesel thermal power generation was seen as a quick and easy solution to the challenge of providing baseload electricity generation to compensate for the fluctuations of renewable energy. Moreover, it could be shut down and restarted rather easily. However, to attract investment in thermal power, the agreements have needed to include provisions guaranteeing a minimum amount of power purchased by government, regardless of whether the government actually took up the power.

Energy transition is a long term endeavour. The expiry of some power purchase agreements has led to companies pulling out extra capacity, as IBERAFRICA did by putting up one of their thermal plants for sale. Such developments point to an important shift in the fuel mix, as does the coming onstream of projects like the Lake Turkana wind project, and increasing geothermal capacity. However, some power purchasing agreements for thermal plants were signed in 2015 which means thermal power will be part of Kenya's power generation mix for a while longer (Githae, 2020). As a result, the cost of thermal plant agreements will continue to be passed on to users in high electricity prices, which rule out using electricity for household cooking.

An option that has been posed is moving towards gas for power generation by converting today's thermal fuel or heavy fuels plants to natural gas. Such conversions of plants with existing power purchase agreement may address the dual challenges of high cost and pollution. A regional element of that would be the initial importation from Tanzania and Mozambique of natural gas to be used in the plants. The proposal to have a natural gas pipeline from Dar es Salaam through Tanga and onwards to Mombasa has been mooted. This would create intra-African trade and, if managed well, could lead to lower landed costs. The government is embarking on a review of its thermal power generation and the feasibility of transitioning current capacity to natural gas.

CONCLUSION AND POLICY IMPLICATIONS

An initial review of power purchasing agreements suggests that fossil fuels will remain in Kenya's energy mix for the foreseeable future. However, it is clear that a shift to renewables would be greatly enhanced with a transition from the thermal production of electricity using heavy fuels to using natural gas which has lower carbon emissions. Before gas can be introduced, a comprehensive review of current plants and their ability to make the transition is needed, along with a review of the power purchasing agreements currently in force. The goal of making the shift to gas would be to lower the cost of electricity generation and pass that benefit onwards to the end users.

Secondly, tax policy has an impact on the uptake of modern energy options and can reduce the use of dirty fuels. A policy to ensure the transition to safer and better energy options is critical if an energy transition is to be effective.

Tax incentives to make clean, renewable energy more affordable have a direct impact on health and should be included in any policy to reduce non-communicable diseases. By linking this policy to health benefits, it is less vulnerable to change in government tax policy whenever government needs to plug holes in other budget areas.

Kenya's oil and gas sector is experiencing challenges that require robust policy review. The ability to attract new players in the current era of energy transition, coupled with the COVID-19 pandemic, is going to be a herculean task. The temptation to compete in a race to the bottom to attract investment is likely to be very risky. In the event the country moves to produce oil and gas, the issue of the climate change energy transition comes into play. As this transition is essential to the future of all peoples, it would be prudent to allocate future energy revenues from the fossil fuel sector towards the energy transition.

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BIOMASS ENERGY: RENEWABLE, BUT IS IT SUSTAINABLE?

INSIDE

As shown in the first graph of the Compendium, over 50% of the energy used by Kenyans in 2019 came from wood biomass. In previous years, the percentage was even higher. Biomass dominates because most of the energy used by Kenyans is for domestic use, largely cooking with some heating. The energy used in manufacturing, heavy and light industry, as well as transport, remains much smaller than the energy used in Kenyan homes.

The story of biomass in Kenya's energy system runs through this Compendium, starting with the first graph and continuing in the first article of Section II, "Household Energy Choices." Here in Section IV we put the focus on biomass energy itself. The statistical graphs put together by Tony Watima look not just at the use of biomass energy, but also at the consequences for forest cover and forest products in Kenya. These statistics show why biomass may be renewable because trees regrow, but also why biomass energy may not be sustainable.

The first essay from Barbara Heinzen and Leo Kemboi compares biomass energy prices to the cost of other household fuels in order to explain why biomass remains the single most used primary fuel in Kenya. The second essay by Martha Wakoli addresses a different question: given that biomass used for cooking is the most common source of energy used in Kenya, where are the women in energy management and policy thinking in Kenya? The final essay in this section comes from Sarah Odera, who argues provocatively that biomass energy is here to stay. This conclusion defies conventional wisdom which expects biomass to be replaced by cleaner, modern fuels such as gas cylinders or electricity, either from the grid or a more local system.

If Sarah Odera is right, it returns us to the biomass statistical graphs: biomass may be renewable because it grows back, but can it grow back faster than it is used? If not, this may be a renewable fuel, but not a sustainable one.

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CHAPTER ELEVEN: BIOMASS ENERGY IN NUMBERS: IS IT SUSTAINABLE?

TONY WATIMA

Most of Kenya's energy use is in households and most involves firewood, as shown in the graph below using data from the Kenya Household Cooking Sector Study, 2019.

WOODFUEL USE

97%

Rural houses using woodfuels as their primary fuel.

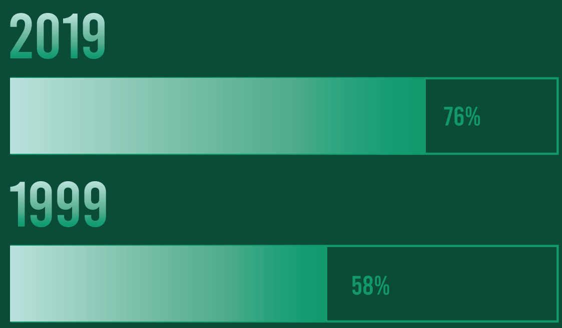
70%

Households using woodstoves as either their primary/secondary cookstove

1.3 MILLION

Households using charcoal cookstoves as their primary cookstove (*10.3% of households in Kenya*)

Households using Three Stone Fire



395.2KG

Annual national charcoal consumption among households

KSHS. 68 BILLION

Market value of charcoal consumed a year

Types of Charcoal Stoves

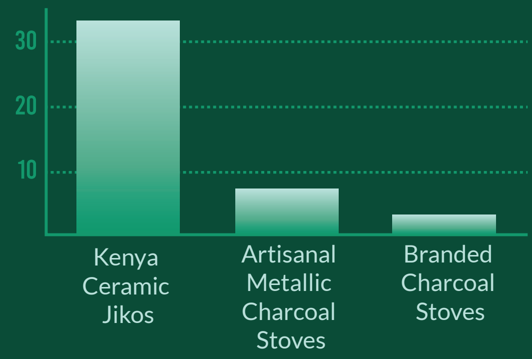


Figure 22: Household use of biomass, source: Kenya Household Cooking Sector Study 2019

Biomass is a notoriously dirty fuel, but only a minority of households have access to clean cooking solutions.

Figure 23 looks at the proportion of households with access to clean cooking solutions, improved cooking solutions and traditional cooking solutions. Traditional cooking solutions include the Three Stove Open Fire, metallic charcoal stoves and kerosene wick stoves. Clean cooking solutions include LPG, biogas and electricity. Improved cooking solutions include charcoal and woodstove, largely using biomass.

Given this reliance on biomass, especially fuel wood, it is reasonable to assume Kenya's forest cover will have suffered. However, recent data from KNBS show a slight increase in forest cover from 4,103,000 hectares in 2014 to 4,224,300 hectares in 2018, as shown in Figure 24, Forest Cover.

Figure 23: Limited household access to clean cooking solutions. Source: Kenya Household Cooking Sector Study 2019 . Clean Cooking Association of Kenya.

This graph compares Kenya's total forest area, named "Available Forest Cover", to the hectares of gazetted "government forest." Government always auctions what is officially called government forest to loggers, but what is designated as government forest excludes areas such as water catchment areas, water towers, national parks and reserves that have forest cover.

However, remote sensing data from NASA*, shown in Figures 32 and 33, show the annual losses of land with 30% tree cover and of primary forest in Kenya from 2001-2018. In that time, 312, 233 hectares of land with 30% tree cover were lost, while 43,029 hectares of primary forest were cut down.

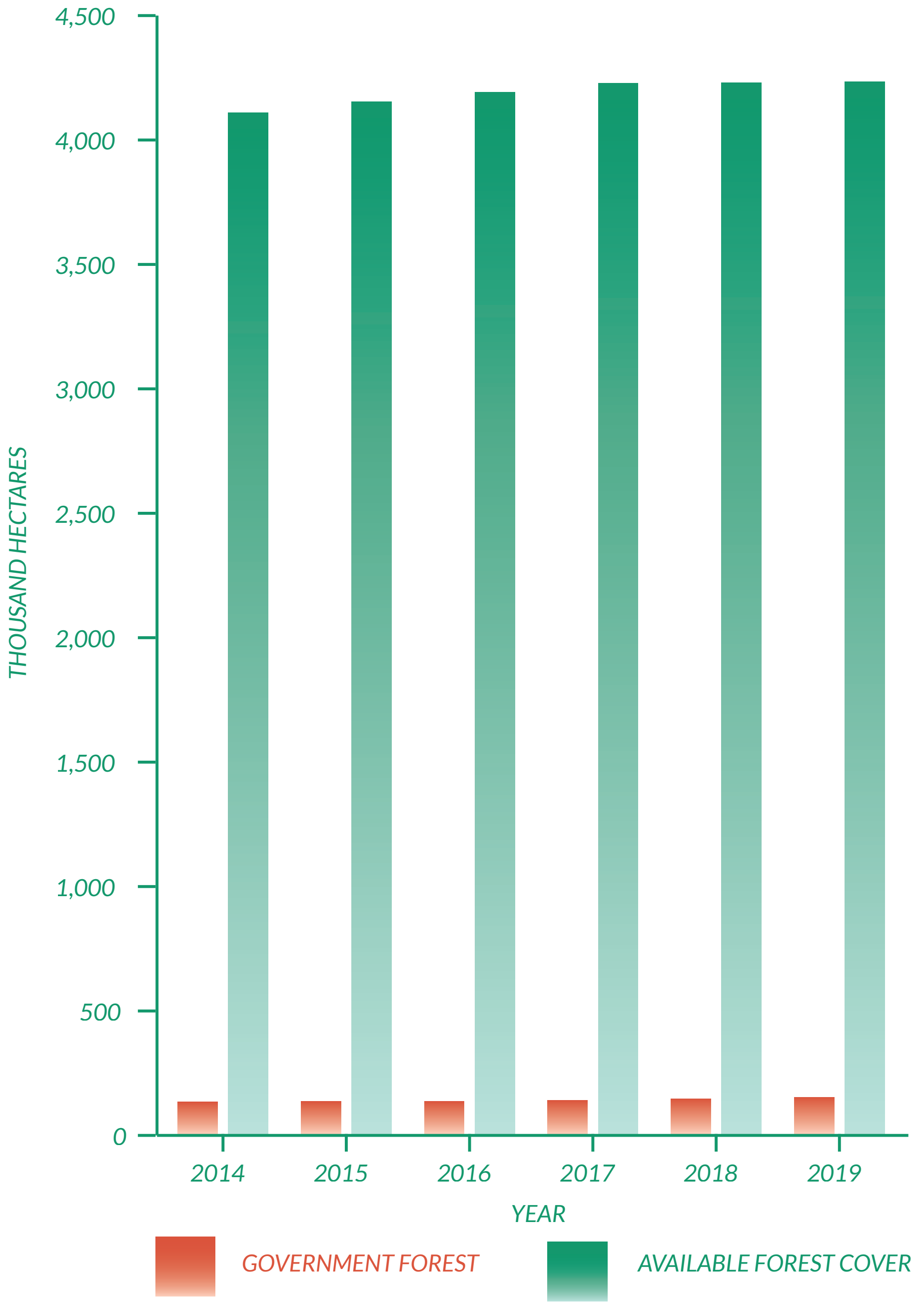


Figure 24 Forest cover in Kenya 2014-2018 (KNBS Statistical Abstract, 2020).

** Mongabay. "Deforestation statistics for Kenya". Accessed on 1 December 2020 from www.rainforests.mongabay.com ; Data Source: Tree cover loss: Hansen/UMD/Google/USGS/NASA via Global Forest Watch. Administrative boundaries: Global Administrative Areas database (GADM), version 3.6.*

Given the changes in tree cover and primary forest shown in these figures, the government restricted the sale of products from state forests starting in 2018.

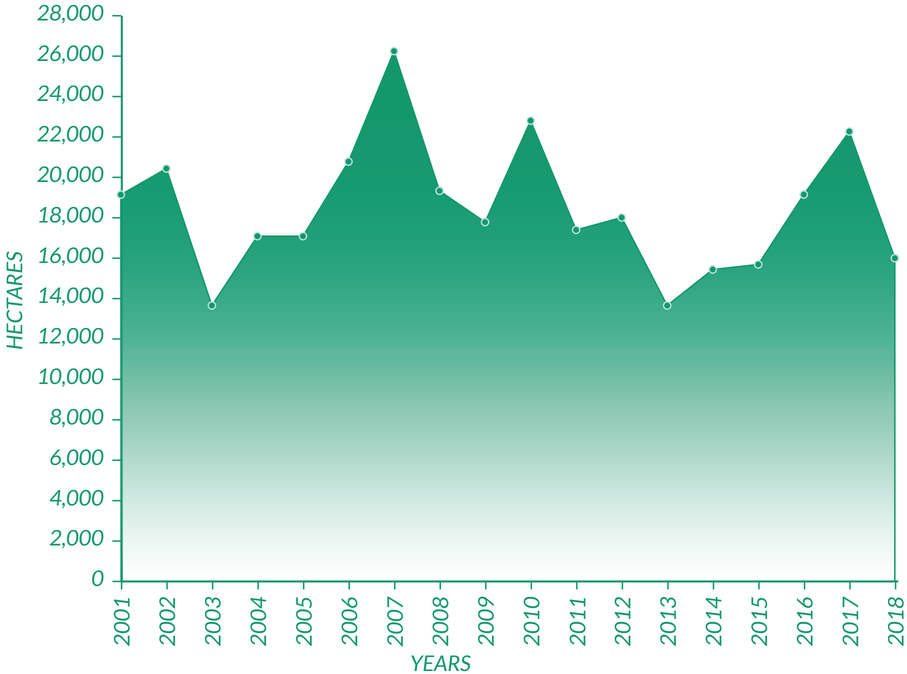


Figure 25: Annual loss of land in Kenya with 30% tree cover.

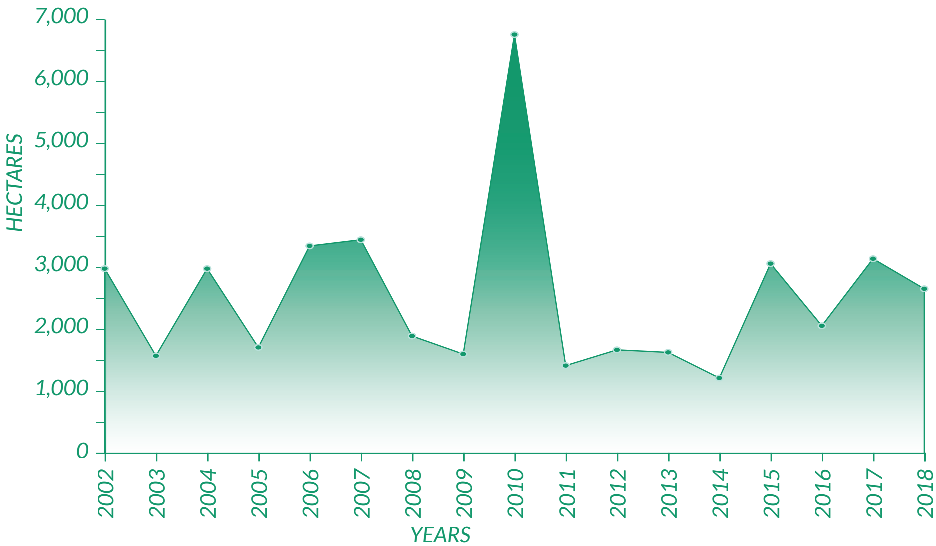


Figure 26: Annual loss of primary forest in Kenya, in hectares, 2002-2018

The graph in Figure 27 shows the three types of products extracted from auctioned government forest. It shows that timber sales had been reducing between 2014 and 2015, then increased in 2016 before declining in 2017 and 2018. All this data suggests that there has been a serious decline in tree cover and primary forest in less than 20 years, not just for fuel, but also for building materials. As a sustainable energy source, biomass can regenerate unlike fossil fuels. However, if biomass is used faster than it can grow back, its use is unsustainable.

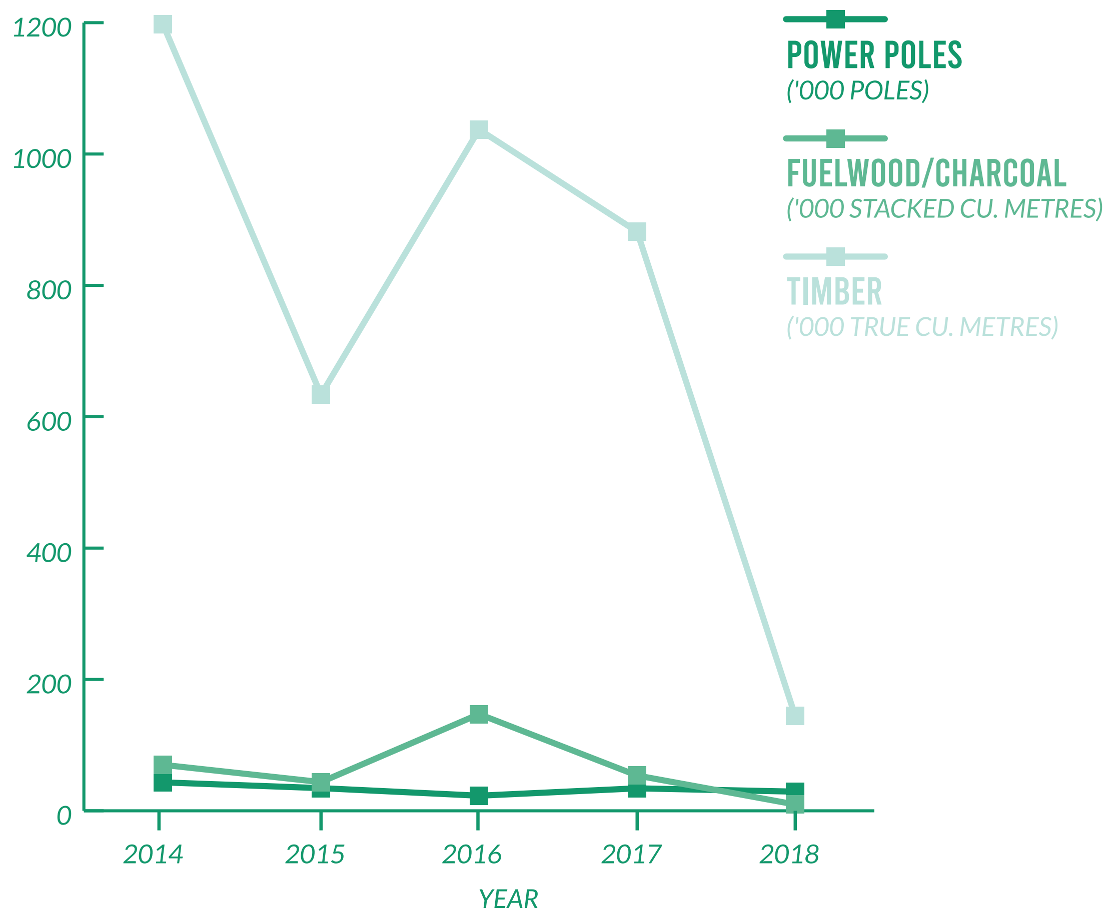
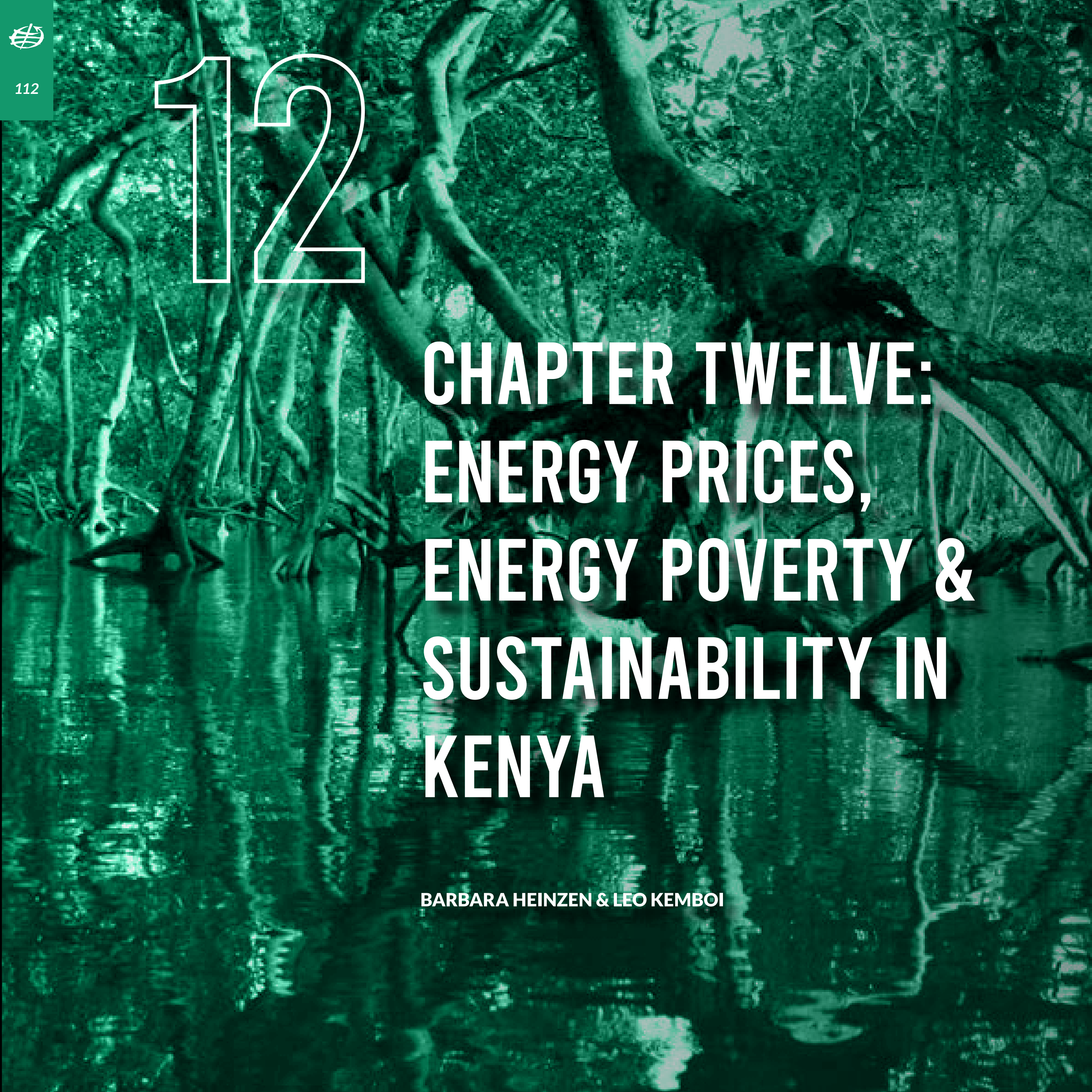


Figure 27: State Forest products 2016-2018. Source: KNBS Statistical Abstract 2019.



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CHAPTER TWELVE: ENERGY PRICES, ENERGY POVERTY & SUSTAINABILITY IN KENYA

BARBARA HEINZEN & LEO KEMBOI

EXECUTIVE SUMMARY

How might the cost of energy affect energy poverty among Kenyans and how might the energy they use affect the sustainability of Kenya's natural world? In 2018, nearly 70% of recorded energy use in Kenya came from biomass, most of it as household firewood or biomass waste. When the cost of biomass is compared to the cost of other fuels, including LPG and electricity, it becomes clear that the lower cost of biomass is a major reason biomass dominates energy use in Kenya.

INTRODUCTION

The cost of energy is a crucial policy question and has become an important political question, featuring prominently in electoral campaigns. Energy prices also shape our response to climate change and the speed of any global transition from high carbon energy, especially fossil fuels, to low carbon energy systems. Electricity is at the heart of this transition and can be generated using renewable energy sources like solar and wind. But can the cost of low carbon electricity compete with other fuels used by Kenyans? This chapter looks at the role of energy prices in reducing energy poverty in Kenya and increasing sustainability, including a reduction in climate change risks.

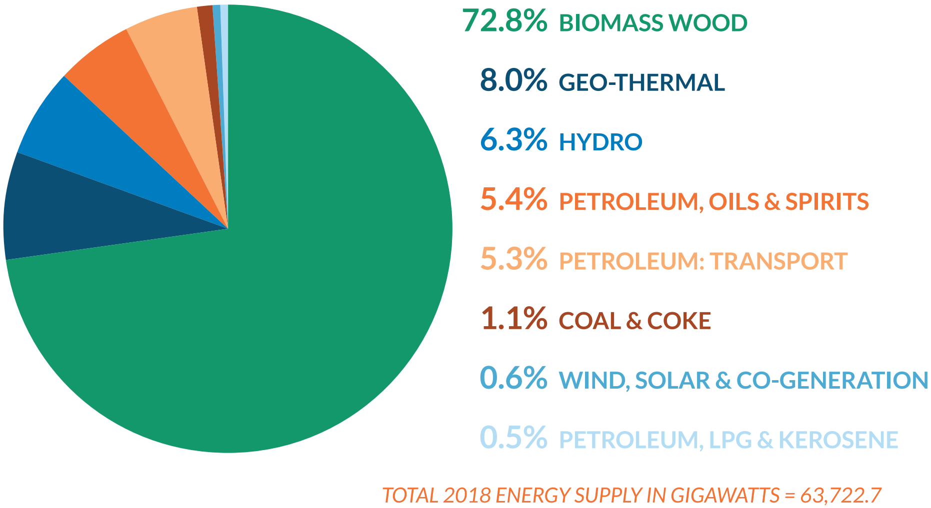
KENYA'S ENERGY MIX - SUPPLY AND USE IN 2018

Energy supply

The statistics on energy in Kenya are hard to find and often inconsistent, contradictory or incomplete (See p. 8: "Where is the energy data?" by Tony Watima). This article uses the energy data is for 2018, published in the Kenya National Bureau of Statistics (KNBS) Economic Survey of 2019*.

Figure 28 shows that in 2018, almost three-quarters of Kenya's energy supply came from biomass – wood fuel, charcoal and agricultural wastes. The rest came from fossil fuels and from renewable power feeding into the electricity system. The numbers in Figure 28 need to be taken with a grain of salt, however, as they do not include the thermal energy from fossil fuels used to power the electricity grid. Nor do they include energy from local energy systems powered by wind, solar or diesel generators. There are also inconsistencies in reports from KNBS. Most energy statistics used in this paper use come from the KNBS Economic Survey 2019 which reported that biomass** provided 46,400 gigawatts (GWh) of energy in 2018. In the following year, the KNBS Economic Survey of 2020 reduced the share of biomass in the energy mix to just over 50%, because they found that biomass only contributed 20,303 GWh to the mix, a drop so precipitous that it is hardly credible. What is clear from both economic surveys, is that biomass is the single most important source of energy Kenya.

Figure 28: Source of data - KNBS Economic Survey 2019, Table 9.11(b).



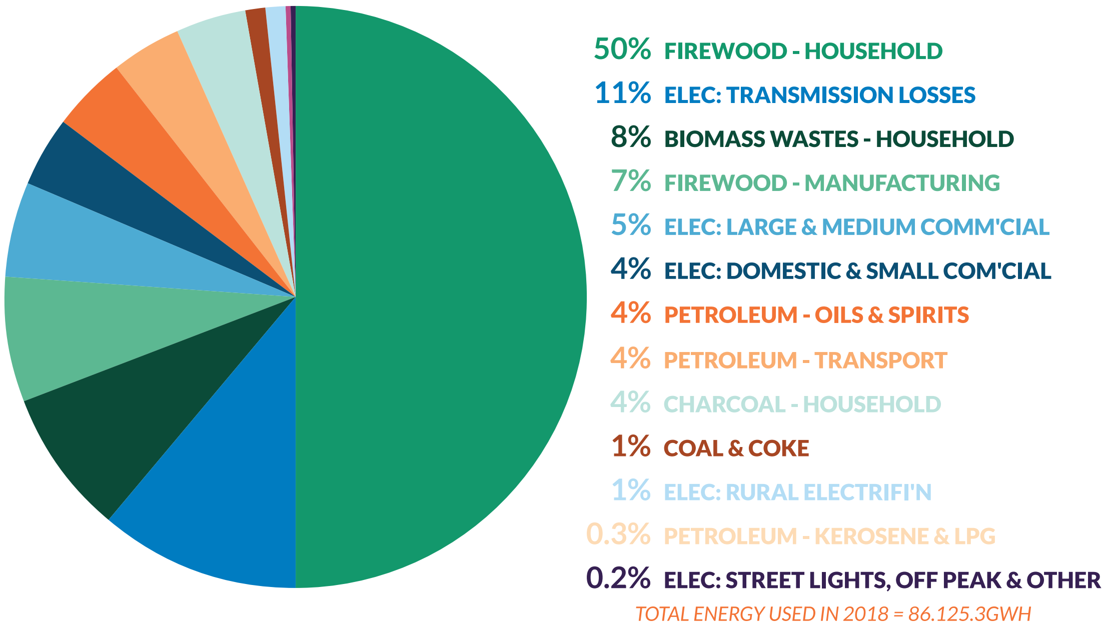
* *Kenya National Bureau of Statistics (KNBS), Economic Survey, 2019, using 2018 data. The 2018 data show a much greater reliance on biomass than the numbers for 2019 published by KNBS in 2020. As there is no explanation for the difference, the Energy Compendium has presented both in different articles.*

** *Kenya Statistical Abstract 2019, https://www.knbs.or.ke/?wpdmpro=statistical-abstract-2019, Table 9.8, accessed 20 October 2020.*

Energy use

The 2018 statistics on energy use are slightly different from supply, but biomass still accounts for 69% of the energy use in Kenya, especially in rural areas where 70% of Kenyans still live.*** About a fifth of energy in 2018 came from electricity, largely powered by renewables (see Figure 29 below). However, according to the data, half of the power generated was lost in transmission****, and never used. Large and small businesses were major users of electricity, followed by households, while only 1% went to rural electrification. Fossil fuel in 2018 accounted for 9% of energy use, most of it as petroleum products such as transport fuels or a variety of oils and spirits. Coke and coal were a small part of the mix, as were kerosene and LPG, liquid petroleum gas. Household use of electricity and fossil fuels was less common in 2018, although it has increased since then.

*Figure 29: Source KNBS Economic Survey 2019******



*** *World Bank data, reported in https://www.theglobaleconomy.com/Kenya/rural_population_percent/ accessed 21 October 2020.*

**** *KNBS, Economic Survey, 2019, Table 9.11(b), https://www.knbs.or.ke/?wpdmpro=economic-survey-2019 . accessed 24 November 2020.*

***** *In the KNBS Economic Survey of 2020, it is hard to clarify what numbers describe the supply of primary energy available, versus numbers describing what primary energy was consumed in Kenya. That may be why the primary energy supply noted in Figure 28, is smaller than the energy used noted in Figure 29.*

ENERGY PRICES, ENERGY CHOICES AND SUSTAINABILITY

Summing up: Kenya's energy mix

Despite the modernisation of Kenya's economy, the energy system still relies on biomass, especially wood fuel used in rural households and agricultural industries. Urban households also use biomass, especially charcoal. Energy in the form of electricity is largely used by businesses and urban consumers, while both LPG and kerosene are relatively small contributors to energy use in Kenya.

This structure of energy use has been shaped by the relative prices of different fuels which have affected energy poverty among Kenyans and the sustainability of Kenya's natural world.

To think about the role of prices in energy poverty and sustainability in Kenya, we will first consider the fuels used in household cooking, and then examine the impact of electricity prices on household energy choices and climate change.

Cooking fuel prices

Cooking uses most of the energy consumed in households and rightly gets most of the attention. In 2019, the Kenyan Ministry of Energy published the Household Cooking Sector Study, which contains valuable information on energy and cooking in Kenya.* Using household survey data, they found that 70% of all Kenyan households still use wood for cooking especially in rural areas, as seen in Figure 30. Charcoal was second, followed by LPG, kerosene and electricity.

* *Ministry of Energy, Kenya, Household Cooking Sector Study, 2019. Accessed 28 October 2020, available at: https://sentaokenya.org/wp-content/uploads/2019/03/Kenya-Household-Cooking-Sector-Study-2019.pdf This is an outstanding piece of policy research.*

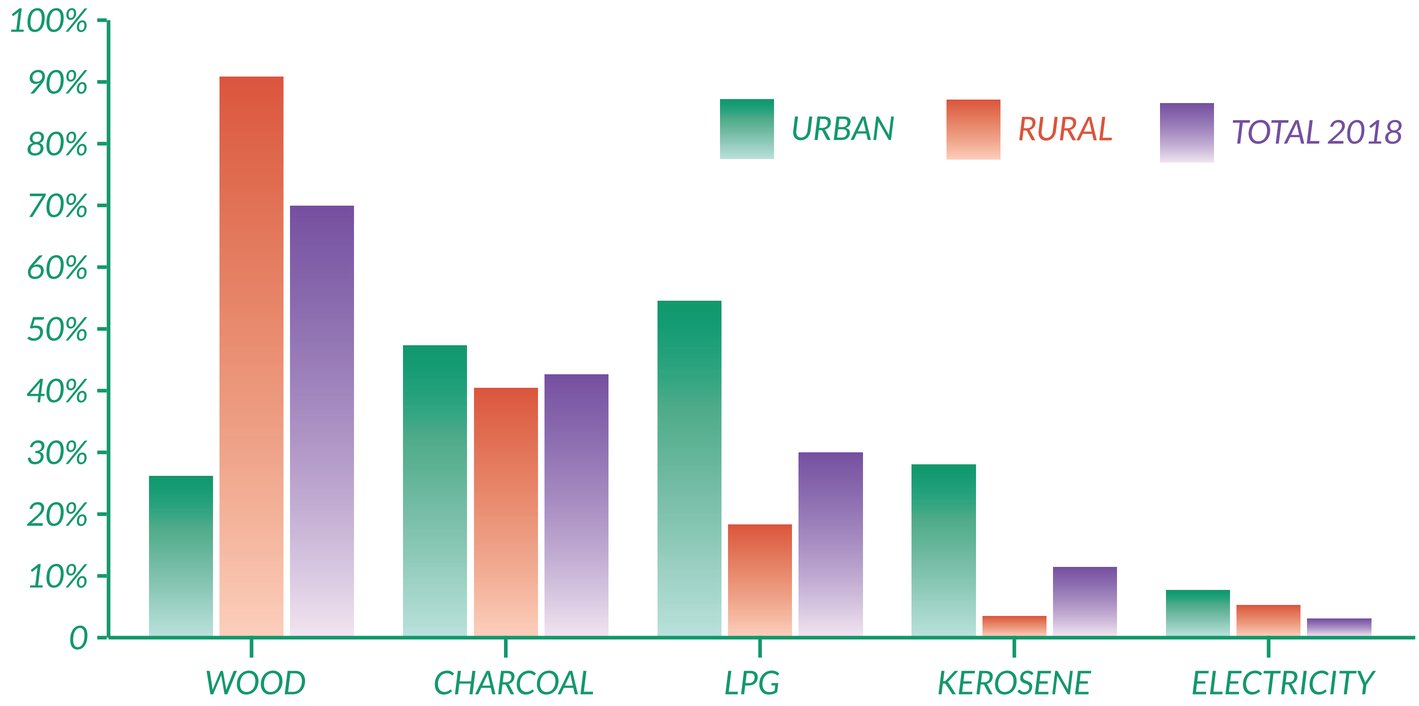


Figure 30: Percent of rural and urban households using different cooking fuels as primary or secondary fuel, 2018. Source etc. Source: Ministry of Energy, Household Cooking Sector Study, 2019.

In Figure 30, the data for 2018 are compared with data from an earlier study done for the Global LPG Partnership.** This graph shows that the use of Liquid Petroleum Gas (LPG) increased over eight years, as did charcoal use, but kerosene for cooking declined. Overall, however, the importance of biomass as a cooking fuel continued, as either a primary or secondary fuel.

** *Study done for Global LPG Partnership, GLPGP Kenya Market Analysis: Final Report, updated August 28, 2013. Accessed 8 September 2020 at: https://www.cleancookingalliance.org/binary-data/RESOURCE/file/000/000/234-1.pdf*

Biomass fuel prices, limited data

There is very little price data for different types of biomass fuel. Agricultural waste prices are not covered by KNBS, while firewood is mostly gathered and considered to be free. Where firewood is for sale, the price is not tracked by the Kenya National Bureau of Statistics, although there are published statistics for the price of charcoal.

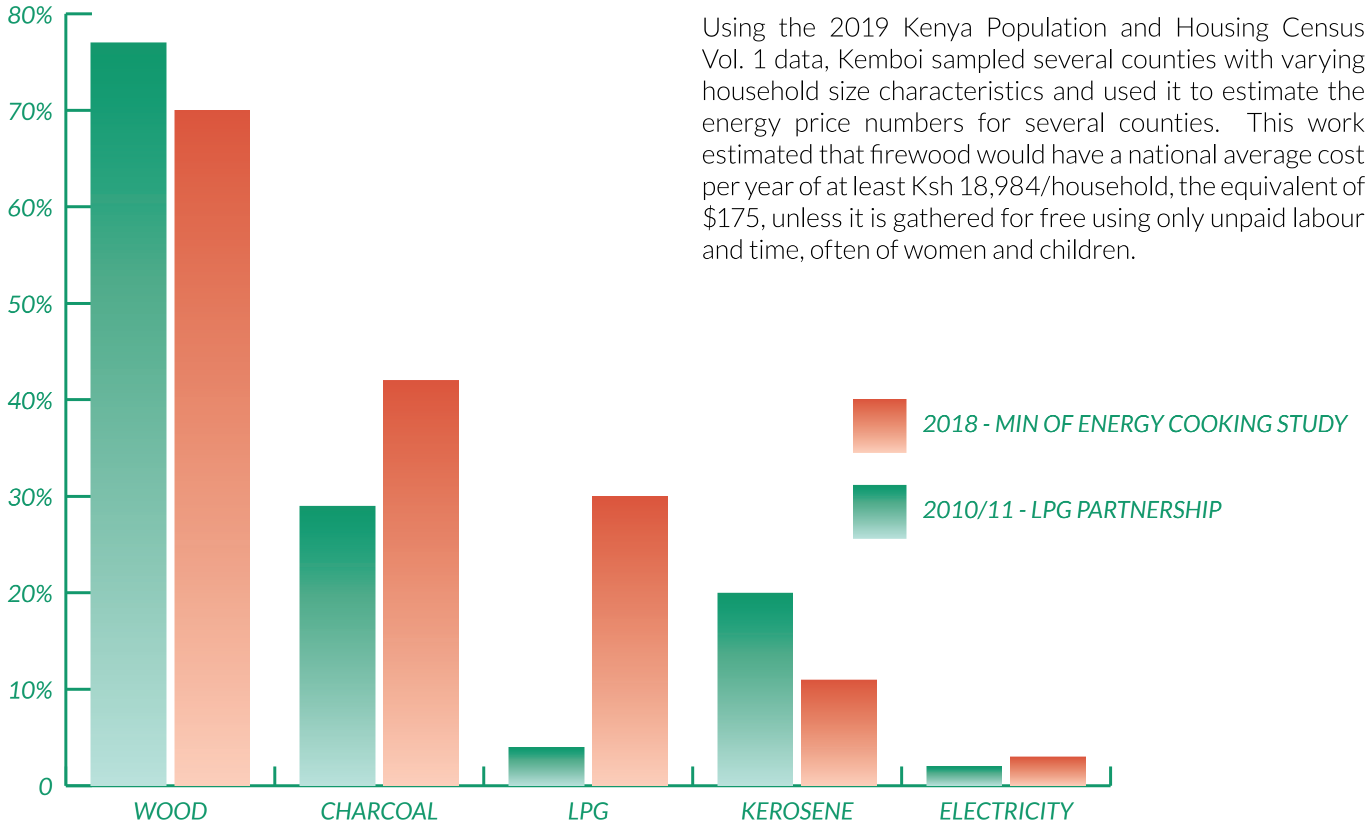


Figure 31: Continued importance of biomass cooking fuels, 2010 v 2018. Many households use multiple fuels.

Firewood prices –estimates

Leo Kemboi, one of the authors of this chapter, did a rough estimate of the cost of firewood. Kemboi found that firewood prices differ significantly from urban to rural areas. Fuso Nerini, Ray and Boulkaid (2017) estimate that in the case of Nyeri County, yearly firewood costs would range from $52 to $132 US dollars. This would make it an average of $92 or approximately Ksh 10,000.* Nyeri County has an average household size of three people, which makes the cost of cooking with firewood per person every year to be an estimated Ksh 3500 or $32.41.

Using the 2019 Kenya Population and Housing Census Vol. 1 data, Kemboi sampled several counties with varying household size characteristics and used it to estimate the energy price numbers for several counties. This work estimated that firewood would have a national average cost per year of at least Ksh 18,984/household, the equivalent of $175, unless it is gathered for free using only unpaid labour and time, often of women and children.

* *At the time of writing, 1 USD= Ksh 108.*

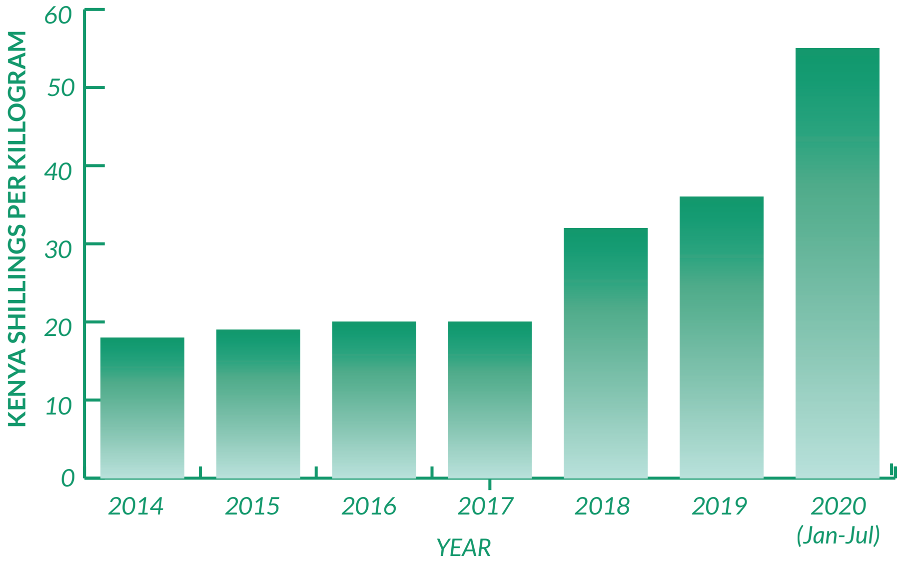
Charcoal prices 2014-2020

In recent years, the nominal price of charcoal rose significantly between 2014-2020. The main driver of higher charcoal prices was a 2018 government policy that suspended logging initially for 90 days** and then remained in force. Charcoal prices for a 4-kg tin rose immediately from 81 Kenya shillings in 2017 to 126 shillings in 2018, a 55% rise that caused considerable hardship.*** Figure 32 shows the average price of a kilogram of charcoal has risen steadily since then.

As the ban on logging in Kenya's national forests was repeatedly extended,**** charcoal merchants brought in charcoal from other countries, including Uganda, Somalia, Congo and Tanzania, to take advantage of the higher prices. In July 2020, a 4-kg tin of charcoal cost 228 shillings, compared to an average price of 81 shillings in 2017.*****

Despite these rising costs, the demand for charcoal remains high and continues to exert pressure on forests, farmlands, and community rangelands, inside Kenya and in the wider region. Moreover, the ban has served to make the trade more profitable as there is still no clean and affordable replacement fuel.

Figure 32: A national ban on logging in 2018 led to a dramatic rise in charcoal prices compared to 2014.



** Victor Muisyo, 2018.

*** Nation, More Pain for Poor as Charcoal Price Hits Sh2,500 a Bag. Daily Nation, March 19, 2018, https://nation.africa/kenya/business/more-pain-for-poor-as-charcoal-price-hits-sh2-500-a-bag-23614

**** Keriako, T., 2018.

***** Kenya National Bureau of Statistics, Leading Economic Indicators, accessed 8 September 2020 https://www.knbs.or.ke/?wpdmpro=leading-economic-indicators-july-2020

LPG, Liquid Petroleum Gas, and Kerosene Prices

The two most important fossil fuels at the household level are liquid petroleum gas (LPG), and kerosene, which together made up less than 1% of all the energy used in 2018. Both serve as cooking fuels, while kerosene is also used for lighting.

Of the two, LPG is the cleaner cooking fuel and has seen an impressive increase in use.* According to the 2019 ***Cooking Study,*** four factors supported the growth in LPG use: first was the introduction of smaller, more affordable canisters with 6kg and 3kg sizes, rather than only the larger 13kg canister; second, cylinder design was standardized, created compatibility across brands; third, the last-mile distribution was improved; and finally there were changes in the tax regime, including a zero-rating for LPG and an increased tax on kerosene.

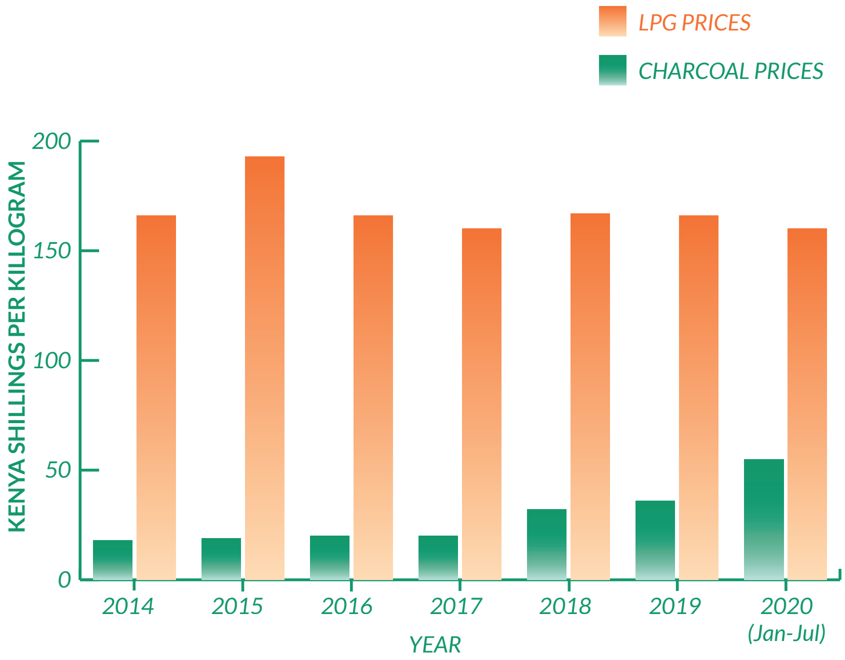


Figure 33: Cleaner cooking with LPG still costs much more than charcoal.

However, even with these improvements, biomass fuel for cooking still dominates as the price of LPG cannot compete with low-cost firewood and charcoal. Figure 33 compares the prices of charcoal and LPG as reported in the KNBS ***Leading Economic Indicators***, July 2020.**

** Bio-ethanol is a potential clean cooking fuel, but not yet readily available. However, many of the factors that influence LPG use are likely to apply to bio-ethanol.*

*** KNBS, Leading Economic indicators, July 2020. Accessed 25 November 2020, available at: https://www.knbs.or.ke/?wpdmpro=leading-economic-indicators-july-2020*

Kerosene, also known as paraffin or illuminating kerosene, is also used for cooking and is a leading economic indicator tracked by the Kenya National Bureau of Statistics. It is considered a clean and convenient cooking fuel when used with an improved stove, but contributes to indoor air pollution when that is not the case. As noted in Figure 30 above, kerosene was used by 28% of urban households, but only 3% of rural households in 2018.[***]

Between 2016 and 2019, the price of kerosene doubled, before dropping in the first seven months of 2020 due the impact of COVID-19 on global oil markets. The increased kerosene prices from 2016–2019 followed the anti-adulteration levy introduced on kerosene by Parliament.

This levy was designed to prevent companies or individuals from mixing either petrol or diesel with kerosene to sell to unsuspecting motorists.[****] This recent history of kerosene prices illustrates how national policies and global markets have both influenced the price of kerosene and the fuel choices users are making (Figure 34).

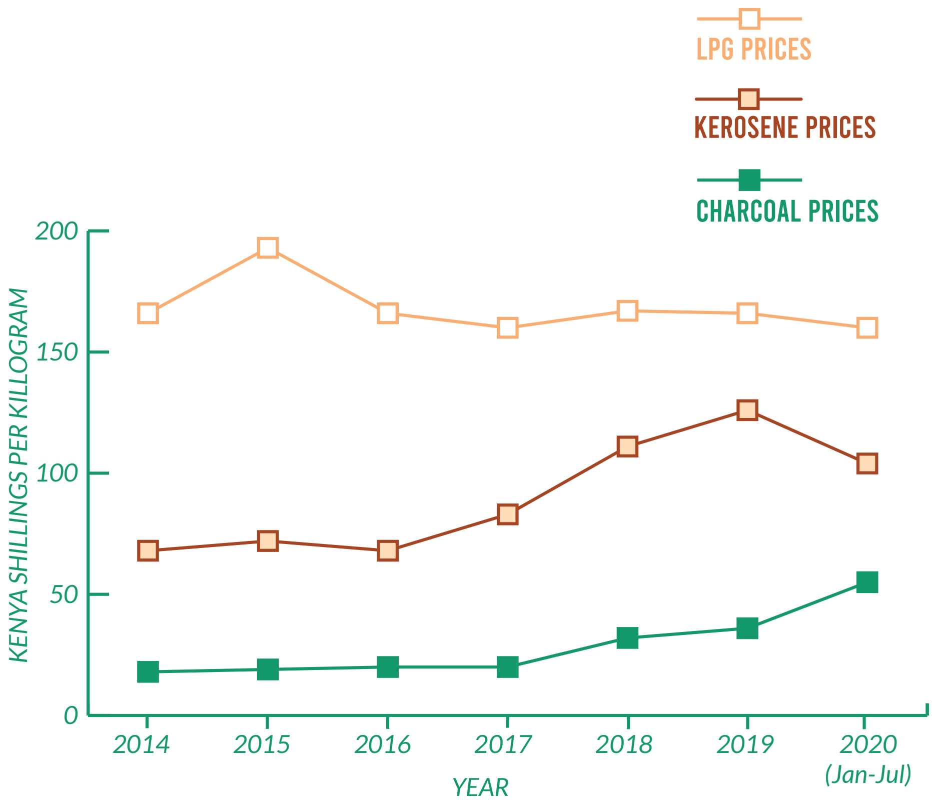


Figure 34: Kerosene prices/kg are between the prices for charcoal and LPG.

Overall, however, while kerosene prices per kilogram have remained lower than LPG, they were still higher than charcoal, as seen in Figure 34.

*** *Ministry of Energy, 2019.*

**** *Sunday Nation, "'Tax on Kerosene Has Made Life Difficult,' Senators Tell Agency," Daily Nation, August 4, 2019.https://www.nation.co.ke/kenya/business/tax-on-kerosene-has-made-life-difficult-senators-tell-agency-191904#:~:text=83%20for%20kerosene.*

Cooking fuel costs: additional considerations

It is not simply the lower price per kilogram that makes charcoal and wood fuel still so competitive with both LPG and kerosene, especially in rural areas where most Kenyans live. Gathered wood fuel for personal use has no financial cost and the three-stone open fire (TSOF) is simple and effective, as noted by the 2019 ***Household Cooking Sector Study***:

In addition to being durable and sturdy, the TSOF has an all-in-one design that can accommodate varying sizes and shapes of cooking appliances … No parts require replacement …[it can serve] dual or triple purposes including roasting, drying and space heating while cooking …. Multiple solid fuel sources are compatible including firewood, maize cobs, maize stalks, and animal dung among others. Moreover, a three-stone open fire costs nothing to build. It only takes three similar sized, typically spherical stones to build a TSOF. Such stones are widely available and therefore there are no upfront costs of purchase or installation.*

LPG is also at a disadvantage compared to charcoal and kerosene which can be sold in small quantities. Kerosene is sold in litres and a sack of charcoal can be broken into smaller lots which might serve to cook only a single meal.

For buyers with little spare cash, the ability to buy small amounts of cooking fuel for small amounts of money a few days at a time is a huge advantage. By comparison, the 14kg LPG canisters cannot be broken down, although smaller 6kg and 3kg canisters have made a difference.

The distribution of LPG, especially in rural areas, is also still limited. A rural user has to get to a market, pay a deposit for the canister, transport the canister back to the kitchen, and finally connect the canister to a more expensive stove as shown below, using data from the 2019 Cooking Study:

Type of stove	Urban price, Ksh	Rural price, Ksh
Kenya Ceramic Jiko (KCJ)	408	388
Metallic charcoal stove	529	417
Kerosene wick stove	503	675
LPG Multiple burner	14,963	10,873
LPG/Electric stove	28,920	39,250

Table 7: The cost of different types of stove.

* *Ministry of Energy, 2019. This study has assembled a wealth of information about cooking in Kenya.*

COOKING FUEL PRICES, ENERGY POVERTY & SUSTAINABILITY

Two conclusions are clear. First, for a household, the price of energy includes both the price of fuel and the cost of the technology to use it. Second, price is not the only important factor. The ease of use and availability of cleaner cooking fuels, especially in rural areas, also shape the energy choices people make.

Price, however, is a core issue. As of 2015, 86.5% of the population was living on less than $5.50/ day or about $2,000/year.** With budgets that small, neither LPG nor kerosene will quickly replace biomass in many Kenyan households.

The current assumption is that biomass is unsustainable because much of the wood and charcoal is taken from forests and rangelands, rather than grown as a crop. Biomass also contributes to energy poverty because of the health hazards of its smoke. Kenya's government wants to increase access to clean cooking from 15% of the population in 2018 to 46% by 2030, reducing the use of biomass fuel. However, that ambitious goal is only likely to be achieved if the price of clean cooking is much more affordable than it is now.

Electricity Prices

Ideally, electricity generated from renewable sources should be the clean sustainable energy of the 21st century in Kenya. However, given the costs of capital, distribution and maintenance, it may not be able to reduce energy poverty for many poor Kenyans. Moreover, more than the other sources of energy, electricity prices are affected by Kenyan regulations.

In 2018, 21% of Kenya's energy was in the form of grid electricity, but about half was lost in transmission. Most of the rest of Kenya's electric power was consumed by 3,120 commercial and industrial consumers, both large and small, according to the KPLC Annual report (KPLC, 2017/2018), while less than 30% of use-able electricity was consumed by households, as shown in Figure 35.

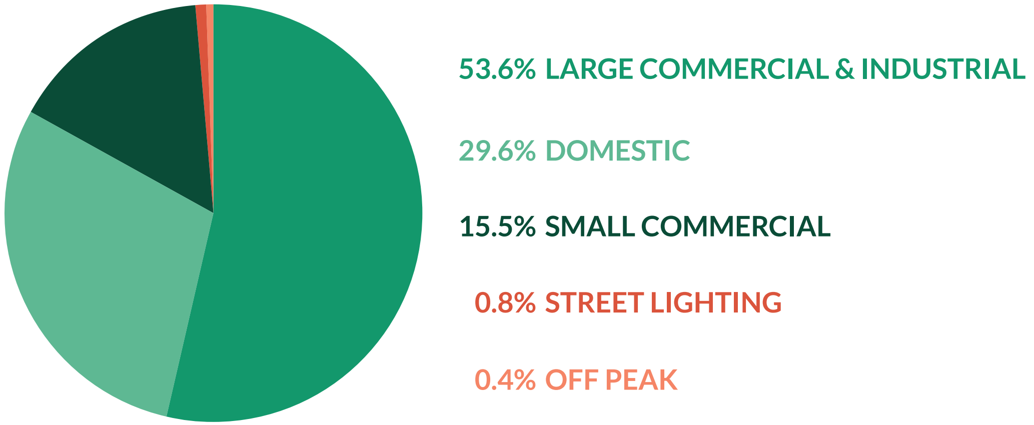


Figure 35: Large & small businesses consumed 69% of Kenya's electric power in 2017/18.

** See https://www.macrotrends.net/countries/KEN/kenya/poverty-rate

HOUSEHOLD USE OF ELECTRICITY

Many domestic consumers do not use electricity because they are not connected to the national grid. While the number of connections in Kenya is rising fast from 2.8 million subscribers in 2014 to 6.7 million consumers in 2017/18, the connection rate is still very low, especially in rural areas. Kenya aims to achieve 40 % rural electrification by 2024, but in the meantime, electricity use is largely found in urban areas which have five times the number of connections compared to rural Kenya.

According to the ***Kenya Integrated Household Budget Survey, 2015/***16, lighting is one of the main uses of electricity, especially in urban areas. Rural households depend heavily on paraffin lamps, but also use solar energy for lighting as well as battery-powered torches and lamps, among other devices. According to this survey, when rural and urban populations are combined, 41% of all Kenyan households used grid electricity for lighting, with nearly 60% of households using a variety of other devices and fuels, as seen in Figure 36.

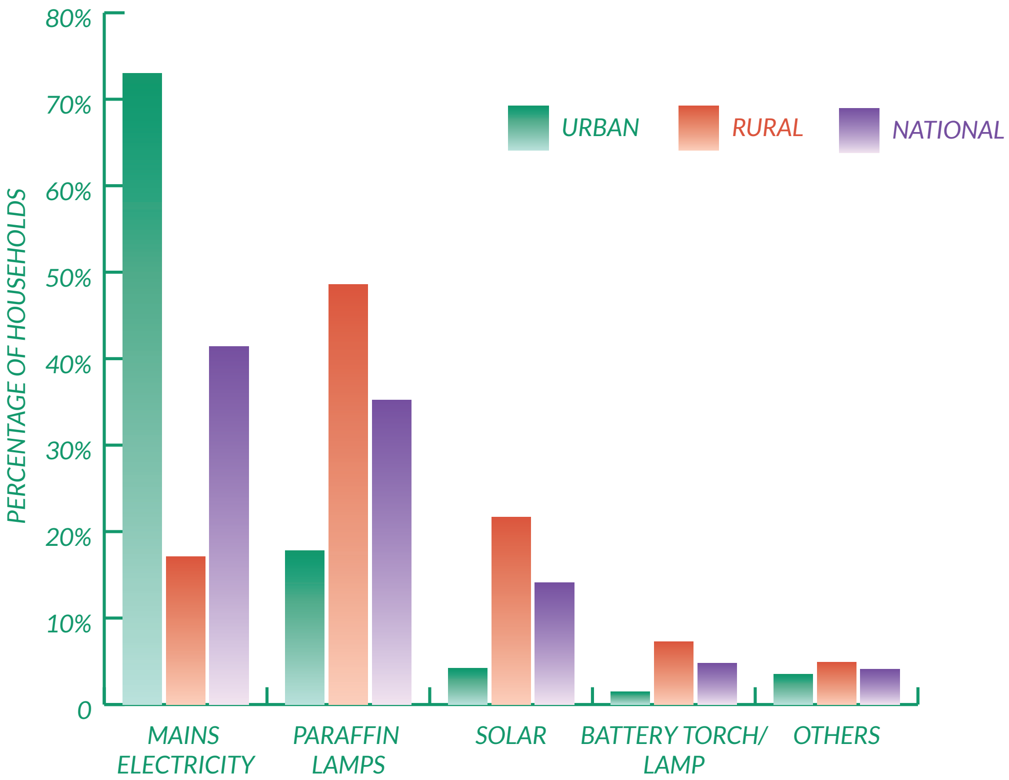


*Figure 36: More urban households use mains electricity for lighting while rural homes rely on paraffin and solar lamps.**

* *(Kenya National Bureau of Statistics 2018), Basic Report, Integrated Household Budget Survey 2015/16.*

Sustainability and the price of electricity to households

Despite the low penetration of electricity into Kenyan households, especially in rural areas, the more households can afford to switch to electricity, the more sustainable will Kenya's energy use become.

Already in 2018, 70% of the power in the national grid came from renewable sources of energy, with only 30% generated from thermal oil, as seen in Figure 37. These numbers do not include the growing use of household solar panels, especially in rural areas, or on other sites.

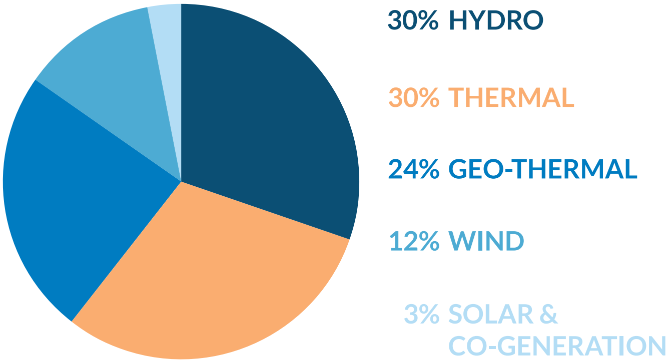


Figure 37: 70% of Kenya's installed electricity capacity came from renewable sources in 2018.

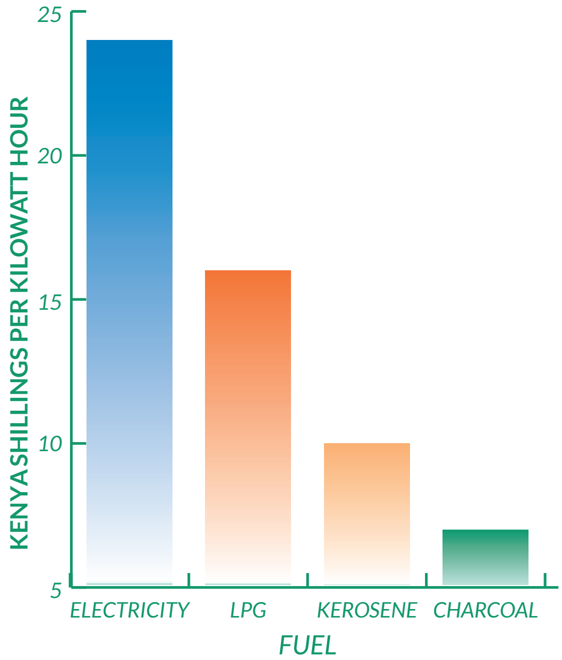
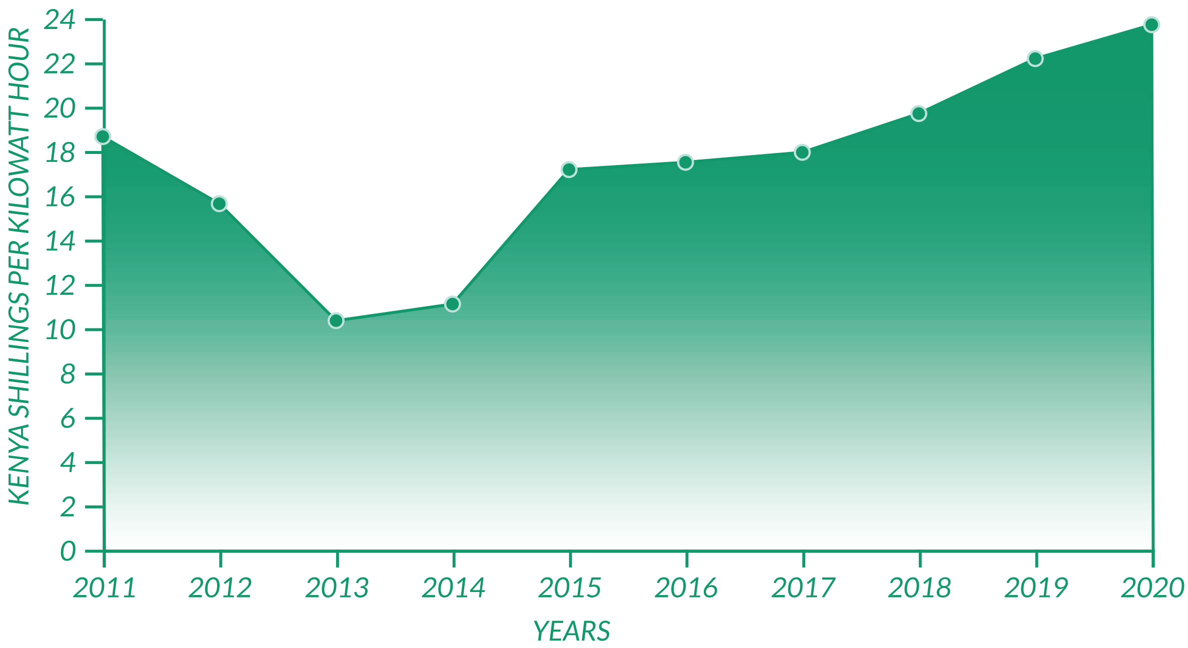


Figure 38: The dry wood used in rural areas is gathered for free, while electricity is the most expensive of the other fuels used in households.

However, as seen with household choices of cooking fuels, price is a critical factor and the high price of using electricity is a major deterrent to increased use of electricity in people's homes. As seen in Figure 38, when fuel prices per kilowatt hour are compared, electricity from the grid costs twice as much as kerosene and is more than three times the price of charcoal.*

Moreover, the electricity price has been rising fairly steadily since 2011, as shown in Figure 39.** It is possible that the fear of future price rises is another reason households don't use it.

Figure 39: The rising price of electricity may be an additional disincentive to using it.



* *Heinzen calculations, various sources.*

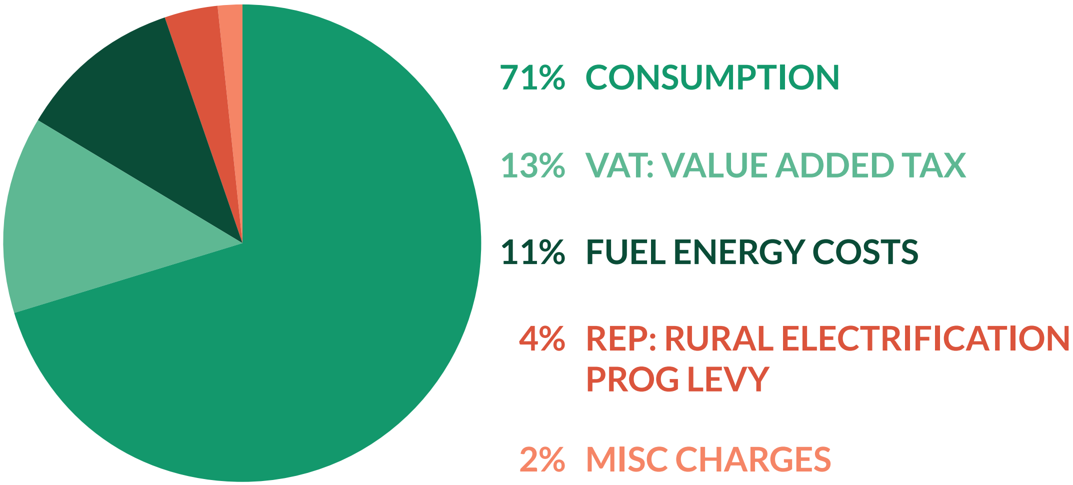
** *Sources of data: : KNBS Monthly CPI and Inflation Rates (Various Issues); Kemboi's own calculations.*

How is electricity pricing done?

Of all the sources of energy, only electricity prices are set by the regulator, the Energy and Petroleum Regulatory Authority (EPRA, formerly known as the Energy Regulatory Commission of Kenya). Amongst other regulatory issues, the Energy Act of 2019, Section 11(d) gives the EPRA the mandate to set the tariff structure and terms for the supply of electrical energy and investigate tariff charges, whether or not a specific application has been made for a tariff adjustment.

Once the price is set, the Energy and Petroleum Regulatory Authority gazettes the tariff structure and terms based on existing laws and regulations. The final price to consumers includes non-fuel tariffs, taxes and levies, fuel energy costs, a foreign exchange rate fluctuation adjustment, inflation adjustment, and security support facility (See Figure 40). Just over 70% of the price is based on consumption. For more information on how electricity prices are set, see the article in Section V: "What Is Behind the Price Kenyans Pay for Electricity?"

Figure 40: Breakdown of charges on Kshs 1,000 electric bill dated January 2020.



Summing up: electricity, energy poverty & sustainability

In most developing countries, spending on energy accounts for a larger share of household income than it does in developed societies. This makes Kenyans particularly vulnerable to rising tariffs (Zhang, 2013) perpetuating energy poverty even though domestic electricity connections are increasing all the time thanks to the "Last Mile" programme. However, many households still find the price of electricity is too high, straining their budgets, or forcing them to stop using electricity completely.

As a result, despite the large share of renewables used to generate electricity, the overall energy system is still unsustainable, continuing an over-reliance on biomass which increases environmental degradation and risks more serious climate change.

CONCLUSION: ENERGY PRICES, POVERTY AND SUSTAINABILITY

Today, 16 million people are living below the poverty line in Kenya.* Among them, four million people are in hard core poverty (KNBS, 2018)** while another estimated four million Kenyan households are simply considered poor. Households headed by older people (60 years old and above) recorded an especially high poverty rate of 36.3%, according to the Wellbeing Report published by KNBS in 2018.

Studies have shown that energy consumption, including electricity, increases with income in emerging markets and developing economies (Chang, 2015). From that perspective, energy access and affordability are a development problem to be solved in tandem with economic growth. To improve access to energy, therefore, developing economies like Kenya must adopt growth models that double incomes periodically.

In the absence of better incomes, poorer Kenyans will continue to rely on cheaper and often dirtier fuels like biomass and kerosene. In this case, energy poverty continues. Moreover, as biomass fuel becomes scarce, its price will rise, further increasing both energy poverty and the incentive to mine more firewood and charcoal. So long as firewood and charcoal are taken from the landscape without replanting or natural regeneration, the unsustainable degradation of Kenya's natural resources, biodiversity and landscape will continue.

* *The KNBS defines Overall Poverty as the households and individuals whose monthly adult equivalent total consumption expenditure per person is less than Ksh 3,252 in rural and peri-urban areas, and less than Ksh 5,995 in core-urban areas.*

** *The KNBS defines Hardcore or Extreme Poverty as the households and individuals whose monthly adult equivalent total consumption expenditure per person is less than Ksh 1,954 in rural and peri-urban areas, and less than Ksh 2,551 in core-urban areas..*

POLICY PROPOSALS

A different future is also possible. Economic growth may increase incomes enough for households to switch to cleaner, more convenient energy. There might also be a change in relative prices where the cost of biomass becomes higher than alternatives like electricity, LPG or local renewable energy networks. Alternatively, biomass may remain the lowest cost fuel, but become a product cultivated for home use or sale rather than an unsustainably mined natural resource. If that happens, especially if cultivated biomass fuel use native species, then the current degradation of the environment could be significantly reduced.

Two areas of policy are worth considering: first, policies to lower the price of grid electricity; and second, policies to promote sustainable biomass fuel and local renewable energy systems.

Photo by FOTOGRIN from shutterstock.com

Lowering electricity prices

In order to lower the price of grid electricity, the following recommendations are made:

Phase out inefficiencies: Many inefficiencies become part of huge power bills. These start from the inception of power projects, connection to the grid, and ultimately to the consumer information of bills.* Removing these inefficiencies will lower the cost of providing power to customers.

Lower taxes or no tax on electricity: Taxes and levies form a large share of electricity costs. Given Kenya's low GDP per capita, electricity is not affordable. If the Government removed or lowered these taxes, electricity would be more affordable.

Competition in contracts with independent power producers: In order to get the most efficient technology at the least cost, Independent Power Producers should compete with each other for contracts, so that only the lowest bidders can undertake power production. (PPP Unit, 2020).

Discourage subsidies with Independent Power Producers: Taxpayers currently shoulder subsidies provided to power producers, but these agreements often lack a strong institutional and regulatory environment and are kept confidential. As a result, players ramp up costs to increase their returns without necessarily generating greater levels of renewable production and installation (Zhang, How Fit are Feed-in Tariff Policies?, 2013). Without subsidies, power producers will need to be more responsive to what the market can afford, which could lower costs to consumers.

Sustainable biomass and local renewable energy

Given that biomass is likely to continue to be used, especially in rural areas, the following recommendations should be considered.

Agro-forestry support: Given the current structure of energy prices and use, biomass fuel is likely to continue. More support should be given to establishing sustainable woodlot/charcoal businesses using native species. More support should also be given to other low-carbon renewable fuels like ethanol. This would improve rural incomes, reduce pressure on the natural world and increase access to low cost fuel.

Carbon tax, land use & redistribution: Land degradation, as well as fossil fuel use, is a major contributor to climate change. A carbon tax that applies to any fuel that reduces forest cover could dramatically change the relative prices of charcoal and cleaner fuels. However, higher fuel prices will result, so the proceeds of the carbon tax should be distributed to poorer households to cover the increased cost of clean fuels.

Support off-grid electricity: Given the high cost of connecting to the national grid, support for local electricity systems based on renewable energy should be considered. Taxes on imported solar powered and renewable energy lamps used by households and businesses in Kenya should be lowered or eliminated.

Support feed-in tariffs: To encourage households to invest in their own solar power panels, electricity pricing should include feed-in tariffs paid to households for any excess power they produce that can be fed back into the national or local grid.

* *The Nation, 2020. High electricity bills, delayed token purchases expose the rot at Kenya Power. The Nation. https://nation.africa/kenya/news/high-electricity-bills-delayed-token-purchases-expose-rot-at-kenya-power-35472 (Accessed Monday, 17 February 2020).*

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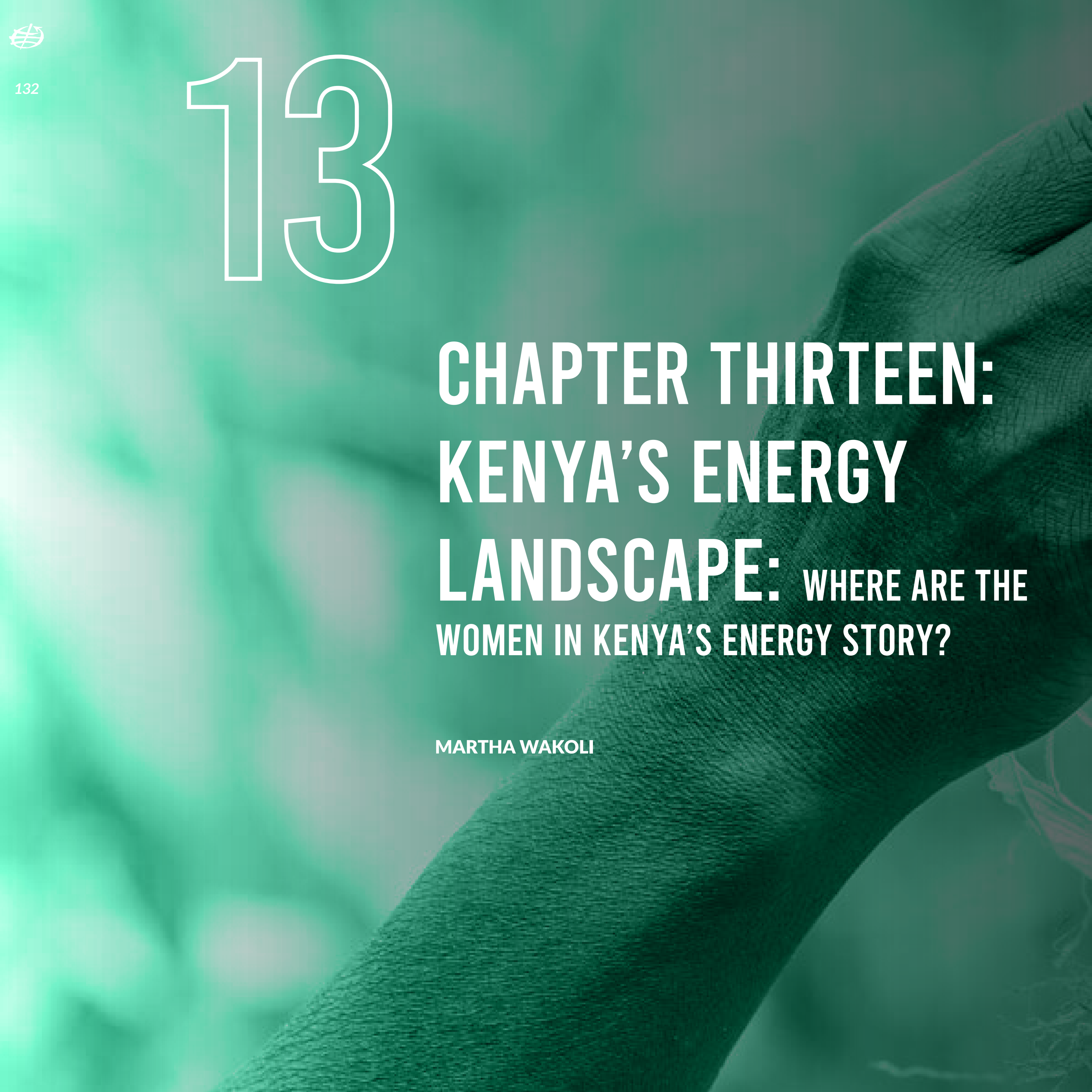


13

CHAPTER THIRTEEN: KENYA'S ENERGY LANDSCAPE: WHERE ARE THE WOMEN IN KENYA'S ENERGY STORY?

MARTHA WAKOLI

EXECUTIVE SUMMARY

An analysis of Kenya's existing policies and statistics on energy and gender reveal that women continue to be under-represented in the leadership of energy institutions. The limited availability of gender disaggregated data on energy development is an obstacle to the engendering of energy plans, budgets and programs. This hampers sound decision-making on interventions, because biomass dominates energy use in Kenya, and women are more likely to be exposed to the harmful effects of dirty cooking fuel. It is therefore crucial to centre them in designing interventions.

Today, more than 50% of Kenya's population is female. In limiting women's contributions to energy leadership, Kenya risks sentencing the country to a future of poverty – not just energy poverty but extreme poverty in general. This paper highlights the crucial role women should play in securing a sustainable energy future and recommends actionable steps Kenya could take to harness women's contributions towards achieving universal energy access for all by the year 2030. As the former US First Lady Michelle Obama famously said, "No country can ever truly flourish if it stifles the potential of its women and deprives itself of the contributions of half of its citizens."

ENERGY SOURCES AND USES IN KENYA

Kenyans use three main types of energy; biomass, petroleum and electricity. Biomass dominates energy consumption, providing 68% of energy. Petroleum provides 21% and 9% comes from electricity, most of it generated by hydro power, geothermal energy and oil. Biomass is in the form of wood fuel and charcoal, both of which are widely used in rural areas for cooking and heating (Owiro et al., 2015). Three-stone fires are still used for most cooking, fuelled mostly by charcoal in urban areas and by wood in rural areas (IEA, 2019).

Figure 41 below shows Kenya's past and present energy mix with a projection to 2040 as modelled by the International Energy Agency. In 2010 and 2018, bioenergy still constituted more than 65% of the energy mix. By 2040, under existing government policies, bioenergy is still expected to constitute about 30% of energy use while other low carbon energy sources such as geothermal and wind whose development is currently being accelerated will contribute another 30% to the energy mix.

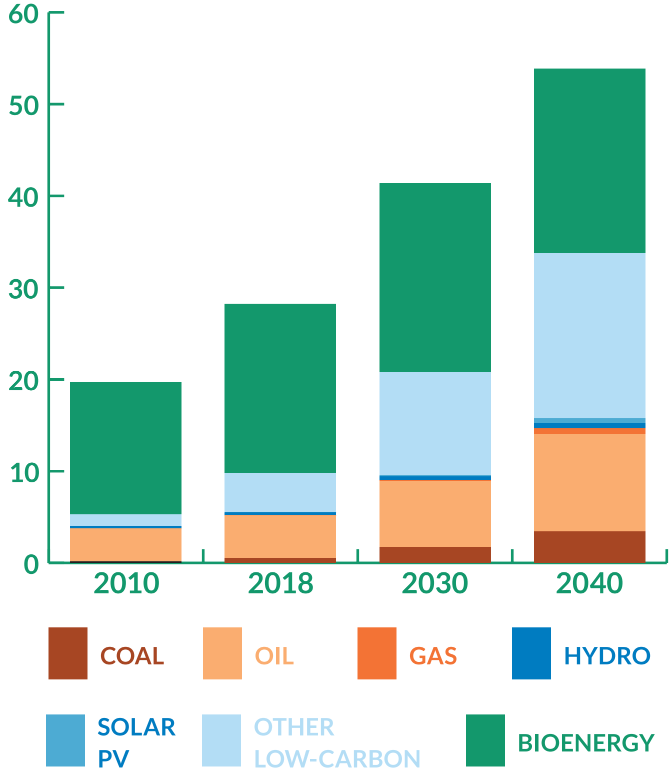


Figure 41: Graph showing the primary energy mix in Kenya (Source: IEA, 2019)*

* *IEA, 2019. Kenya primary energy demand and GDP in the Stated Policies Scenario, 2010-2040. Paris : IEA https://www.iea.org/data-and-statistics/charts/kenya-primary-energy-demand-and-gdp-in-the-stated-policies-scenario-2010-2040.*

Oil remains the dominant fossil fuel outside of biomass. Its use is projected to triple over the next 20 years largely because of growth in the transport sector, although it is also used in electricity generation. (IEA, 2019). It is a serious contributor to greenhouse gas emissions in Kenya.

Today, the transport sector in Kenya accounts for 13% of the total national emissions, and this is likely to increase to 17% by 2030 due to rapid motorization (Eshiwani, 2019). Current forecasts assume that Kenya's use of fossil fuels, including oil, will continue to grow if existing policies are implemented.** However, that could change if there is a global price on carbon emissions to reduce climate change risks.

Kenya has made efforts over the last decade to create an enabling policy environment to improve electricity access and reliability. It is projected that Kenya will have achieved 100% access to electricity by 2030. However, affordability remains a major hindrance to the adoption of electricity as a primary energy source for cooking and heating in many homes. Today, Kenya's electricity generation mix is more than 75% renewable as shown in Table 8 (Kenya | Tracking SDG7, 2019).

** *IEA, Fossil fuel final energy consumption in Kenya by scenario, 2018-2040, IEA, Paris https://www.iea.org/data-and-statistics/charts/fossil-fuel-final-energy-consumption-in-kenya-by-scenario-2018-2040.*

Kenya's electricity generation mix

GENERATION SOURCE	PERCENTAGE
Hydro	29%
Geothermal	30%
Wind	12%
Solar	2%
Thermal (Fossil)	27%

Table 8: Kenya's electricity generation - primary energy mix. Source: Tracking SDG7, 2019.

Figure 42 illustrates the electricity generation mix in megawatts (MW) in October 2019.

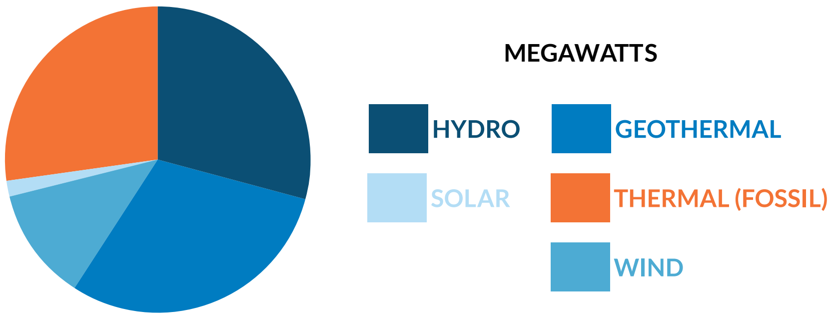


Figure 42: Kenyan electricity generation mix in MW. ***

With the above insights on current and projected energy sources and uses in Kenya, how then does this affect women specifically?

*** *Kenya Power electricity generation data: October 2019*

ENERGY POVERTY AND WOMEN

There is a lack of gender specific data in energy which limits our understanding. Transportation and manufacturing account for most of the fossil fuel use, for example, but we don't know how, or if, that affects men and women differently. This chapter therefore uses available data on biomass and electricity, which together constitute over 75% of energy use in Kenya, to draw gender specific examples that can be instructive in drawing conclusions.

Energy poverty is broadly defined as a lack of access to modern energy services. This includes household access to electricity and clean cooking facilities that avoid the air pollution caused by dirty cooking fuels and poorly designed stoves. Globally, energy poverty has been shown to contribute to extreme poverty. Studies have shown that children in electrified homes attain higher education levels than those without electricity. Better lighting increases home study time resulting in better grades at school (Independent Evaluation Group World Bank, 2008). By comparison, the lack of light for studying makes it harder for poor children to continue with their studies and this poor education limits their ability to have a decent income later in life. Further, low income households typically spend more than 20% of their household income on energy. There is a strong association between energy poverty and a low standard of living (Njiru and Letema, 2018)

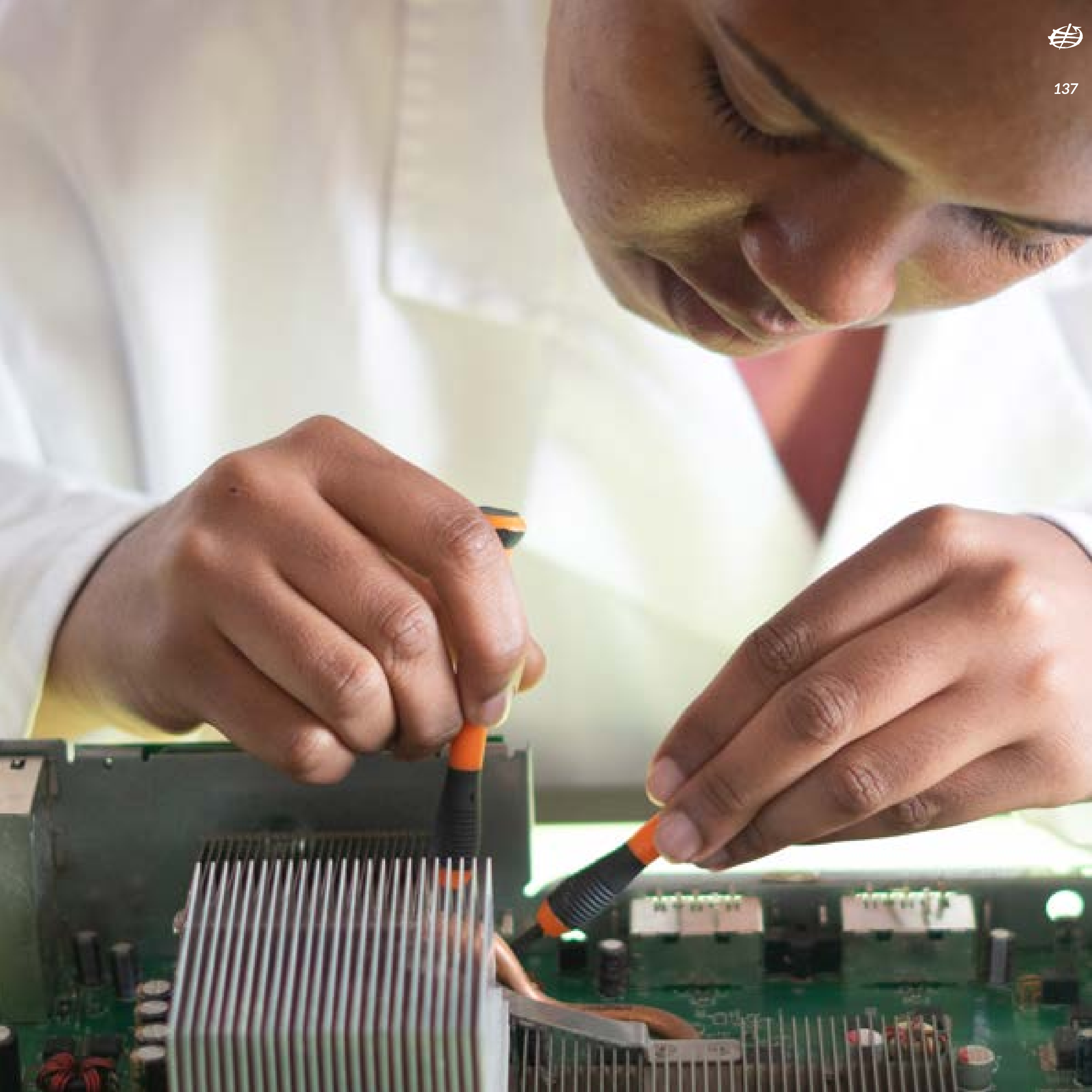
With respect to how energy poverty affects women, first, studies show that female-headed households and elderly women are at a higher risk of energy poverty. Research carried out in Homa-Bay County revealed that 74% of widows did not have access to either grid or off-grid electricity due to the high connection/subscription fees (Ministry of Energy, 2019).

Second, it has been shown that women in Kenya spend on average of 77 minutes per week gathering biomass for energy, in comparison to 13 minutes by men (Ministry of Energy, 2019). This is attributed to the decline in forest cover because they often collect firewood on foot and have to walk longer distances over time to find enough fuel for their use. This reduces the time available for higher value tasks such as getting an education, running a business, or caring for younger children.

Third, indoor air pollution caused by inefficient cooking fuels has been estimated to cause early deaths, especially among women and girls. In Kenya, about 21,560 deaths are attributed to household air pollution annually (Kenya Household Cooking Sector Study, 2019).

Lastly, women's reproductive health is also affected by energy poverty, especially in rural areas and informal settlements. Health centres in rural areas or informal settlements frequently experience electricity blackouts and interruptions. These contribute to increased maternal mortality as well as lower life expectancy. China's experience demonstrated a correlation between an increase in per capita energy consumption and a rise in life expectancy (Njiru and Letema, 2018).

These examples illustrate that women, especially those residing in rural areas and urban informal settlements, are inordinately affected by energy poverty. In the longer term, the country will pay a high cost in poor health and education for all Kenyans by not pulling women out of energy poverty.



KENYA'S AMBITIOUS DEVELOPMENT GOALS

In recognition of these facts, the Sustainable Development Goals (SDGs) were adopted in 2015 by all member states of the United Nations, including Kenya, to guide the world on how to end poverty, protect the environment and ensure human prosperity by 2030*. SDG 7 on sustainable energy is one of the fundamental pillars of the climate change mitigation agenda and also affects women. This SDG focuses on three areas: universal electricity access, transition to 100% renewable energy, and adoption of clean cooking fuels.

SDG 7 is especially relevant in Kenya. Africa contributes the least to greenhouse gas emissions but is poised unfortunately to suffer some of the most drastic consequences of climate change. Africa also has the highest number of people still living in off-grid or under-grid areas with no access to electricity, leading to some of the most extreme cases of energy poverty in the world today (SEforAll, 2019). SDG 5 is also relevant as it aims to achieve gender equality and empower all women and girls by the year 2030.

In addition to being a signatory to the Sustainable Development Goals, Kenya, as a member of the African Union, is a signatory to Agenda 2063 that aims to achieve "an Africa whose development is people-driven, relying on the potential offered by African people, especially its women and youth, and caring for children." ***(Agenda 2063 'Popular version', 2015)***.

Nationally, Kenya's own development blue-print, Vision 2030, aims to accelerate the transformation of the country into a rapidly industrialising middle-income nation by the year 2030. The Vision 2030 Medium Term Plan 2018-2022 has been harmonized with the current government's "Big Four" agenda that has four main priority areas: 1) industrialization, manufacturing and agro-processing; 2) affordable housing; 3) food and nutrition security; and 4) universal health coverage. The success of this agenda is intended to enhance economic growth and alleviate the high cost of living affecting many Kenyans, including Kenyan women and girls. However, the success of this vision largely hinges on the success of the energy sector **(** Treasury and Building, 2018).

In order to achieve these goals, Kenya has focused most of its efforts on electricity use and access, but as previously mentioned, electricity is only a small part of the whole energy system. By comparison, progress on clean cooking has been much slower, yet this affects women much more. Data on household cooking has only been collected from 2017 ***(Kenya Household Cooking Sector Study, 2019)***, but shows that the use of gas or electricity for household cooking is largely confined to wealthier urban areas. The uptake of clean cooking solutions is hampered by factors such as limited distribution networks and supplies of clean cooking equipment and fuels especially, in the rural areas, as well as an inability to afford the cleaner cooking solutions (Ministry of Energy, 2019). Given these obstacles, it is not surprising that a large majority of households in rural areas and informal urban settlements still rely on charcoal and wood.

* *United Nations Development Programme, UNDP, undated. https://www.undp.org/content/undp/en/home/sustainable-development-goals.html/, Accessed 31 January 2020*

Photo by Belikova Oksana from shutterstock.com

Participation of women in the Kenyan energy sector

It is evident that energy poverty affects the well-being and future success of women and their children. However, while Kenya has great aspirations to reduce energy poverty and develop a modern industrial economy, there is still a long way to go, especially in the participation of women in energy policy positions.

To understand the extent to which women are already shaping the transformation of Kenya's energy system, this chapter looks at the evidence in three significant areas: political power, money and private sector participation.

Political power and the energy sector

When it comes to political power, Chapter Four of the Kenyan Constitution has a provision that states, ***"...in addition to the measures contemplated in clause …6.., the State shall take legislative and other measures to implement the principle that not more than two thirds of members of elective bodies shall be of the same gender."***

The Constitution of Kenya (Amendment) Bill 2018, which is yet to be assented into law, proposes a framework to implement this provision and increase the representation of women in both elected and appointed posts to the 33% threshold (The Constitution of Kenya Amendment Bill, 2018). In 2019, the Ministry of Energy launched a gender policy which is the first such legislative instrument on the African continent. This progressive move was made to raise the level of gender awareness, change attitudes, and build a work culture of gender equality among staff in the energy sector (Ministry of Energy, 2019).

Historically, the provision of electricity in Kenya was a centralized function. This meant that government had the primary responsibility for increasing access, as well as harnessing our renewable resources for the generation and efficient use of energy. This responsibility was met through parastatal companies. These companies are important sites of political power and money, where women could play an enhanced role in directing the use of resources towards reducing energy poverty. Even though the electrification rate has increased drastically over the past five years, the cost of the electricity is largely prohibitive and the power supply quality is poor with most rural consumers experiencing frequent blackouts ***(Kenya | Tracking SDG 7, 2019)***. Because expensive and unreliable electricity affects women and their children, one can argue that if more women could influence electricity policies, the situation would improve.

With regard to representation in leadership, the record of the state corporations under the Ministry of Energy and Petroleum so far could do better. According to the Kenya Census 2019, there are roughly 400,000 more women and girls than men and boys in Kenya (24 million women compared to 23.6 million men, or 49.6% male and 50.4% female (Census, 2019). The constitution requires at least 33% of women in elective office, and a similar rule may soon apply to appointed positions. Figure 43, below, shows the percentage of women on boards and in senior management within the Kenyan electricity and petroleum state corporations. It is worth noting that though some women are present in senior positions, only EPRA has met the proposed 33% minimum threshold for both board and senior management appointments.

A review of the annual reports of these parastatals provides insight into their annual budgets and the scale of their projects. Furthermore, they benefit from credit from multilateral lenders and other international financiers. The money available to these entities points towards their influence in the energy sector. Given the roughly 50/50 split in the population, what Kenya should be aiming for ideally is an evenly matched representation of both genders in leadership and other influential roles within the electricity and petroleum state corporations. That is not yet the case, which implies there is a clear opportunity to utilise the talents of more women to steer these institutions to fully attain the SDG 7 target by 2030.

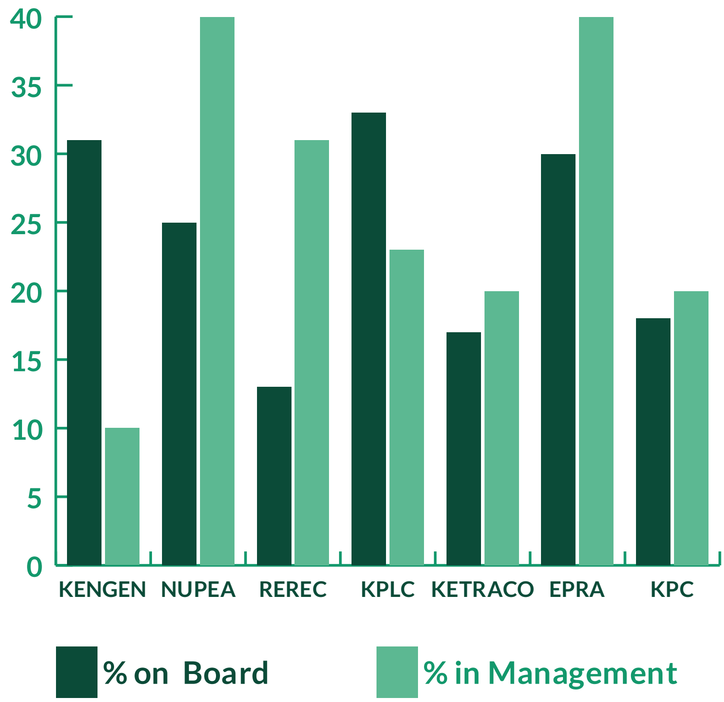


*Figure 43: Graph showing the representation of women in energy sector parastatals**

* *Data used to generate this graph was compiled from the websites of the various state corporations: KPLC, REREC, KENGEN, KETRACO, EPRA, KPC and NUPEA that were all accessed on 27 January 2020.*

WOMEN IN RENEWABLE ENERGY & CLEAN COOKING

The passing of the Energy Act 2019 (Issue, 2019) offered a more structured way for the private sector to engage in all aspects of energy access, efficiency and clean cooking. A review of existing literature underlines positive change brought on by the 'democratization' of the energy sector leading to new opportunities for women. Women are now participating as sales agents for selling solar home systems* or as founders and employees of mini-grid companies in solving the electricity access problem. Additionally, the production of energy efficient charcoal and fuel-wood stoves has provided significant employment opportunities in urban and rural areas (Mokveld and Eije, 2018).

Presently, Kenya has a grid-tie option being offered to consumers who would like to lower their power bills by including a component of solar photo voltaic (PV) in their existing power connection. This provides opportunities for women in the installation, repair and maintenance of these systems. A good example is the programme run by Strathmore Energy Research Centre known as the Women in Sustainable Energy Entrepreneurship(WISEe)** that equips women with skills to install and maintain solar PV systems. In technology and innovation, Strauss Energy has a 50/50 gender representation in both its board and management team, and sells an innovative solar tile that is used for roofing while also generating electricity.***

Women are also proving to be effective and innovative entrepreneurs. A recent study shows that 93.2% of the rural populations in Kenya still rely on solid biomass fuels as their primary fuel source (Kenya Household Cooking Sector Study, Energy, 2019). A similar fraction of those living in informal settlements within urban areas also rely on biomass for cooking. Anecdotally, in Kenyan homes, the bulk of the population using dirty fuel to cook is female. These facts imply an urgent need to accelerate progress within the clean cooking sector to but they also point towards a business opportunity.

On this front, Chebet Lesan founded a company called Bright Green Renewable Energy.**** This company focuses on recycling urban and agricultural waste to provide briquettes and aid the clean cooking revolution. Another innovative company, Giraffe Bioenergy***** was founded by a Kenyan, Dr Linda Davis, to improve rural livelihoods by growing and processing cassava as a clean biofuel for cooking. It is worth noting that women entrepreneurs face unique challenges, especially with respect to financing. In an interview, Dr Davis states that the perception has always been that women should be doing small businesses that require minimal funding. In her experience as an entrepreneur trying to provide a solution at scale, fundraising has proven significantly harder for her than for her male counterparts. ******

* *https://www.globalcitizen.org/en/content/women-solar-energise-africa-impact-investing/, accessed 27 January 2020.*

** *Program run by Ms. Tameezan wa Gathui trains female engineers and technicians on solar PV T1-T3 installation.*

*** *https://straussenergy.com/, accessed 31 January 2020*

**** *See https://www.cartierwomensinitiative.com/candidate/chebet-lesan, accessed 11 August 2020) or https:// www.changemakers.com/globalgoals2015/entries/bright-green-renewable-energy, accessed 31 January 2020. There's a company with a similar name in the UK but they are not affiliated.*

***** *https://giraffebioenergy.com*

****** *https://www.youtube.com/watch?v=tjunZueofxM*

These are some examples where the agency and ingenuity of Kenyan women is highlighted. Such stories demonstrate that despite their under-representation in the energy sector, women are already making valuable contributions to Kenya's energy transformation. While more needs to be done by the powerful to overcome systemic barriers and provide fair opportunity to all, these illustrations offer insights into what measures could be taken to further empower women and increase their participation. Better and more accessible training and capacity building, as well as investing in women-led enterprises, can help Kenya to meet Sustainable Development Goals 5 and 7, to improve women's lives by improving the energy system as a whole.

Above: "Training of women solar technicians in Kenya" Courtesy of WISEe Coop Society Ltd.

CONCLUSION

This chapter provides a brief overview of the participation of women in the Kenyan energy sector from legal compliance with respect to gender representation, to their role in the design and use of technologies for increasing electricity access and clean cooking. It also highlights the link between the widespread use of biomass for cooking and its negative impact on women's health. The research shows that the progress of women and the success of the energy sector are inextricably linked.

This paper also invites us to imagine an alternative future for clean cooking. Given the big push to increase electricity access, could the cost of electricity become low enough to allow it to become a domestic cooking fuel? Or, could one of the fossil fuels such as liquefied petroleum gas be subsidized by the government in order to increase its adoption? These questions point to the need for further research and innovation around the clean cooking challenge beyond simply making biomass better.

While women are still under-represented in most energy sector institutions, a few have demonstrated the potential of the sector and found innovative ways to contribute, especially within the private sector. In conclusion, it is evident that Kenya will not attain its energy goals, national or international, unless the energy sector improves on its collection of energy engendered data, harnesses the potential of women, and provides affordable energy indiscriminately to all Kenyans, urban and rural, men and women alike.


Photo by Ramiz Allafi from shutterstock.com

POLICY RECOMMENDATIONS

As Kenya continues to work towards the achievement of SDGs 5 (women) and 7 (energy), the following policy recommendations are proposed:

For the government

To conduct a baseline study across all counties on participation of women in the energy sector and create a database to allow for reporting and tracking progress within a defined timeline to better understand the gaps and how to close them. Gender specific data has been shown to be useful in designing influential interventions.

For the private sector

To build the technical capacity of women by offering energy specific scholarships or having women-only training sessions for skills such as making briquettes, conducting energy audits, or installing solar systems in Nairobi, Kisumu and Mombasa counties. These three counties already have the existing training infrastructure required and can be easily adopted as centres of excellence for training women from across the whole country.

For financiers

To incentivise companies to have more women on boards and in management by offering better credit rates for diverse teams. Secondly, to have gender specific financing packages for women entrepreneurs.

Additional Recommendations

Increase deliberately the representation of women in leadership roles within the sector by implementing affirmative action or quota rules across county and national government agencies.

For the arid and semi-arid counties, leverage the learning of energy specific vocational skills can be part of a young person's coming of age. In the case of girls, it could be an alternative to the harmful practice of FGM as a rite of passage.

In Turkana County, partner with Lake Turkana Wind Project to offer internships and training to women technicians and engineers. The same approach can also be employed in Garissa County with the 50MW solar project.

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14

CHAPTER FOURTEEN: BIOMASS IS HERE TO STAY: TOWARDS A SUSTAINABLE FUTURE

SARAH ODERA

EXECUTIVE SUMMARY

Biomass is used for cooking in domestic and institutional settings and to generate process heat in industrial settings. Charcoal and firewood are the most common forms of biomass. Firewood use is more prevalent in rural areas (used in 84% of households) with charcoal used more often in urban settings. The tea industries use firewood for drying and withering tea leaves, while cottage industries such as brick-making, bakers and tobacco processers also use it in their operations.

Despite policy interventions that have raised prices for firewood and charcoal, biomass fuel is likely to continue to be used for some time to come.

Kenya therefore needs to develop a sustainable value chain encompassing production, transportation and consumption of biomass energy. This could start with a suitable regulatory framework that legalises and regulates biomass fuel production and sale. A suitable regulatory framework would encourage farmers to grow trees as an energy cash crop, helped by support from extension service workers who can advise on the best tree species that have high calorific values and do not produce toxic smoke or harm the wider ecology. Regulation should also focus on encouraging sustainable consumption using the most efficient technologies that both reduce the amount of fuel used and the emissions of harmful smoke.

INTRODUCTION

Biomass is renewable organic solid material that is obtained from plants and animals. In the energy sector it is used for generating heat for cooking, and industrial-scale steam generation to carry heat for multiple functions such as drying tea leaves. Biomass energy comes in many forms including charcoal, firewood, briquettes, pellets, agricultural residue, such as coffee and macadamia husks, bagasse* from the sugar industry, and others.

The objective of this chapter is to discuss biomass utilisation in Kenya and address a fundamental question: is biomass energy here to stay? This chapter is structured as follows: first, it describes the current role of biomass in Kenya's energy mix in industrial and domestic sectors. This will be followed by an analysis of factors influencing biomass energy consumption in Kenya which concludes that biomass energy is here to stay. The chapter closes with recommendations for ensuring a sustainable biomass energy system.

* *Bagasse is the dry, fibrous residue remaining after juice has been extracted from sugar canes.*

Photo by Marius Dobilas from shutterstock.com

THE ROLE OF BIOMASS IN KENYA'S ENERGY MIX

Biomass is used to generate heat for cooking in the domestic sector as well as in institutions such as schools, hospitals, and prisons. Biomass also has a modest industrial role as described below.

Biomass for cooking

Firewood and charcoal are the forms of biomass typically used for cooking in domestic settings. Fifty-five percent of Kenya's population use firewood for cooking; the vast majority of rural households, 84%, use firewood, and about 9% of urban residents do so. Charcoal is used by 11.6% of Kenyan households; 6.6% of rural and 17.7% of urban households rely on charcoal for cooking. It is worth noting that the majority of households in Kenya use multiple fuels for cooking. A survey undertaken by the Clean Cook Stoves Association of Kenya (CCAK) found that just 6.6% of households only utilised LPG for all cooking. The rest combined LPG and charcoal. Households in the rural areas often utilised a combination of charcoal and firewood.

According to CCAK, rural people largely depend on fuel that has been collected, not purchased, and use a three-stone cook stove. This simple stove has energy efficiencies up to 16%** with high emissions of smoke (CCAK, 2017) These low efficiencies increase the quantity of fuel required and therefore the time spent fetching firewood.

This burden is primarily felt by women and children who could have allocated this time to income generation or education. The high emissions lead to respiratory diseases which can cause death. In Africa, 41,000 people die annually of respiratory illnesses associated with emissions from cooking (UNEP, 2017).

Firewood is also used for cooking in Kenyan institutions such as schools, hospitals, and prisons. It is estimated that one child in a learning institution consumes between 0.25 to 0.74 m^3 of firewood per year. A survey undertaken by the Clean Cookstoves Association of Kenya revealed that the majority of institutions use firewood for cooking. However, unlike their domestic counterparts more than half of these institutions rely on improved cookstoves. Full transition to improved cookstoves by these institutions has the potential to reduce biomass consumption in Kenya by 45%-65% (CCAK, 2017).

** *Energy efficiency of 16 % means that only 16% of every stick of wood produces the heat needed for cooking. A more efficient stove needs less wood to achieve the same task, such as boiling water.*

Firewood for industry

Firewood is also used in industrial settings for the generation of process heat including in cottage industries like brick making, tobacco curing, fish smoking, sugar jaggeries and baking. The tea industry in Kenya is one of the largest consumers of wood fuel, using it to dry and wither tea leaves. According to Kenya's Bioenergy Strategy, data describing biomass consumption in these industries is scarce. However, it is important to note that some enterprises, particularly the tea and tobacco factories, have established plantations to secure their supply of wood fuel (Ministry of Energy, 2020).

Charcoal production technologies

Charcoal is an urban fuel produced through a series of combustion processes that limit oxygen to create a slow burn. Charcoal is preferred over firewood in urban settings due to its high energy density, cheaper transport costs, and relative cleanliness. Charcoal cooking appliances are also more affordable than technologies using cleaner fuels such as LPG or electricity. This has made charcoal preferable in some contexts, although government measures, such as removing VAT on LPG cylinders, and innovations like smaller gas cylinders to make them more affordable, has reduced consumption of charcoal. Over the past five years the number of households relying on charcoal has gone down by 5%, but this reduction in charcoal use may be threatened by the government's recent re-introduction of VAT on LPG.

One of the challenges of charcoal production is the inefficient technologies used in the combustion process. Ninety percent of charcoal used in sub-Saharan Africa is produced from traditional earthen kilns (SEI, 2016).

An attempt to improve the traditional earthen kiln has been made through various methods, such as the utilization of metal sheets or wire mesh to cover the charcoal in order to prevent contamination, and the addition of a chimney to regulate air flow (KFS, no date). It has however been observed that the improved earthen kiln does not necessary yield better efficiencies or higher quality charcoal. In one study, it was found that experienced 'charcoalers' obtained higher efficiencies with the traditional earthen kiln than their counterparts using the improved earthen kiln. The improved earthen kiln has however been recorded to have efficiencies of up to 30% (Morgan-Brown and Samweli, 2016). An update from the Kenya Forest Service compared the efficiency, durability and prices of a range of charcoal kilns, with the more expensive systems having the greatest efficiency. One of the challenges faced by low income of charcoal producers is their inability to afford more efficient kiln technologies such as brick kilns (KFS nd).

FACTORS INFLUENCING BIOMASS ENERGY CONSUMPTION

A survey undertaken in Western Kenya revealed that selection of fuels for cooking is driven by the availability and cost of both the fuel and cooking technology. These factors will now be discussed.

Biomass availability and cost

Biomass has historically been easily available, especially in rural areas when compared to fuels like LPG and electricity. In urban areas retail charcoal is easily bought in most neighbourhoods. Anecdotal evidence in Nairobi for example indicates that most people live between 50m and 100m from a charcoal retailer. Rural consumers collect firewood from nearby areas. A survey undertaken by CCAK indicated that 56% of rural users had never failed to obtain the quantity of fuel that they require for daily use. These users collect the fuel at no cost, a significant factor of firewood consumption.

Beyond availability and low cost, users of biomass, particularly firewood, prefer to use it with a three-stone cookstove, the most common cooking technology for firewood, because it is convenient and adaptable. After collecting the stones, they are quickly arranged as a durable cook stove which is easily adapted to bear multiple sizes and shapes of cooking pots. It can also burn agricultural residue in addition to firewood and provides space heating while also repelling insects due to the generation of smoke.

Despite the advantages of biomass energy, climate change coupled with deforestation are reducing biomass availability. People are increasingly walking longer distances to fetch firewood or switching to poor quality agricultural residues; this is a trend which is not just limited to arid and semi-arid regions like Turkana, but is also seen in high agricultural potential areas like Nyeri and Embu.

Another factor limiting the use of biomass has been policy interventions driven by the goal of increasing forest cover in the country. In 2018, the government put in place a moratorium on logging in public and community forests. This followed a ban on production and transportation of charcoal in Kitui County, which is one of the largest production regions in the country.


Photo by DIOssina from shutterstock.com

These actions increased the retail cost of biomass (Forest News, 2020). As a direct result, some charcoal merchants shifted to neighbouring countries like Uganda for charcoal supplies. Despite elevated transport costs, they benefited from increased profit margins as these countries had lower production costs. Some households in informal settlements also shifted to electricity acquired through illegal connections, paying a fixed price that is not dependent on consumption. Lastly, because of higher charcoal costs, some households had to reduce consumption by limiting activities like heating water for bathing (The East African, 2019; The Standard, 2018).

Consumers who purchase firewood were also affected by the logging moratorium which caused the purchase price of firewood to increase by 25%. Industrial consumers with the tea and tobacco factories passed the cost onto farmers by reducing what they paid for their crops of tea and tobacco. Institutions like schools and prisons had to absorb the higher fuel cost, which reduced the financial strength of their operations (KEFRI, 2020).

The ban on charcoal production in Kitui also created an underground market because the producers did not have alternative means of income generation. Producers' profits were reduced as charcoal transporters paid them less, citing the higher costs of moving charcoal illegally (Kenya News, 2020).

Why biomass is here to stay

Biomass currently meets over half of Kenya's energy needs and energy systems have historically changed very slowly. Despite the many factors such as climate change and policy interventions that reduce the availability of biomass, biomass will play a significant role in Kenya's energy mix for the foreseeable future unless conditions change radically. First, the majority of Kenyans still live in rural areas (68.9% today according to the 2019 census undertaken by KNBS) where firewood is still freely available, despite threats imposed by climate change and policy interventions. Motivation for transition may therefore be limited. Further, fuels like LPG, which are identified as clean cooking solutions for the Kenyan market, are expensive and difficult to access, especially in rural areas due to poorly established distribution networks.

Until cleaner fuels are affordable and accessible it is likely that biomass will play a significant role in Kenya's energy mix for years to come.

While it is difficult to determine how long biomass will retain its prominence in Kenya's energy mix, it is evident that it will be utilised for the foreseeable future. This is observed in policy documents such as the Kenya's Sustainable Energy Action Agenda which has the goal of improving penetration of improved cookstoves from 37% in 2016 to 57.7% in 2030. Promotion of cookstoves indicates that biomass is expected to play a critical role in Kenya's energy mix beyond 2030, which is why the government will focus on improving efficiency of utilisation.

Sustainable Biomass

Evidence indicates that biomass will play a significant role in Kenya's energy mix for the foreseeable future. Sustainability of this fuel needs therefore needs to be considered in the development of current energy systems. A sustainable biomass energy system needs to consider the entire value chain, encompassing production, transportation, and consumption. Recommendations towards sustainability are discussed in the following sections.

Photo by Vlad Karavaev from shutterstock.com

Regulatory framework

The biomass regulatory framework has done little to create an enabling environment for the biomass value chain in Kenya. Nor have the charcoal regulations – which detail requirements for charcoal producers, transporters, wholesalers, and retailers – curbed the corruption that thrives when this fuel is considered illegal. In some cases, it is reported that as much as 25% of the retail cost of charcoal is bribes paid out during transportation (Neufeldt, et al, 2015).

Moratoriums on logging imposed by governments in order to regain forest cover also contribute to the perception that biomass is an illegal fuel, even though most charcoal is produced from private land, outside the moratorium's jurisdiction. The regulatory frameworks at both at county and national government level should clarify what constitutes legal charcoal production and focus on enhancing the sustainability of this sector. By creating a strong legal trade, charcoal prices should fall, reducing the value of corruption and increasing the sustainability of supply and employment. Some measures that can be considered in policy reforms are discussed below.

Sustainable production

Sustainable production of charcoal and firewood begins right from selection of the tree species used to provide fuel. Good species can be describing as those with the following characteristics (Pisces, 2012):

- High energy density;
- Grows quickly with good yield;
- Can regrow from the base after harvesting;
- Does not produce toxic smoke when burned;
- Wood can be easily split after harvesting;
- Does not interfere with the local ecology.

Selection of species can only be undertaken where land was intended for wood fuel production. As such formalisation of this sector and its recognition as a 'cash crop' can serve to enhance fuel quantity and quality. Recognition of tree growing for charcoal production would enable farmers to benefit from extension services targeted at improving their agricultural practises.

It may further fuel the implementation of the mantra 'cut one tree, plant two' envisioned in the charcoal regulatory framework, as these farmers would strive to ensure that their income is sustainable, simultaneously contributing towards maintaining tree cover in the country.

Another option to enhance sustainability is to use charcoal production to control invasive species such as prosopis by turning them into charcoal. Invasive species cause loss of grasslands, woodlands, and settlement areas. Removing them is good for the environment generally, especially if native species are planted in their place or allowed to grow back. (Nike & Meshack, 2017).

Alternative fuels like briquettes and agricultural residue such as bagasse, coffee husks, macadamia husks and briquettes can also be used for heat generation. These alternative fuels present an opportunity to reduce deforestation. Briquettes are a common alternative fuel.

A large challenge however is the standardisation of fuel quality. Briquettes can be made from saw dust, charcoal dust and various forms of agricultural residue such as rice husks, macadamia shells and coconut waste. A study conducted by Energy4Impact revealed that the quality of briquettes produced in the Kenyan market is highly variable, potentially spoiling the market as it is seen as an unreliable fuel. If the Kenya Bureau of Standards could provide certification to briquette producers and enforce reliably high standards, that would encourage adoption of the fuel (E4I, 2013).

Utilisation of alternative biomass – including briquettes, agricultural residues such as maize cobs, sugar cane bagasse and macadamia husks – for heat generation is not well documented. However, they present an opportunity to reduce dependence on charcoal and firewood, thereby reducing deforestation. One of the hinderances towards adoption of these fuels could be sustainable supply chains that link producers with consumers. Development of a mechanism to allow collection of such fuels from the point of production and distribution to industries may increase adoption into the energy mix (KEFRI, 2020).

Sustainable consumption

More sustainable production of biomass fuel needs to be supported by more efficient consumption. Current interventions are typically directed at domestic consumers who are urged to use improved cookstoves which are more energy efficient. According to the World Bank's multi-tier framework, improved charcoal and firewood cookstoves are expected to have efficiencies of at least 40% and 30% respectively. In line with this, the Government of Kenya, through its Sustainable Energy for All Action Agenda published in 2016, has included improved cookstoves in its modern energy access targets. The government intends to have a penetration rate of 57.7% for improved cookstoves by the year 2030 (Ministry of Energy, 2016).

Transition to improved cookstoves with higher efficiencies will reduce quantities of fuel consumed and emissions produced during cooking. Improved take-up of more efficient cookstoves, in turn, will follow the creation of a strong enabling environment.

This would include: increasing availability of cookstoves, enhancing consumer awareness, increasing access to finance for both suppliers and consumers, as well as developing business models that enhance accessibility.

One of the challenges facing the improved cookstoves sector include difficulty in standardisation. This leads to fabrication of poor-quality stoves with lower efficiencies. According to research undertaken by the CCAK, sector stakeholders indicated that emissions standards for biomass stoves in Kenya were too stringent, rendering majority of the stoves non-compliant. As such these standards are currently under review. Additionally, the informal sector which produces majority of the stoves used in the country lack incentives to undertake the frequent testing required to adhere to the standards. Standardisation methodology should be accessible and implementable by the informal sector.

They should also be required to adhere to the standards to ensure penetration of high quality improved cookstoves in the Kenyan market.

In industry, interventions have addressed efficiency of technologies like boilers that use wood fuel. There has been training on energy management for factory staff, and industries have also focused on improved fuel management, including planting woodlots and reducing moisture content to increase calorific value before use (KTDA, GIZ, Ethical Tea Partnership, 2019)

Industries are also testing different biomass fuels, not all of which work as expected. An example was seen when some tea factories attempted to use bagasse after the moratorium on logging increased the cost of firewood. Unfortunately, bagasse residue ended up clogging their boilers leading to high maintenance costs, but the willingness to experiment with alternatives is important.

CONCLUSION

In conclusion, it is clear that Kenya's energy system, both domestic and industrial, is still very dependent on biomass fuel. Not only do energy systems change slowly, a number of additional factors argue that biomass will remain an important fuel for the foreseeable future. Because the role of biomass in Kenya's energy future can no longer be ignored, public policy must look at new ways to make this energy source not just the most affordable, but also one that is healthy for Kenyans and for their environment.

It means changing from an extractive model where wood and charcoal are mined from the country's forests and grasslands, to a model where biomass is an accepted renewable rural harvest, providing both fuel and income for years to come.

Photo by GranTotufo from shutterstock.com

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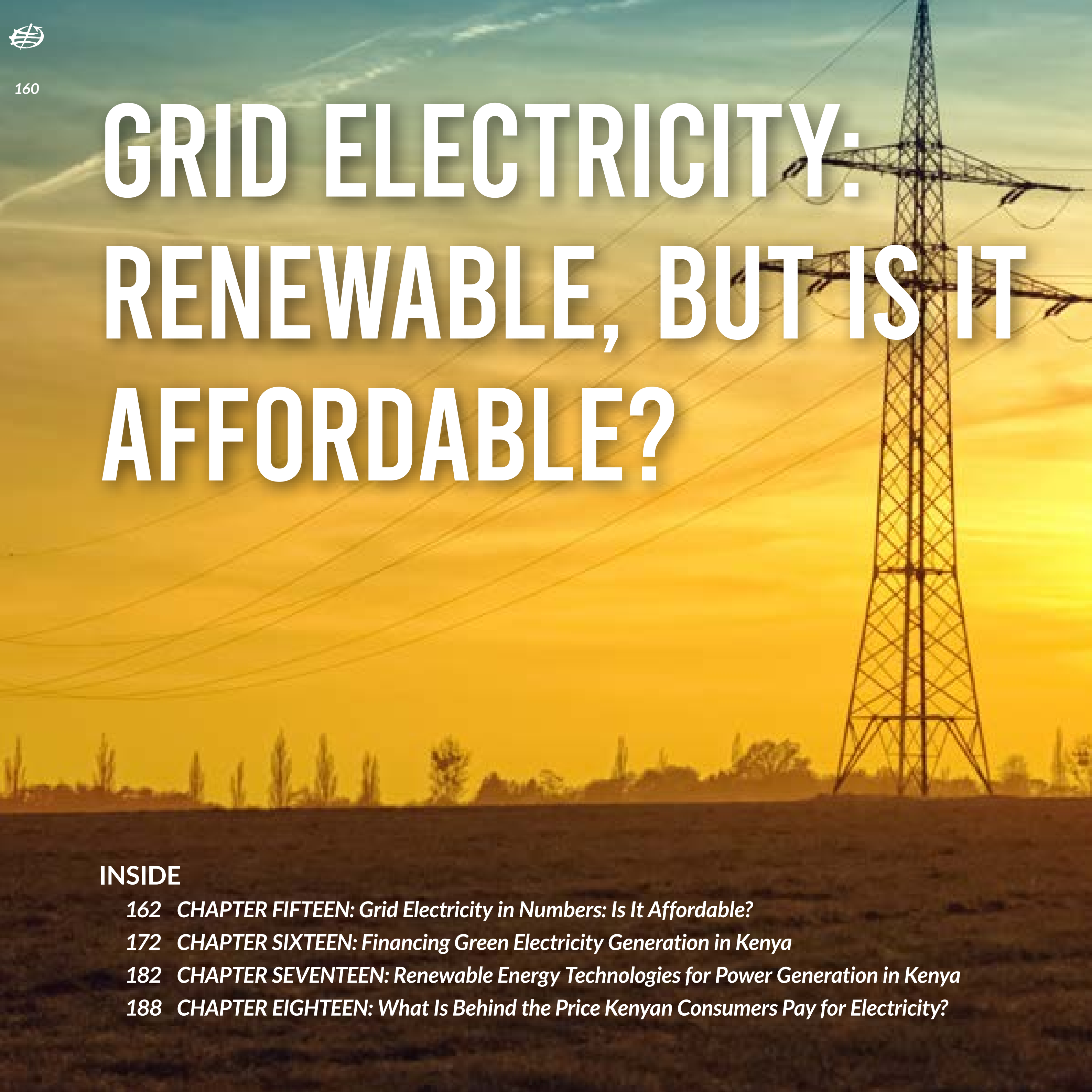


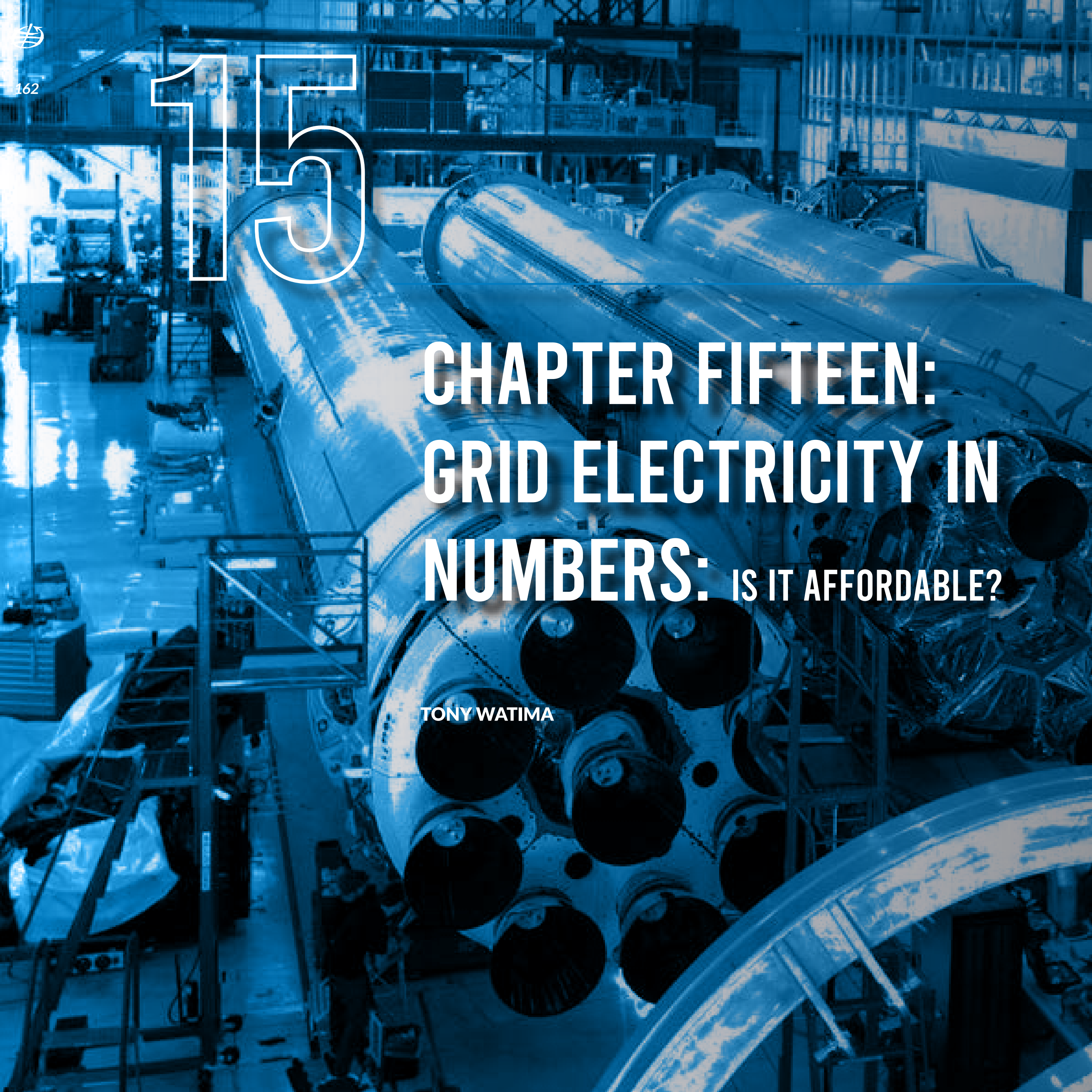
GRID ELECTRICITY: RENEWABLE, BUT IS IT AFFORDABLE?

INSIDE

Throughout this Compendium, writers have pointed out that Kenya's energy system is dominated by biomass and, as Tony Watima's statistics in the Introduction show, 70% of Kenya's energy use in 2019 came from households. This section of the Compendium looks at the "power sector", the more centralised generation and distribution of electricity in Kenya. Electrical power, produced in large power stations and distributed through a network of transmission lines, is seen as a critical component in building a modern Kenyan economy. It deliberately imitates energy investments made in countries that have already industrialised using large-scale energy projects.

Kenya's earliest investments in electricity were in the 1920s when a variety of small dams were built to generate electricity. Over time, these grew into a larger system of dams and power stations, serving the urban centres of the country with a national distribution grid. As population and economic activity expanded, the need for electrical power also grew, leading to the development of geothermal power from the Rift Valley, wind power from Turkana and proposals for a coal-fired power station in Lamu. As of 2020, Kenya was producing more power than was being used, with most of it coming from renewable sources: hydro, wind and geothermal, although a considerable share is currently lost in transmission.

This section of the Compendium starts with Tony Watima's statistical graphs on the state of electrical power today. The first essay by Muthoni Nduhiu and Samorin Olufunso then looks at how to finance more power generation in Kenya, followed by a description from Jesse Nyokabi of possible technologies for storing the renewable electricity Kenya produces. The last article by Leo Kemboi takes a look at what determines the price Kenyan consumers pay for electricity. As shown elsewhere in this Compendium, electricity is the most expensive energy used in Kenyan households while biomass is the most affordable. That is why biomass remains, for the time being, the dominant fuel in Kenya.



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CHAPTER FIFTEEN: GRID ELECTRICITY IN NUMBERS: IS IT AFFORDABLE?

TONY WATIMA

Kenya is fortunate in having abundant sources of modern renewable primary energy to power the national electricity grid, as shown in Figure 44

PRIMARY ENERGY USED FOR ELECTRICITY GENERATION IN KENYA 2015-2019

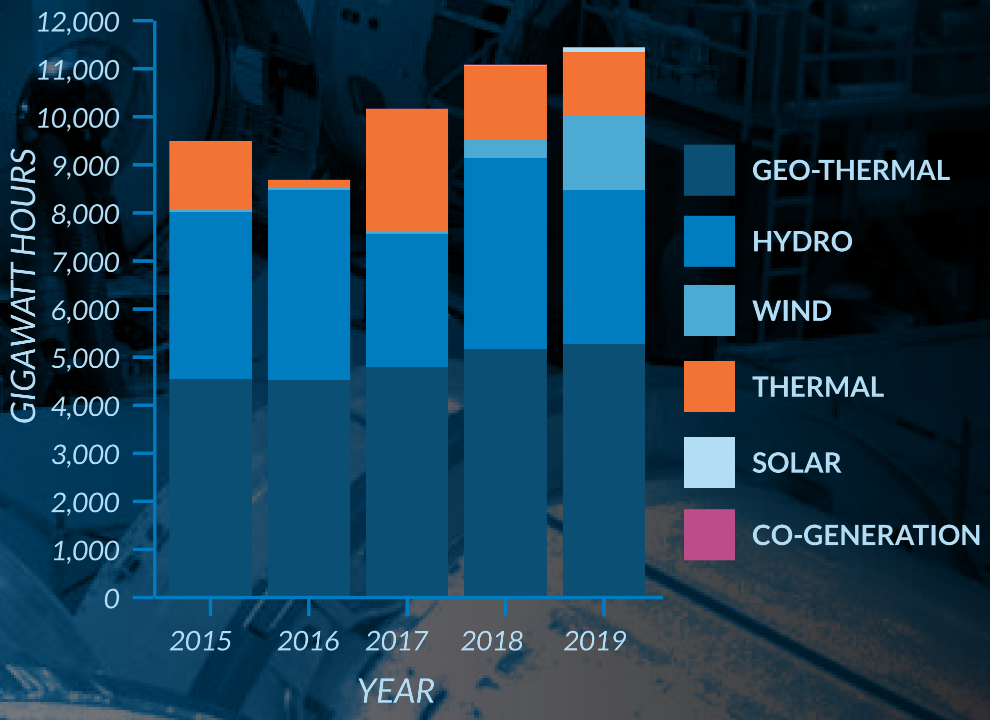


Figure 44: Kenya's national grid is largely powered by renewables

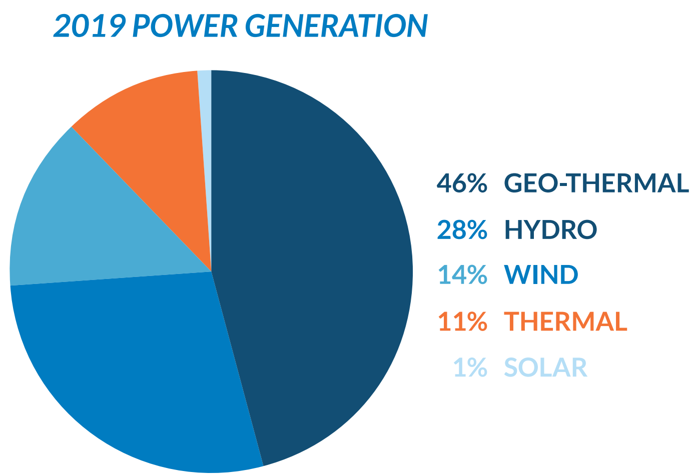


Figure 45: Renewable vs thermal sources of power generation. Source: KNBS Economic Survey 2020

In 2019, only 11% of electricity was generated using fossil fuels in thermal power stations.

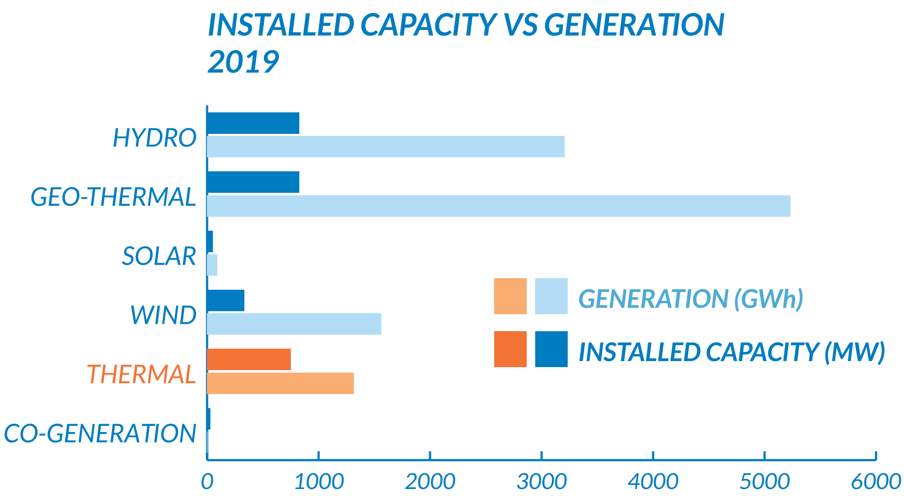


Figure 46: Geothermal energy leads in generation of grid power. Source: KNBS Economic Survey 2020

The graph in Figure 46 looks at installed capacity against generation in 2019. Geothermal can be seen to lead in generation but has the same installed capacity as hydro. Also, thermal has more installed capacity than what is generated, showing that much of the thermal plants are sparingly dispatched.*

** Installed capacity refers to the maximum theoretical electric output a power station could produce when operating at 100%. Generation refers to the maximum electric output a power station is expected to achieve given current operating conditions.*

Figure 47 shows electricity generation includes imports which comes from Uganda and Ethiopia. It is evident that there has been increased importation of electricity especially from 2017 to 2019. One of the reasons for the increased importation is that electricity coming from Uganda and Ethiopia is cheaper compared to local supply. The graph also shows that both geothermal and wind energy have increased while thermal energy from fossil fuels has declined.

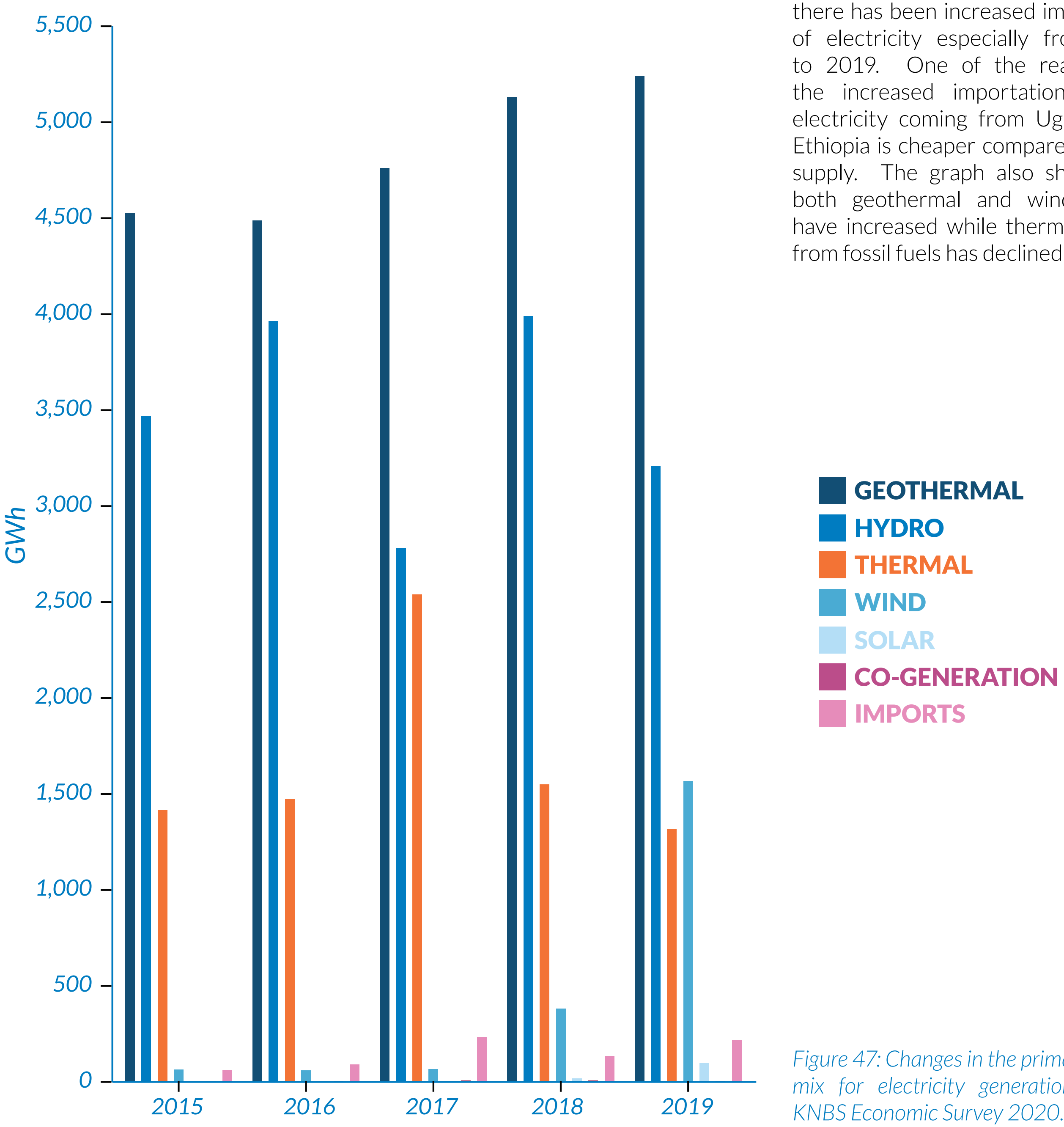


Figure 47: Changes in the primary energy mix for electricity generation, source: KNBS Economic Survey 2020.

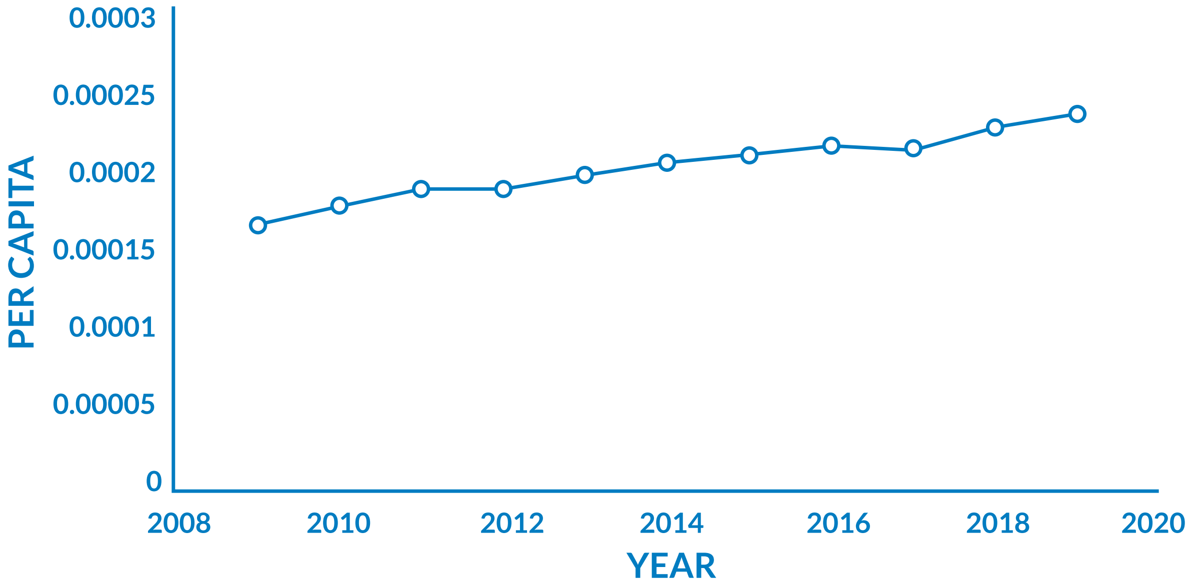


Figure 48: Rising ability to generate electricity in Kenya. Source: KNBS Statistical Abstract 2019, Economic Survey 2020 & CEIC Data.

The graph in Figure 48 shows how much power was generated per capita from 2009 to 2019. It shows that there has been continuous and healthy increase in power generation every year except between 2016 and 2017 when there was only a minimal increase.

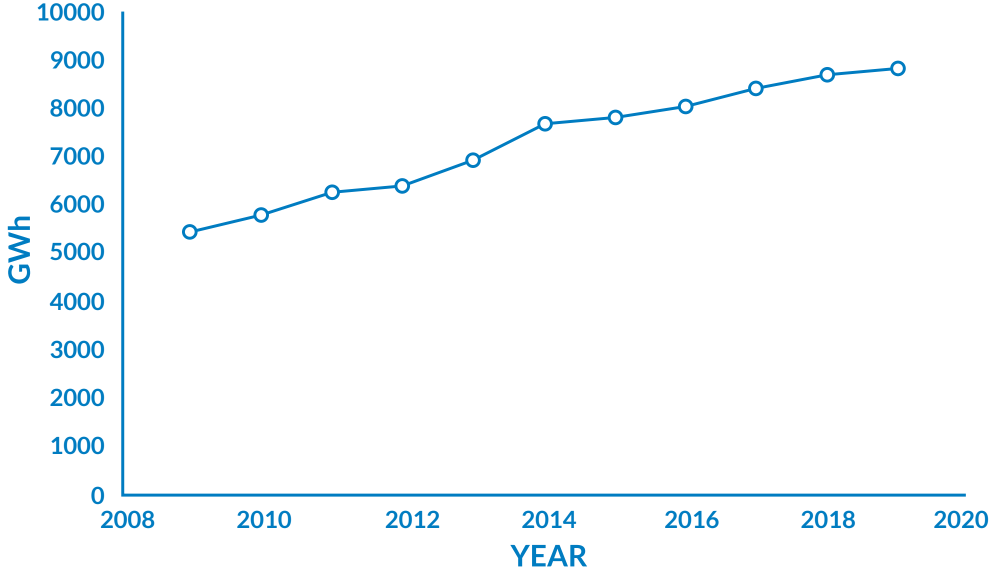


Figure 49: Demand for grid electricity has also risen, Source: KNBS Statistical Abstract 2019 & Economic Survey 2020.

This graph shows demand uptake for electricity from the national grid has been rising.

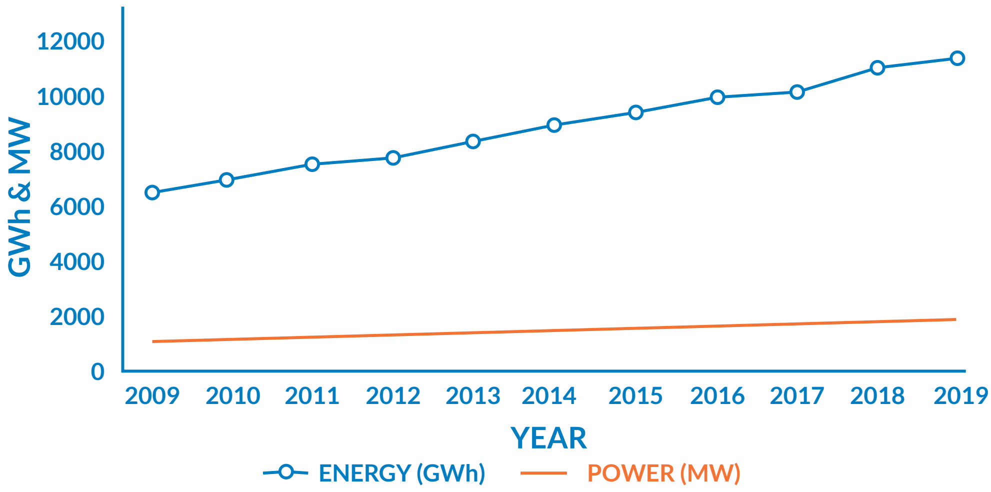


Figure 50: Supply of grid electricity is greater than demand. Source: KNBS Statistical Abstract 2019 & Economic Survey 2020.

This graph in Figure 50 compares power which is the installed capacity with energy defined as the generation of electricity. We can see that from 2014 the gap between generation and installed capacity started increasing after the government entered into a number of purchasing power agreements for its rural electrification programme It was expected that there would be a surge in electricity demand after the implementation of the programme.

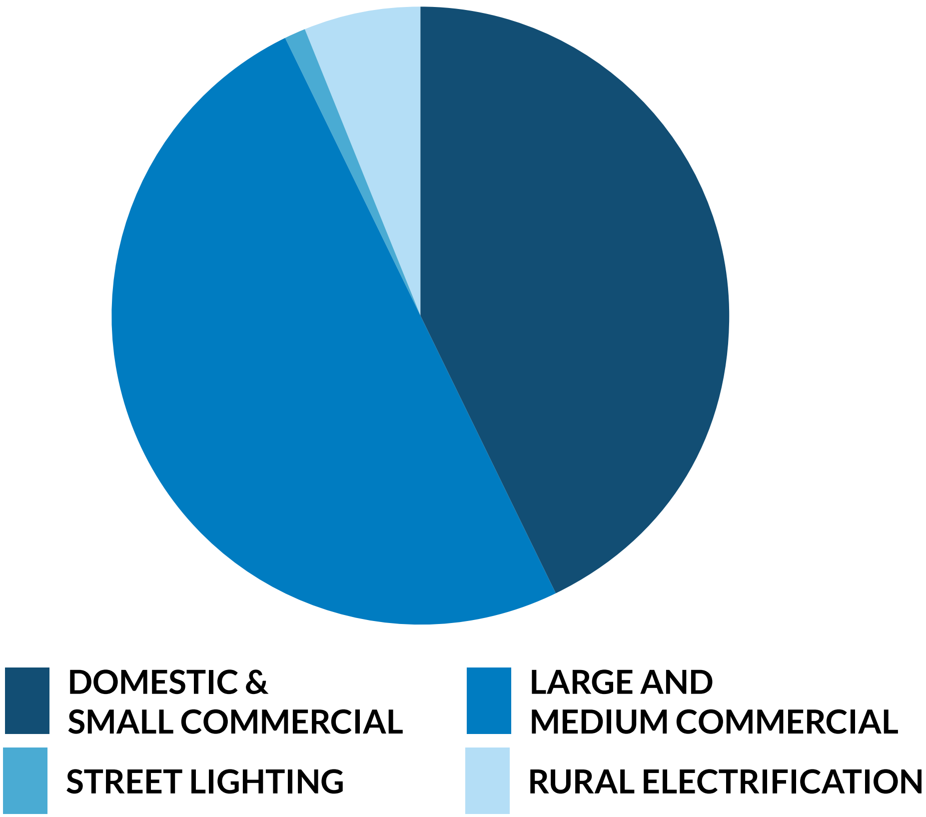


Figure 51: Who uses electricity from the national grid? Source: KNBS Economic Survey 2020

Figure 51 looks at the different types of electricity customers for Kenya Power. Large and medium-sized commercial customers are the most important energy users, followed by domestic and small commercial users, with rural electrification and street lighting taking the remaining shares.

NUMBER OF CUSTOMERS CONNECTED TO ELECTRICITY VS ELECTRICITY SALES

OVERVIEW

1. Data on domestic consumers shows a rather stagnating demand of electricity which most likely is due to a number of households moving to solar.
2. Data on rural electrification program shows an unsustainability problem. Despite increasing access to electricity through the rural electrification program, there has been little demand to commensurate the rural electrification program.

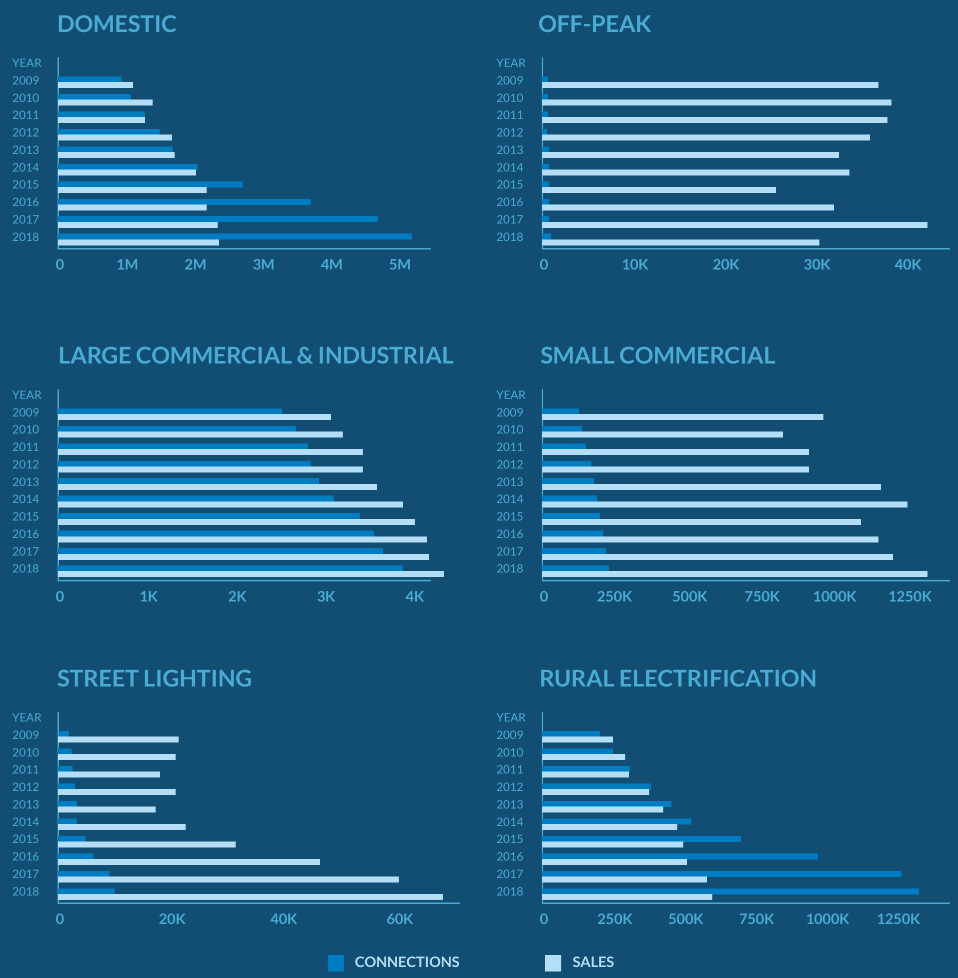


Figure 52 is uses statistics from the KNBS Statistical Abstract for 2019. The black bars indicate number of customers connected to electricity, while the grey bars indicate electricity sales. They show where customers are connected to the grid, but do not use much power. This is especially true of domestic customers and rural electrification. Other users, street lighting, off peak users and businesses use considerable power for a relatively small number of connections.

Figure 52: Connections v use of grid electricity. Source: KNBS Statistical Abstract 2019; grey bars represent electricity sales; black bars indicate the number of customers

In the case of domestic and rural consumers, the price of electricity may simply be too high, as show in Figure 53.

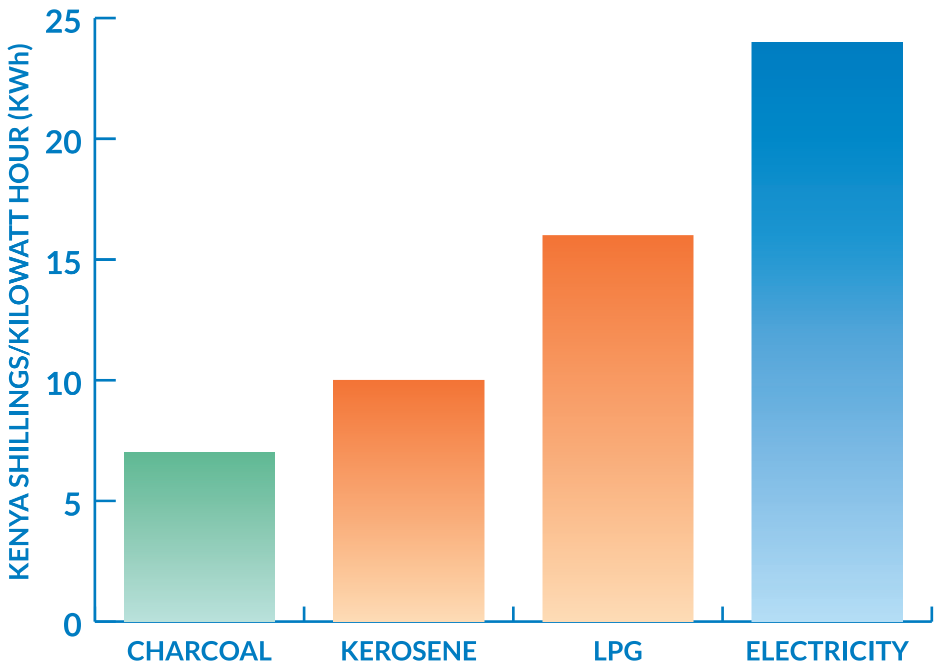


Figure 53: When compared to other fuels, grid electricity is the most expensive. See chapter on "Energy Prices, Energy Poverty and Sustainability in Kenya" in this volume.

Figure 53 compares the price of power from the grid to other household fuels. This shows that grid electricity is more expensive than other fuels, which is a major reason for the continued use of biomass and cheaper sources of energy in Kenyan households.

Anecdotally, there has been growth in the use of decentralised mini-grids and household solar, as panels or small lamps, which may be more affordable than grid power. However, the national statistics on electricity are still focused on the national grid and large power generating systems. One hint that small electric systems may be meeting peoples' needs comes from the statistics on household lighting.

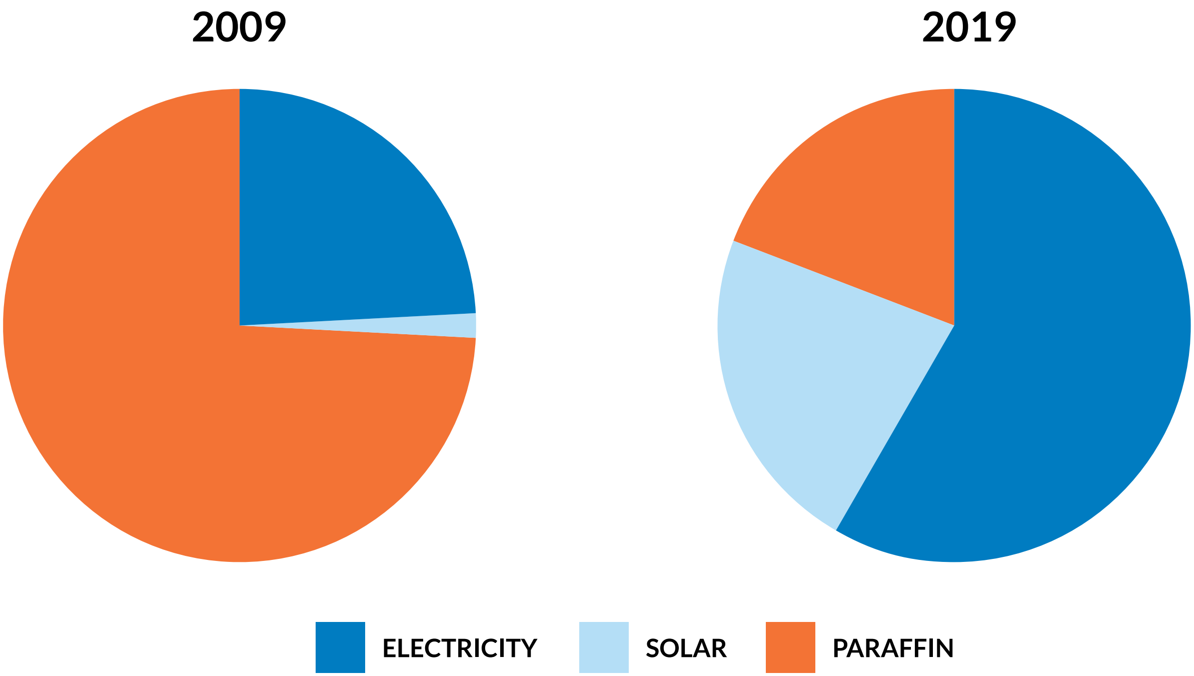
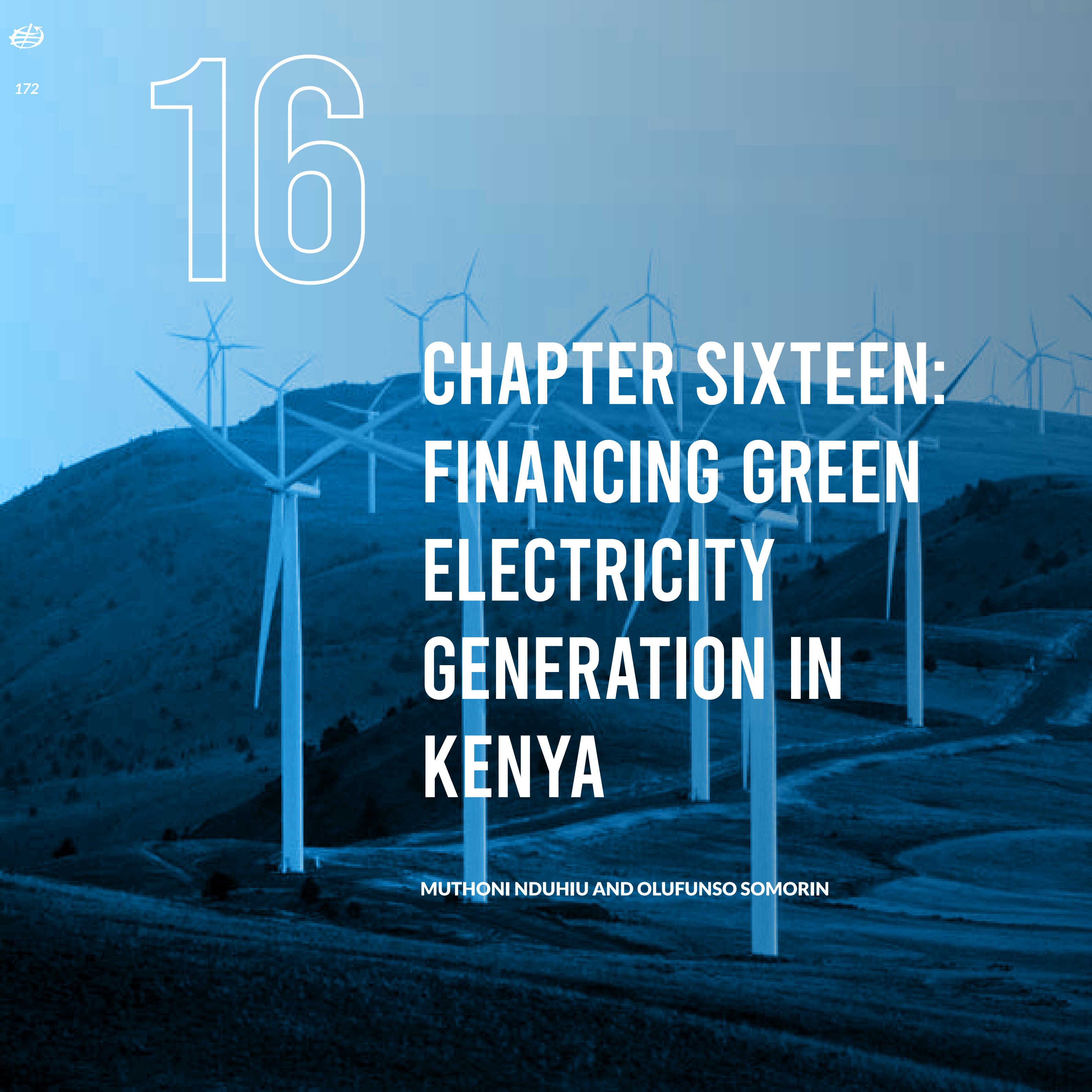


Figure 54: Changes in household lighting, 2009-2019. Source: Kenya Household Cooking Sector Study 2019.

The two charts in Figure 54 compare the type of lighting sources in the ten years from 2009 to 2019. In 2009, paraffin led as the source of lighting with more than two-thirds of households using it, followed by more than a fifth using electricity. Solar had only weak penetration at 1.6%. In 2019, electricity is the leading means of lighting, with more than half of households using it, followed by solar where the uptake has been big in the last ten years – close to a fifth of households now use it. Paraffin, also known as illuminating kerosene, provides only 16.5% of household lighting.

This shows there is transition by households towards using clean forms of lighting, with electricity and solar providing for more than two-thirds of use, the position of paraffin in 2009.



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CHAPTER SIXTEEN: FINANCING GREEN ELECTRICITY GENERATION IN KENYA

MUTHONI NDUHIU AND OLUFUNSO SOMORIN

EXECUTIVE SUMMARY

Electricity currently provides only a relatively low share of the energy used in Kenya, and much of that electricity is already generated from renewable resources. It is expected, however, that the demand for electricity will continue to grow in Kenya just when the pressures of climate change require an expanded use of renewable sources of power rather than carbon-emitting fossil fuels.

This article considers some of the mechanisms available for financing the expanded use of renewable energy in providing more electricity to the national grid serving Kenya's economy and households.

ENERGY AND CLIMATE CHANGE: A HISTORICAL PERSPECTIVE

The world's changing climate has increasingly become a point of urgent action among governments, donors, private sector, civil society and individuals. The effects of climate change are being manifested through extreme weather events such as forest fires, tropical cyclones, floods and droughts. In 2018, the Intergovernmental Panel on Climate Change (IPCC), a body which provides policy makers with scientific assessments on climate change, released a special report warning the world that urgent measures would need to be taken to drastically reduce carbon emissions by 2030 if we are to avoid long lasting and severe impacts.[*]

When it comes to the causes of climate change, the biggest contributor is human induced carbon dioxide (CO_2) emissions. Carbon dioxide is released into the atmosphere when fossil fuels such as coal, oil and gas are burnt for energy production. The trend of using fossil fuels for energy production can be traced back to the late 1700s during the Industrial Revolution, where Great Britain started using coal to power steam engines, manufacturing and overall development. This practice later spread to America and other parts of the world.

As countries continued to experience and benefit from the growth and transformation of their economies as a result of industrialisation, the use of fossil fuels has grown exponentially.

To date, all countries still use fossil fuels – oil, coal and gas – which provide 84% of all global energy needs.[**] The resulting past and present emissions of CO_2, plus other greenhouse gases from fossil fuels, have caused the earth's temperature to rise to the point of endangering humans and the entire global ecosystem.

Realising the negative impacts of fossil fuel use, various protocols began to be enacted to have countries commit to reducing the extent of fossil fuel burning. In 1994 the United Nations Framework Convention on Climate Change (UNFCCC) came into force, with the objective of preventing dangerous human interference with the climate system.

In 2015, the UNFCCC enacted the Paris Agreement under which nations across the globe agreed to set ambitious goals to combat the impacts of climate change and adapt to its already manifested effects.

One of the certain ways to combat the impacts of climate change is to reduce the use of fossil fuels. To do that, several countries who are signatories to the Paris Agreement have made commitments to reduce on their fossil fuel use and transition to cleaner energy sources such as solar, wind, geothermal and hydro-power. A majority of African countries, despite their minimal contribution towards global emissions, have also committed to the Paris Agreement and set ambitious targets to increase the use of renewable energy sources for electricity generation. Fortunately, the continent is rich in renewable energy sources and therefore offers several opportunities that can be harnessed.

* *Summary for Policy Makers of IPCC Special Report on Global Warming of 1.5C approved by Governments https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/*

** *See Forbes article June 20, 2020, "Fossil Fuels Still Supply 84 Percent of Global", accessed 9 December 2020. https://www.forbes.com/sites/rrapier/2020/06/20/bp-review-new-highs-in-global-energy-consumption-and-carbon-emissions-in-2019/?sh=668aab0a66a1*

RENEWABLE ENERGY IN KENYA

Electricity is still a relatively small share of Kenya's total energy use, but plays an important part in the development of a modern economy. For a long time, Kenya has been using renewable sources of energy for electricity production and is now a leader in the use of renewable energy sources to generate electricity. According to a Bloomberg Index which measures investments in renewable energy, Kenya in 2019 ranked the best in Africa and the fifth globally in its investments and opportunities in clean energy.*** Since colonial times, the main source of Kenya's renewable energy had been hydroelectric power from sources such as the Masinga, Kiambere, Gitaru and Kindaruma dams.

However, as climate change increased temperatures and brought reduced and erratic rainfall patterns along with frequent droughts, water levels in the hydro dams began to decline. This drastically affected their capacity to generate enough electricity to meet the country's demand, resulting in frequent power cuts. In such instances, Kenya uses thermal power to fill this energy deficit, running back-up generators fuelled by imported fossil fuels such as heavy diesel oil, diesel and kerosene. This ends up being both expensive and a contributor to CO_2 emissions.

In a bid to reduce the use of fossil fuels in electricity generation while still meeting energy demand, the Kenyan Government has been continuously pushing the development of alternative sources of renewable power, including significant investments in geothermal energy. In addition to geothermal energy, Kenya is also rich in other renewable energy sources such as solar, wind and hydro. In 2018, the country's President made an ambitious commitment to have 100% of the country's electricity generated from renewable energy sources by 2020. The country's development blueprint, Vision 2030, also aspires for universal access to electricity by 2030, a date which has since been brought forward to 2022.**** This access is expected to be achieved through connection to the national electrical grid, mini-grids and stand-alone solar power systems.

These ambitions clearly demonstrate that plenty of opportunities abound in the energy sector in Kenya and concerted effort and investments must be put in place to actualize them. However, for the Government to meet their commitment to increase the generation and use of electricity, significant investments are needed in infrastructure as well as knowledge and technology for the production, transmission and distribution of clean energy.

*** *Keninvest News (2019) "Kenya rises to the top 5 in global clean energy ranking" Accessed 20th November 2020 http://www.invest.go.ke/kenya-rises-top-five-global-clean-energy-ranking/*

**** *Kenya National Electrification Strategy 2018 p 8 http://pubdocs.worldbank.org/en/413001554284496731/Kenya-National-Electrification-Strategy-KNES-Key-Highlights-2018.pdf*

FINANCING RENEWABLE POWER DEVELOPMENT IN KENYA

Financing investments in renewable energy requires significant resources, specialised expertise and technologies. In light of Kenya's development priorities and the economic impacts of COVID-19, public funds alone are not enough to meet these costs and require joint partnership and collaboration between the Government of Kenya, development partners and the private sector. According to Kenya's National Electrification Strategy of 2018, it was estimated that the country needed investments of USD 2.5 billion over a period of five years (2018-2023) to achieve universal access to electricity. In addition, USD 58 million per year for another five years would be needed after that, to keep up with the rate of population growth.*

The Kenyan Government has made concerted efforts to attract investors in renewable energy by creating incentives and an enabling environment. Private sector players are critical in the development of renewable energy, as they have access to large pools of financial resources, research and development which can provide the technologies, innovations and advancements needed in the sector. However, foreign private sector actors tend to be very risk averse when it comes to investing in Africa, as the continent is still perceived to be high risk, especially with regard to regulatory and policy frameworks and financing.

To build the confidence of investors and create a sound regulatory environment, the Government of Kenya enacted the Public Private Partnerships Act, Number 15 of 2013, which sets out a framework for the private sector's participation in the financing, construction, development, operation or maintenance of infrastructure of the Government. A legal framework for public private partnerships provides confidence to investors.

The Government also developed a Feed-In Tariff (FiT) Policy which allows renewable energy power producers to sell their electricity to Kenya Power and Lighting Company (KPLC), Kenya's grid operator, at a fixed pre-determined tariff for a given period of time. This offers producers assurance they will get a return on their investment, without having to worry about fluctuations in electricity prices.

In support of the Kenyan Government's work in enabling private sector investments in the country, development partners have been providing financial instruments to boost investor confidence through risk mitigation. This helps private investors raise the required capital for the high costs involved in renewable energy development. The African Development Bank, for example, provides Partial Risk Guarantees (PRG) to cover investors in Africa in the event of host governments or their entities failing to meet their specified contractual obligations on a project.

During the development of the 300MW Lake Turkana Wind Project, the Bank provided a Partial Risk Guarantee to cover the risk of delays in the construction of the transmission line between Loyandalani and Suswa and relevant substations, completion of which was critical to connecting the project to the national grid.**

* *Kenya National Electrification Strategy 2018 p 10 http://pubdocs.worldbank.org/en/413001554284496731/Kenya-National-Electrification-Strategy-KNES-Key-Highlights-2018.pdf*

** *First ADF Partial Risk Guarantee approved in Kenya for Africa's largest wind power project https://www.afdb.org/en/news-and-events/first-adf-partial-risk-guarantee-approved-in-kenya-for-largest-african-wind-power-project-12324 Accessed 20 November 2020.*

The World Bank's Multilateral Investment Guarantee Agency (MIGA) offers political risk insurance (PRI) which is a tool that protects investors by enabling them to mitigate and manage risks that arise from either the actions or inactions of governments. During the development of the Olkaria Geothermal Plant by a private investor, OrPower 4 Inc, MIGA provided political risk insurance to the power plant investor against events such as civil disturbances, transfer restrictions and interference with fundamental ownership rights. This insurance creates a more stable environment and enables investors to channel resources into a country without being unduly exposed.

As mentioned earlier, financing the development of renewable energy requires significant resources and technologies. To support the private sector in securing the needed financing, development banks have been offering financing to both foreign and domestic private sector borrowers. During the development of the 35MW Menengai Geothermal Plant and the 50MW Kopere Solar Power Project, the African Development Bank together with Climate Investment Fund (CIF) provided loans to the private sector investors of each project at rates which were well below the commercial lending rates, to ease their access to finance. In 2019, the European Investment Bank and Netherlands Development Finance Company (FMO) provided 106 million Euros in financing for two large solar PV projects, namely Radiant and Eldosol Solar, in Uasin Gishu county, whose combined generation capacity is 80MW.

The French Development Agency (AFD) is also providing lines of credit to local banks to finance renewable energy projects either for self-consumption or for connection to the national grid.

As a result of these efforts, incentives and support, Kenya's overall progress in increasing its renewable energy capacity and transitioning to 100% use of renewable electricity has been impressive. As of June 2018, renewable energy accounted for 65% of total installed capacity and 78% of total electricity generation. Geothermal alone accounted for more than 40% of electricity generated.[***] In 2019, the country's electricity generation mix consisted of an average of 86.8% from renewable energy sources, with 45% coming from geothermal energy. This adoption of renewable energy technologies has seen a reduction in the dependence on thermal power by 11.% in 2019.[****]

*** *Kenya National Electrification Strategy 2018 p 13 http://pubdocs.worldbank.org/en/413001554284496731/Kenya-National-Electrification-Strategy-KNES-Key-Highlights-2018.pdf*

**** *Kenya Energy and Petroleum Regulatory Authority (EPRA) 2019 Energy Sector Overview and 2020 Outlook p2 https://www.epra.go.ke/2019-energy-sector-overview-and-2020-outlook/*

UNIVERSAL ELECTRICITY FOR ALL

Although Kenya has gained tremendous ground in increasing its electricity capacity from renewable energy sources, not all of its population has access to electricity. Currently, two-thirds of Kenya's energy use comes from bioenergy,* mostly firewood, charcoal and agricultural residue. Due to population growth, demand for biomass energy has been increasing, resulting in natural resource depletion especially of forests and savannah woodlands. As forests are degraded, they are less able to trap the carbon dioxide gases which cause climate change, less able to attract rainfall, and less able to provide healthy habitats for Kenya's many species of wildlife. The use of biomass over time also poses health risks to frequent users, such as respiratory illnesses due to exposure to smoke.

To achieve inclusive development that reduces reliance on biofuels, electricity must be available to all at an affordable rate. Electricity has the capacity to transform economies and societies by enabling industries to operate that provide jobs and improve livelihoods. With better incomes, cleaner fuels, including electricity, can be afforded by households. Electricity also powers key amenities such as hospitals, schools and sectors such as transport and ICT. Indeed, in Kenya, electric power has been identified as an enabler driving Vision 2030 and the Big 4 Agenda. This agenda aims to achieve sustainable growth in universal health coverage, enhanced manufacturing, affordable housing, food and nutrition. As such, electricity must be available to every citizen at an affordable and reliable form.

Development partners, including the World Bank, the African Development Bank, European Investment Bank, the European Union and the French Development Agency have been working closely with the Kenyan Government to ensure electricity reaches as many citizens as possible through implementation of the Last Mile Connectivity Program. This initiative seeks to grant electricity access to households, low income rural populations, slums and small businesses, in places where penetration is at the lowest. In rural areas for example, individual houses are often built in remote areas far from the national grid, where extension of the grid is not economically viable. As a result, they remain unconnected. The programme therefore seeks to connect about 1.3 million households per year, to the national grid.

* *Kenya Energy Outlook 2019 https://www.iea.org/articles/kenya-energy-outlook*

Off-grid solutions such as solar lights and solar home systems are also enabling in ensuring that electricity reaches those in far-flung areas as well as those who cannot afford the cost of electricity from the national grid. Microfinance institutions have been instrumental in serving this demographic to enable their access to reliable and affordable energy. Microfinance institutions have been providing loans to low income earners to enable them purchase energy solutions such as solar lamps and panels. The loans are paid back over an agreed period of time. This has gone a long way in enabling low income earners and those far from the national grid to access electricity and improve their quality of life.

According to the World Bank's Sustainable Energy for All (SEFA) global tracking framework* the electricity access rate in Kenya is now at 75%, putting the Government on track to achieving SDG 7 on affordable energy access for all by 2030. This access comes from a combination of extending the national grid as well as from off-grid solutions. However, as the national grid is reaches rural areas, the cost of electricity still remains high as compared to the costs of other forms of energy such as biofuels and solar home systems. As such, the demand for grid electricity has not been high and this has resulted in the underutilization of networks constructed. Further, the national grid is characterized by frequent power outages and long electricity restoration periods, which makes it less reliable than other sources such as solar solutions.

Photo by JurateBuiviene from shutterstock.com

* *World Bank Global Tracking Framework https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=KE*

RECOMMENDATIONS AND CONCLUSION

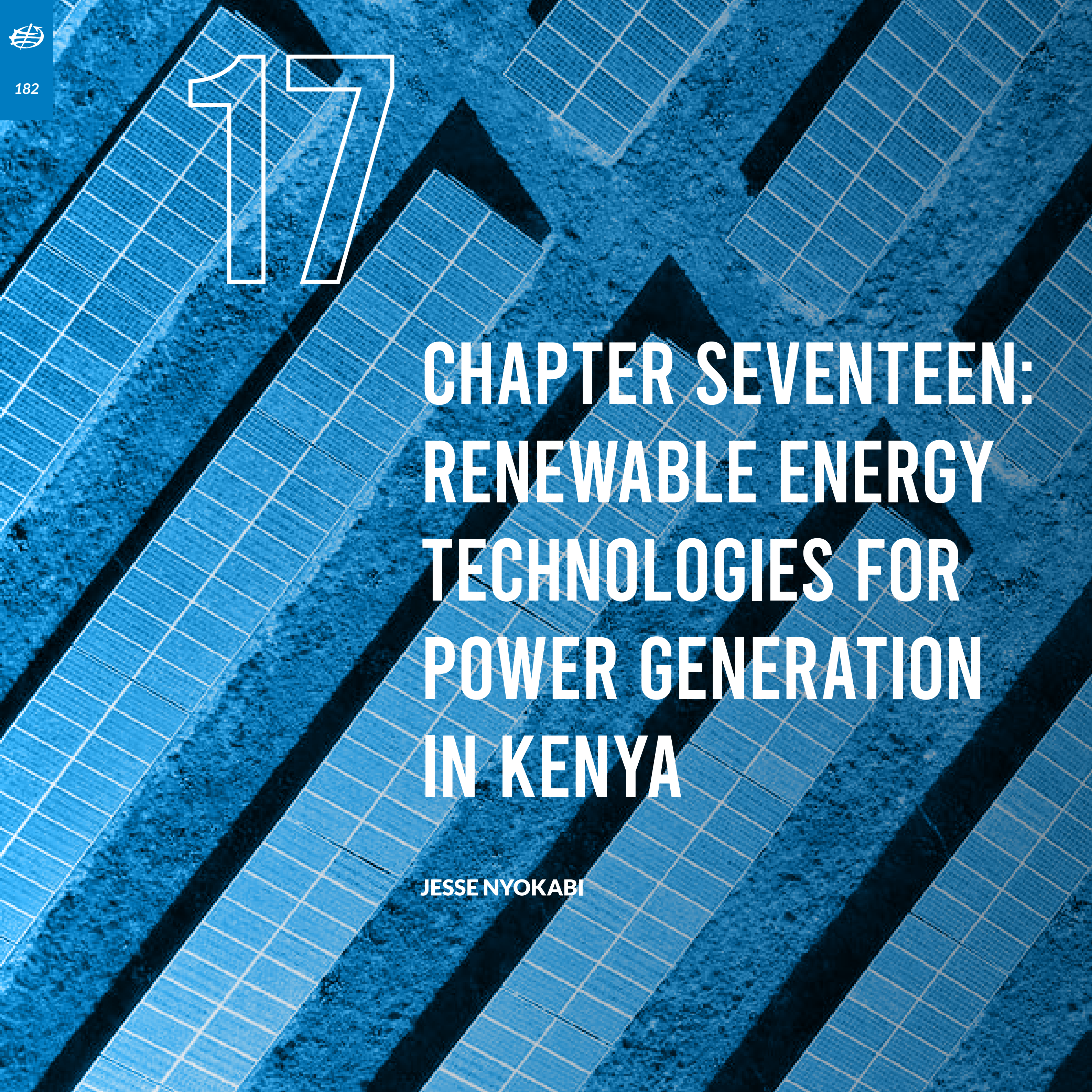
From looking into Kenya's journey towards achieving universal access to electricity using renewable sources of energy, several lessons can be drawn. The first lesson is on the role of incentives and creating an enabling business environment for investors. To attract foreign investments into a country, governments must be willing and ready to provide conditions such as strong laws and policies that protect investor's assets and operations. Without such conditions, private sector actors will continue to shy away from investing. Proper legal frameworks, a welcoming business environment, incentives and overall stability are all required.

Second, when seeking to raise resources for renewable energy development, countries should also explore financing from international climate funds such as the Green Climate Fund (GCF) and Climate Investment Funds (CIF). This avenue of raising financing for the energy sector is extremely important to governments at this time where resources are seriously stretched due to the impact of the COVID-19 pandemic on both global and local economies. Climate funds are instrumental, as they offer concessional financing to countries to tap into their renewable energy sources. However, due to their stringent requirements for proposal development, these funds tend to be viewed by countries as laborious and complicated to access. In response to this challenge, the African Development Bank has been providing training and capacity building to relevant government officials so that they can gain the requisite expertise to develop bankable proposals to access financing from these funds. By supporting countries on access to climate finance, additional needed resources can accelerate renewable energy development.

A third recommendation is that interventions and innovations on enabling household access to energy should not stop at lighting alone. While electricity is unlikely to be used for cooking in the foreseeable future, rural populations could greatly benefit from innovations that use electricity to improve agricultural activities, including irrigation, processing and storage. For example, deploying solar powered irrigation pumps to replace those that use diesel generators is a positive way to increase renewable energy while improving the agricultural sector and reducing emissions. Electricity can also be used to preserve agricultural produce or increase its value by creating other products, like juice. The equipment for processing food can be adapted to use renewable energy such as solar panels.

Sustainable development can only be achieved when it is inclusive and leaves no one behind. Ensuring that electricity is accessible and affordable to all Kenyans should be at the core of all strategies, actions and plans by governments, development partners and the private sector. By implementing models that focus on all end users, including low income households, energy will catalyse development, create opportunities and improve the lives of all Kenyans from the bottom up.

As of 2018, the supply of electricity from renewable sources surpassed the demand, an indication that Kenya is producing excess electricity. Transmission losses, however, accounted for majority of the consumption of electricity, ahead of large and medium commercial use and domestic and small commercial use. The final recommendation is that as the Government of Kenya invests in generation of renewable energy for electricity, attention should also be given to other activities in the value chain such as reducing transmission and distribution losses which will in turn improve efficiencies in the entire power system.



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CHAPTER SEVENTEEN: RENEWABLE ENERGY TECHNOLOGIES FOR POWER GENERATION IN KENYA

JESSE NYOKABI

EXECUTIVE SUMMARY

Currently, a relatively small fraction of Kenya's energy use comes as electricity, ut that is expected to grow. The role of renewable energy technologies in that growth could be significant.

Kenya is geographically endowed with abundant low-carbon, renewable energy with geothermal, hydro, solar and wind resources already playing an important role in electric power generation.

INTRODUCTION

As of 2019, the total installed electricity generation capacity for Kenya is 2898 MW and provides about 14% of all energy used in Kenya. Biomass, especially wood and charcoal for cooking, still supply the bulk of energy used in the country, as only 14% of the population (7.0 million people) have access to clean cooking solutions (IEA et al. 2019a). While the use of electricity is growing at one of the fastest rates in sub-Saharan Africa, there is clearly a huge potential for expanding electrification in Kenya, driven by renewable energy.

RENEWABLE ENERGY AND THE NATIONAL GRID

In 2019, most of the electricity generated in Kenya for use in the national grid came from renewable sources. Hydro (826.2 MW) and geothermal (848.7 MW) each provided about 29% of Kenya's installed capacity, with 13% coming from a combination of wind (336.1 MW) and solar (50.9 MW).

The rest of power generation installed capacity, 29%, was supplied by thermal (808.1MW), using heavy fuel oil and cogeneration (KenGen, 2019).

Hydro power has long been part of Kenya's energy mix, but can be unreliable in the dry season. Climate change, plus the degradation of forests which store rainfall around dammed rivers, further limits the use of hydro power.

Wind and solar both fail when the wind drops and the sun doesn't shine, but electric power from geothermal energy, drawn from higher temperatures underground, is considered to be a steady and reliable energy source. Currently, when all these low carbon renewable sources of energy cannot meet demand, fossil fuels make up the balance of primary energy supporting the national electricity grid.

Photo by Sebastian Noethlichs from shutterstock.com

RENEWABLE ENERGY AND REMOTE AREAS

In addition to the significant use of renewable energy in the grid, renewable energy has begun to play an important role in areas that are beyond the reach of the national system. In these places, small off-grid or mini-grid electricity systems powered by solar and wind can assist the country in achieving the target of universal access to electricity. Various rural electrification programs and private sector-led investments across Kenya already have dozens of micro-grids. Many are powered by solar or wind, but use diesel generators as backup energy to support the micro-grid. For these systems to be more reliable and less dependent on diesel generators, low-cost energy storage will be essential, providing power whenever there is no wind or sun.

Battery systems have the potential to replace diesel generators and increase access to rural electrification by supporting such grid systems in areas very far from the grid, such as North Eastern Kenya. A continued fall in the price of existing energy storage batteries such as the lithium-ion battery, increases the potential to open up remote areas to renewable energy.

ENERGY STORAGE TECHNOLOGIES FOR THE NATIONAL GRID

Batteries, however, are not the only form of energy storage. Another technology is known as pumped hydropower storage (PHS). In this system, electric pumps are installed at a hydropower dam to pump downstream water uphill back to the dam to generate more hydro power. By setting up a floating solar power plant in our dams, Kenya would be able to use solar power to pump the water needed for hydropower recycling.

Solar power can also improve the efficiency of power generation from geothermal energy which is directly proportional to the temperature of the underground geothermal steam being piped into the generator that produces electricity. Concentrated solar power (CSP) uses mirrors to concentrate the sun's energy onto a steam turbine.

It could be used to increase the temperature of geothermal steam, significantly increasing the efficiency of geothermal power generation. More speculatively, geothermal steam could serve as the storage systems of solar energy, improving the reliability of solar power.

Molten Salt Reactors (MSR) provide efficient storage of heat. When used in combination with CSP, they can provide electricity even at night. Molten Salt Reactors are estimated to have low capital costs, low operational risk, and they promise reliably dispatchable low-carbon electricity.

Another promising technology is green hydrogen production. When used in a fuel cell, hydrogen provides renewable, non-polluting energy which only emits steam. However, fuel cells need an initial source of energy to work. Many hydrogen systems use dirty fossil fuels, but excess solar and wind power from the grid could be used to produce green hydrogen for Kenya's existing and future industries.

CONCLUSION AND RECOMMENDATIONS

Renewable energy technologies are improving all the time, and the price of installing and maintaining them is also falling. Kenya's population is not just concentrated in urban areas that can be easily served by a national grid, but is also widely dispersed across the countryside. In these places, renewable technologies used in off-grids and micro-grids, combined with affordable energy storage, could make a critical difference.

To ensure the success of renewable power generation, the national government must put in place supportive policies and regulatory frameworks in order to govern the industry. These policies and tax incentives also would encourage domestic consumers to switch from biofuels to electricity for their everyday needs. Policies should also support research into technologies adapted to Kenya circumstances, and stimulate the take-up of renewable energy technologies by businesses and households.

In short, through the increased use of renewable energy technologies, Kenyans will be able to enjoy a future where energy is clean, sustainable and affordable to all.

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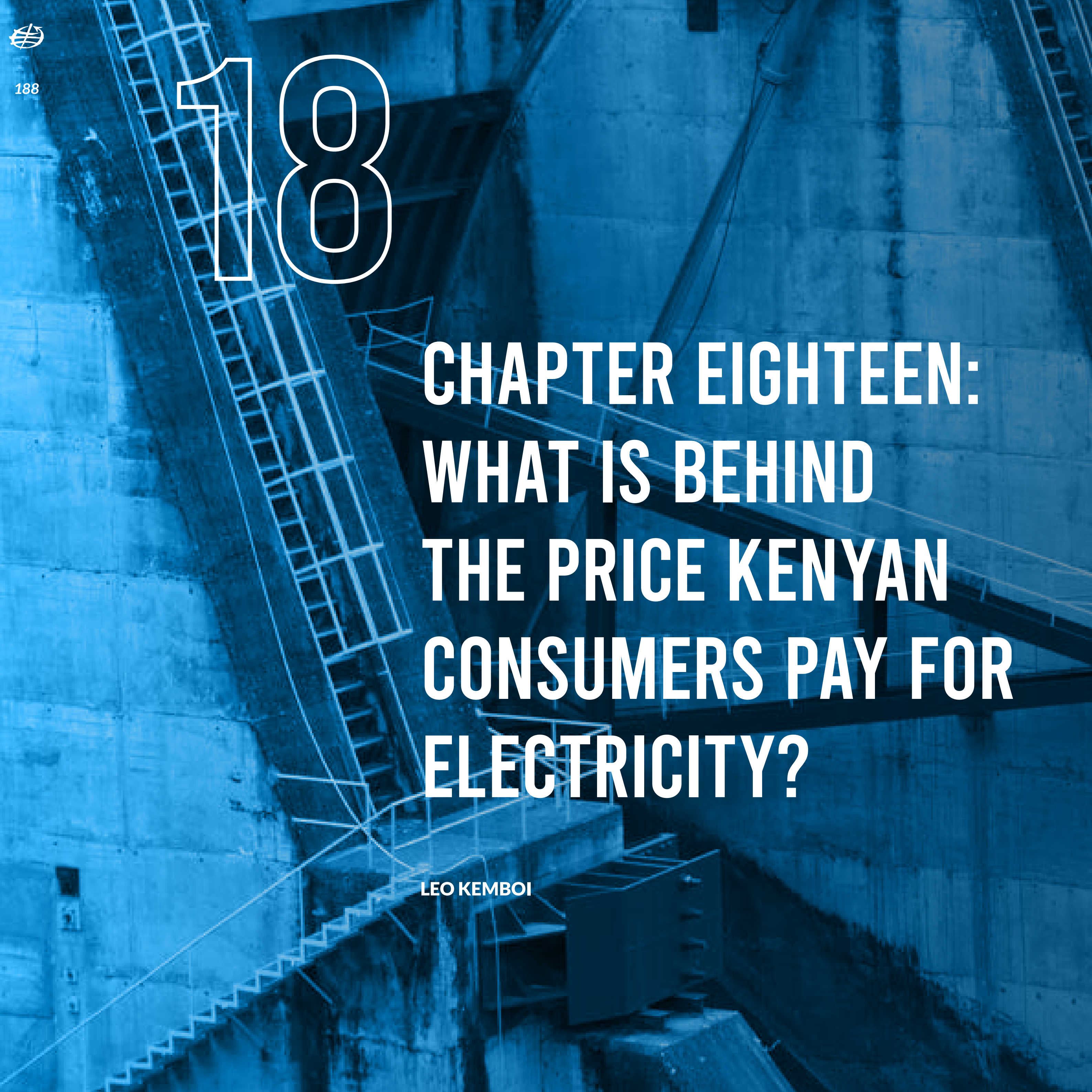

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CHAPTER EIGHTEEN: WHAT IS BEHIND THE PRICE KENYAN CONSUMERS PAY FOR ELECTRICITY?

LEO KEMBOI

EXECUTIVE SUMMARY

Electricity is the most expensive source of energy used in Kenyan households. While much of cost reflects the amount of electricity consumed, there are a number of additional charges that serve a variety of purposes, including financing rural electrification and adjusting for inflation. This article details these additional charges.

INTRODUCTION

Between 2011 and 2013, nominal electricity prices experienced a sharp decline, falling by 34% to just over KSh 10 per kilowatt hour (KWh). After that, prices rose steadily, with a 55% jump between 2014 and 2015 from KSh 11.09 to KSh 17.16 per KWh. Smaller but steady increases followed in every year to 2020, as seen in Figure 55.

Some prices changes seem to have political roots, as Figure 55 shows electricity prices declined or remained flat near the elections held in 2013 and 2017. Before the March 2013 election, prices declined dramatically, while they remained fairly flat before the election in August 2017. The possible role of politics is not surprising as the price of grid electricity is set by the Government's Energy and Petroleum Regulatory Authority (EPRA, formerly known as the Energy Regulatory Commission of Kenya), using a variety of rules. The Energy Act of 2019, Section 11(d) gives the EPRA the mandate to set the tariff structure and terms for supplying electrical energy. The EPRA also investigates tariff charges, whether or not a specific application has been made for a tariff adjustment, and handles other regulatory issues in the energy sector (Energy Act , 2019). When it comes to setting the electricity prices, politics is only part of the story, as the EPRA takes a variety of factors into account, as described below.

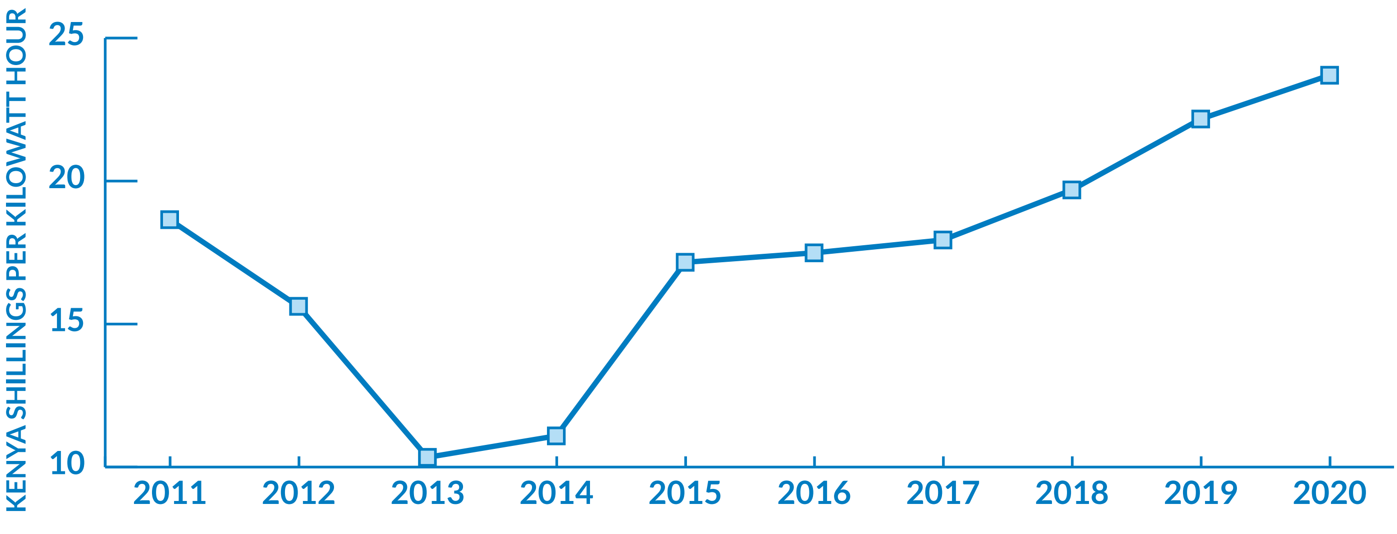

Figure 55: Electricity prices, data from KNBS Monthly CPI and Inflation Rates (various issues), author's own calculations.

COMPONENTS OF A HOUSEHOLD BILL OF 1000 KSH

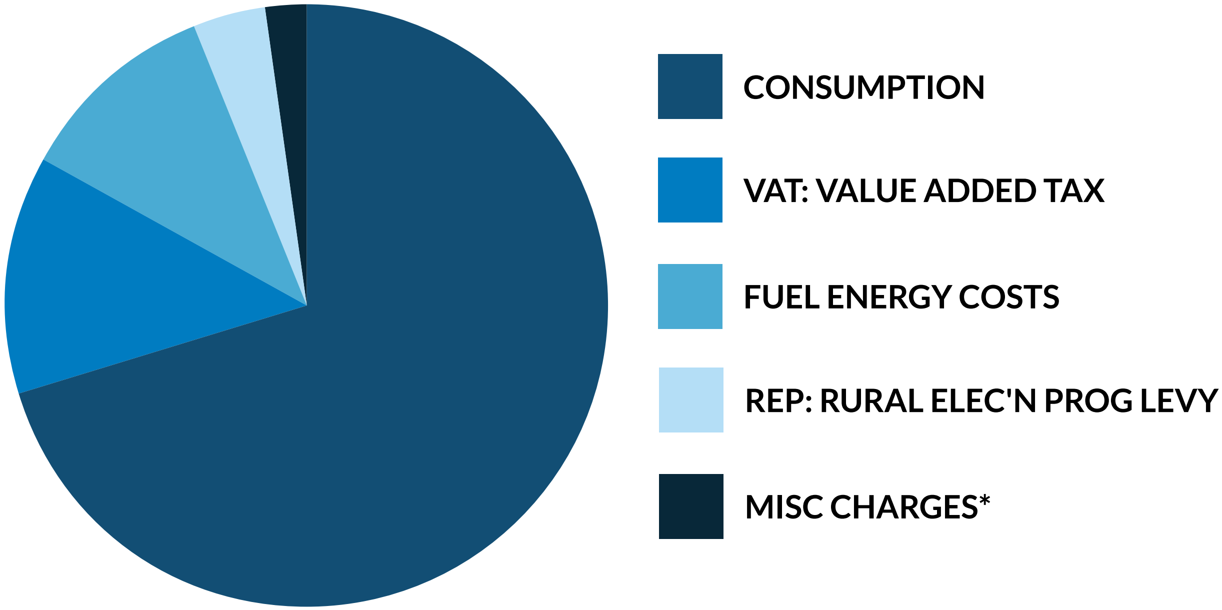

Figure 56: Components of a January 2020 household electricity bill.

A breakdown of the charges on a KSh 1000 domestic electricity bill for January 2020 (Figure 56) shows that 70% of the bill was for the amount of electricity consumed, while the balance covered other charges described below.

Value Added Tax (VAT)

VAT is the largest share of the bill after consumption, and is a 16% tax charged to the following components in the electricity price:

- Demand charge is a charge for maximum electric power demand drawn by a consumer in a billing period;
- Foreign exchange fluctuation adjustment;
- Inflation adjustment;
- Fuel energy cost.

This is a statutory tax collected by the Power Provider and passed to the Kenya Revenue Authority.

Fuel energy costs

Fuel energy costs make up the next largest share of the bill, 11%. All units billed to each post-paid consumer or purchased by each prepaid consumer every month shall attract fuel energy cost charges calculated using a formula provided by the Energy and Petroleum Authority. The fuel cost charge lags one month behind the actual price of the fuel. This money is collected by the Kenya Power and Lighting Company (KPLC), and all of it is passed on directly to electricity generation companies, which in turn pay fuel suppliers.

There are four issues that should be taken into consideration when calculating the fuel energy cost rate. They include:

- Prices paid for fuel by KPLC and electric power producers;
- All units purchased by KPLC from electric power producers and net imports from within the region purchased from the power producers in each year preceding period;
- Specific fuel consumption for specific thermal plants in Kenya;*
- All these fuel energy costs are also calculated and adjusted for system losses.

* *These power plants include Muhoroni I and II, Kipevu I, II and III, iberaafrica, Rabai, Triumph, Gulf, Thika, diesel plants in the off-grid system and others.*

Rural electrification programme (REP) levy

The rural electrification Programme (REP) levy constituted 4% of the KSh 1000 bill for a household in January 2020. It is another tax, levied at 5% of revenue from unit sales. The levy is passed on to the Rural Electrification Authority (REA) for the implementation of the rural electrification projects.

Miscellaneous charges

A variety of charges are added to the bill, making up a final 2% of the amount charged to a household. Two of these charges are taxes, known as levies. According to the code, the consumer shall pay any taxes, levies, or duties imposed from time to time by the government. Given that this is a taxation measure, it is approved by Parliament. When all the taxes and levies are added up (VAT, REP, Water and ERC) they constitute 17.04% of the bill.

Energy and petroleum authority levy passed to the ERC

This levy is charged at KSh 0.03/KWh and is passed on to the Energy Regulatory Commission (ERC), the regulatory arm of the energy sector.

Water levy

All units billed to each post-paid or purchased by the prepaid consumer or each prepaid every month shall be liable to Water Resource Management Authority (WARMA) levy for all power plants that have a capacity equal to or above 1 MW as approved by the Commission. The WARMA levy is 5 cents per kilowatt-hour, charged on the cost of all units generated from hydropower plants above 1 MW.

In addition to the ERC and water levies, there are adjustments made for foreign exchange rate fluctuations and inflation.

Foreign exchange rate fluctuation adjustment

All units billed to each Post-paid Consumer or purchased by each Pre-paid Consumer every month shall be liable to Foreign Exchange Rate Fluctuation Adjustment, which shall be calculated per the formula provided by the Energy regulatory commission. It caters for the fluctuation of hard currencies against the Kenya Shilling for expenditure related to the power sector.

The calculation of foreign exchange rate fluctuation depends on sums of all foreign currency costs for KenGen, KPLC, and the sum of foreign currency costs paid to electric power producers. The Energy and Petroleum Authority is required to publish a monthly gazette notice of the foreign exchange rate fluctuation adjustment applicable to all units billed to all consumers by the KPLC.

Inflation adjustment

All units billed to each post-paid consumer or purchased by each pre-paid consumer every month shall be liable to an automatic adjustment for inflation at the end of every six months. The regulator insists that it is necessary to cater to the effect of domestic and international inflation on the cost of supply. The calculations also consider the system loss factor in distribution and transmission.

The regulator adjusts inflation for the following components:

- Inflation adjustment, KenGen – this is specific inflation relating to contracted KenGen Plants;
- Inflation adjustment, independent power producers, not including KenGen – this is a specific inflation adjustment relating to contracted electric power producers;
- Inflation adjustment, KPLC – this is a specific inflation adjustment relating to KPLC's transmission and distribution operation and maintenance costs.

In adjusting for inflation, the Energy and Petroleum Regulatory Authority has used the consumer price index for urban consumers for city averages in the United States for the dollar-denominated costs (as published by the United States Department of Labour Statistics Index). For the Euro denominated costs, they have used the consumer price index from the Monetary Union of Index of Consumer Prices as published by Eurostat. Using the consumer price index of an advanced economies like the United States or the European Union to calculate electricity prices in Kenya is not a good practice and gives a distorted view.

Using CPI numbers for other economies in calculating electricity prices for Kenya is unfair and can drag prices upward. It is important to note there has been no explanation as to why the Energy and Petroleum Regulatory Authority has used United States CPI and Eurostat CPI.

Non-fuel tariffs with discounts

The example of a household electricity bill does not cover another category of possible charges, the non-fuel tariffs which include discounts that vary according to the customer. The non-fuel tariffs are to be applied by KPLC for the supply of electrical energy from both the interconnected system and the off-grid systems, in each post-paid billing period or prepaid units purchase period. Consumers in Kenya are charged electricity on different tariffs. The discounted tariffs shown below are based on the needs of various consumers in the economy. The discounted tariff is only applicable during the off-peak period.

The tariffs can be classified into two broad categories: domestic consumers and commercial/ industrial consumers. The tariffs are listed as follows:

Electricity tariffs for domestic consumers

Lifeline	This tariff applies to domestic consumers for supply provided and metered by the company at 240 or 415 volts and whose consumption does not exceed 10 units within the period purchased.
Ordinary	This tariff caters for domestic consumers for supply provided and metered by the company at 240 or 415 volts and whose consumption is greater than ten units but does not exceed 15,000 units per post-paid billing period, or prepaid units purchase period.

Table 9: Electricity tariffs for domestic consumers. Source: Oimeke, 2018

Electricity tariffs for commercial and industrial consumers

Small commercial consumers	Applicable to non-domestic small commercial consumers for supply provided and metered by the company at 240 or 415 volts and whose consumption does not exceed 15,000 units per post-paid billing period or pre-paid units purchase period.
Commercial and industrial consumers (CI1)	Applicable to commercial and industrial consumers for supply provided and metered by the company at 415 volts three-phase four-wire and whose consumption exceeds 15,000 units per post-paid billing period.
Commercial and industrial consumers (CI2)	Applicable to commercial and industrial consumers for supply provided and metered by the company at 11,000 volts, per post-paid billing period.
Commercial and industrial consumers (CI3)	Applicable to commercial and industrial consumers for supply provided and metered by the company at 33,000 volts, per post-paid billing period.
Commercial and industrial consumers (CI4)	Applicable to commercial and industrial consumers for supply provided and metered by the company at 66,000 volts, per post-paid billing period.
Commercial and industrial consumers (CI5)	Applicable to commercial and industrial consumers for supply provided and metered by the company at 132,000 volts, per post-paid billing period.
Street lighting	Applicable to public and County Governments metered by the company at 240 or 415 volts per post-paid billing period for the supply of electrical energy to public lamps.

Table 10: Electricity tariffs for commercial and industrial consumers. Source: Oimeke, 2018.

For someone to be able to enjoy the discounted tariff above, they must be able to have met the energy consumption threshold shown over the previous six months.* The discounted tariff system is supposed to provide incentive systems to commercial and industrial consumers to consume more.

* *The energy consumption threshold is an existing monthly consumption average and is determined every six months.*

Security support facility

The last additional charge consumers might face is a charge for a security support facility. This allows the KPLC to meet the contractual obligations it enters into with different power producing firms in the country. The Energy and Petroleum Authority must approve beforehand if the project requires a security support facility. They then calculate the required security support facility every month.

Currently, the security support facility is collected and remitted by KPLC for the Lake Turkana Wind Power Company Limited. The security support facility is kept in an escrow account established as a secure payment. The security facility is supposed to be charged on all amounts billable until the amount in escrow is equivalent to € 42,600,000, equivalent to 4.7 billion Ksh, based on conversion where 1 Euro=109 Ksh.

CONCLUSION

The obvious conclusion to be drawn from this description of electricity charges in Kenya is that they are too complex, unpredictable and burdensome. The resulting electricity prices are often too high for ordinary Kenyans to afford, as seen in the Compendium article on energy pricing. Whether there is the capacity to change how prices are set, however, remains to be seen.

Photo by Syme Mwangi from shutterstock.com

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WHAT MIGHT A DIFFERENT ENERGY SYSTEM LOOK LIKE?

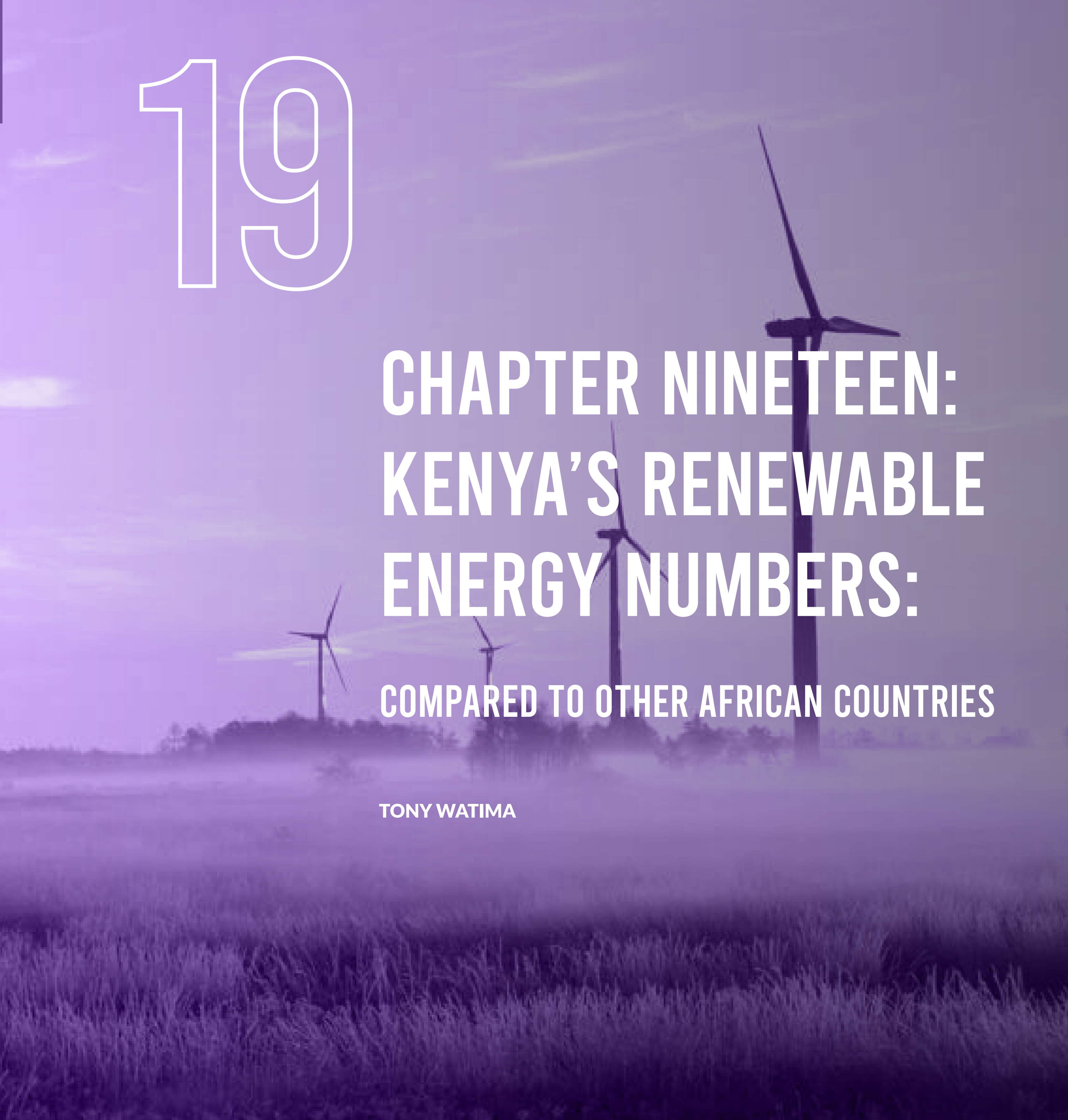
INSIDE

The last section of the Compendium deliberately faces the future to ask, "What might a different energy system look like?" It is now indisputable that the mining and use of fossil fuels, along with changing land use, has released into the atmosphere greenhouse gases like carbon dioxide, CO_2, that had previously been left underground or sequestered in grasslands and forests. These gases have prevented the earth's heat from escaping into space, altering the global climate. Now, every continent in the world is experiencing a general disruption of seasonal patterns, plus more extreme weather and catastrophic events like wild fires, typhoons and floods, heat waves and droughts. Although scientists had warned us these events would multiply, it has been hard to accept that we must change the economic and industrial norms of decades and centuries. That, however, is exactly what is required now.

Kenya's population has grown exponentially over the past 60 years, but industrial development and its jobs have not followed at the same rate. Ten or twenty years ago, the obvious policy choice would have been to develop fossil fuel energy systems to support industry and create jobs. Given the extreme threats of climate change, however, Kenya needs to improve standards of living using a renewable, low-carbon energy system.

The articles in this section of the Compendium consider the challenge of climate change and energy in Kenya. Tony Watima's graph compares Kenya's renewable energy supply to that of other African countries. Martin Brown Munene then looks at the impact of climate change on energy developments, while Robert Ddamulira offers two examples of institutions that put a price on carbon in order to encourage low carbon energy solutions. Jasper Omondi Oduor describes the development of the Eastern African Power Pool which allows countries to share their renewable energy across borders in the region. This section concludes with an essay from Sarah Odera on the growth of decentralised renewable energy systems in Kenya.

Taken together, these articles point to a potentially very different energy system in Kenya's future from the one we now have.



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CHAPTER NINETEEN: KENYA'S RENEWABLE ENERGY NUMBERS:

COMPARED TO OTHER AFRICAN COUNTRIES

TONY WATIMA

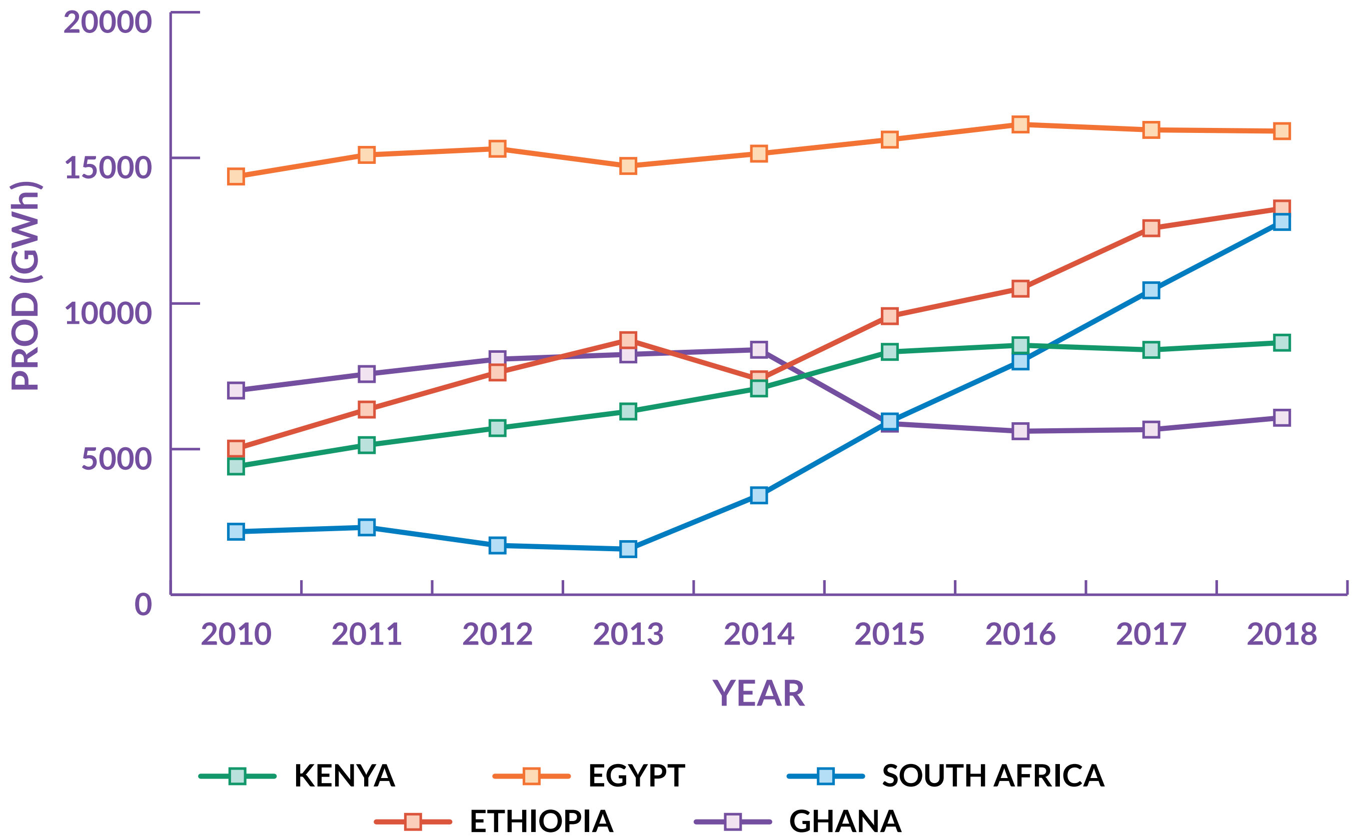
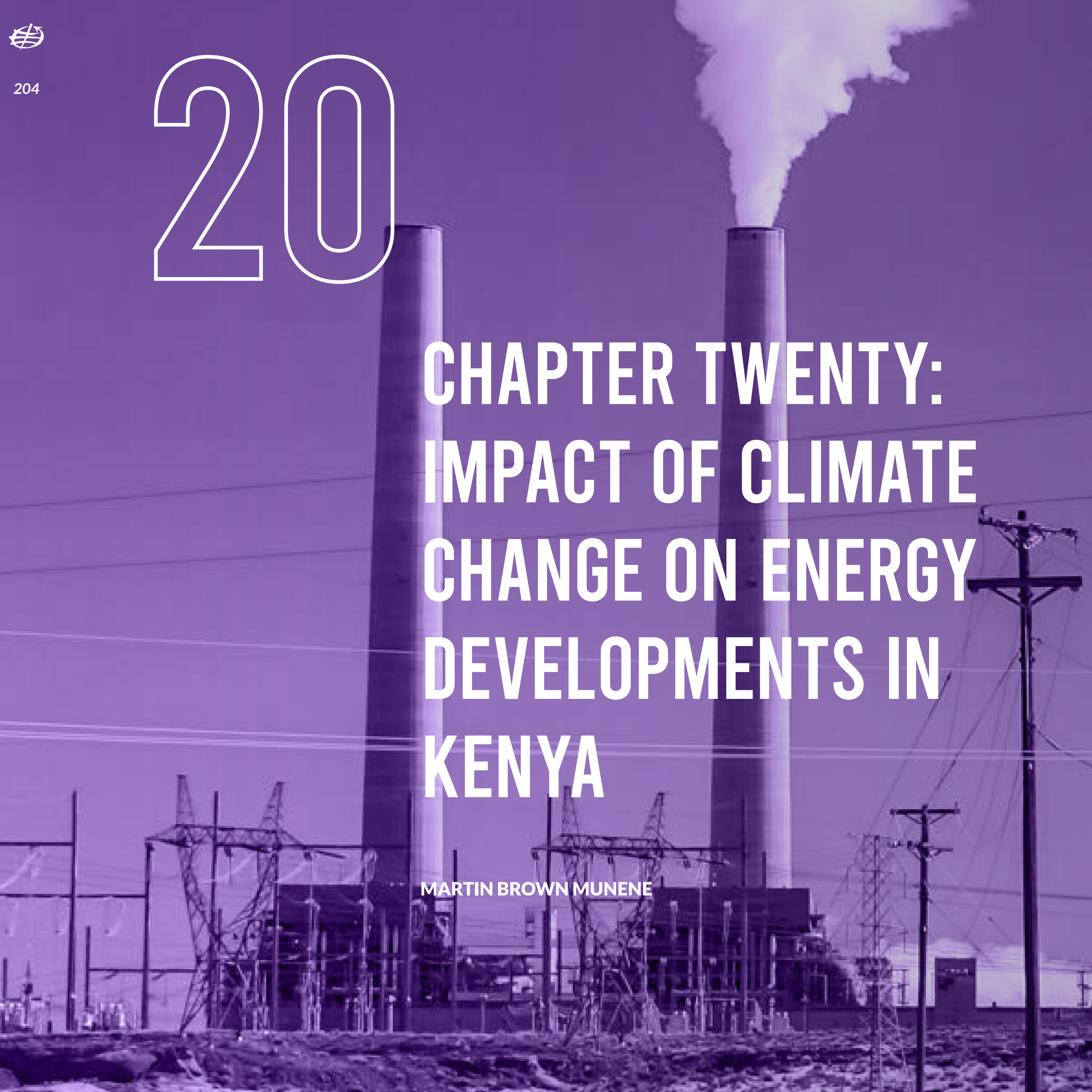


Figure 57: Kenya's renewable energy compared to renewable energy elsewhere in Africa. Source: International Renewable Energy Agency, 2019.

The graph in Figure 57 compares Kenya's renewable energy standing with Egypt, South Africa, Ethiopia, and Ghana to measure its standing in Africa. In 2010, Kenya was only ahead of South Africa and at almost at the same level as Ethiopia in its renewable energy. By 2018, South Africa together with Ethiopia were far ahead of Kenya, which was ahead of Ghana. Ghana's production of renewable energy has been dropping since 2014. Kenya has been increasing renewable energy, but not at a faster rate than South Africa or Ethiopia. Egypt has remained top in renewable energy production ahead of everyone.



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CHAPTER TWENTY: IMPACT OF CLIMATE CHANGE ON ENERGY DEVELOPMENTS IN KENYA

MARTIN BROWN MUNENE

EXECUTIVE SUMMARY

Large investments in energy development are needed to support Kenya's development vision as articulated in its 'Big 4 Agenda' and 'Vision 2030'. However, climate change will affect the country's energy demand and use, how energy is produced and supplied, and the reliability of the electricity grid. These factors are likely to shape future energy investments.

Because Kenya's energy system is likely to be affected by climate change, this article identifies the vulnerability of the sector to both climate impacts and potential responses to these impacts, internationally and inside Kenya.

It highlights the lack of long-term planning that integrates energy and climate change policies, and recommends a closer alignment of energy and climate change plans. This would help to prevent or manage climate change risks while also taking advantage of new opportunities. This chapter calls for further research into the issue, including the development of relevant and reliable data to ensure resilient energy development in Kenya. Overall, it seeks to provide a deeper understanding of the climate-energy nexus in Kenya to spark creative ideas for policy and development solutions.

INTRODUCTION: HOW CLIMATE CHANGE CHALLENGES DEVELOPMENT AMBITIONS

Climate change is perhaps the most complex challenge of the 21st century and is rightly described as the global climate emergency. It is especially difficult for developing countries who had expected to increase their wealth using a fossil fuel economy, but now find themselves experiencing rapid growth in CO_2 just when the world needs a low carbon energy system.

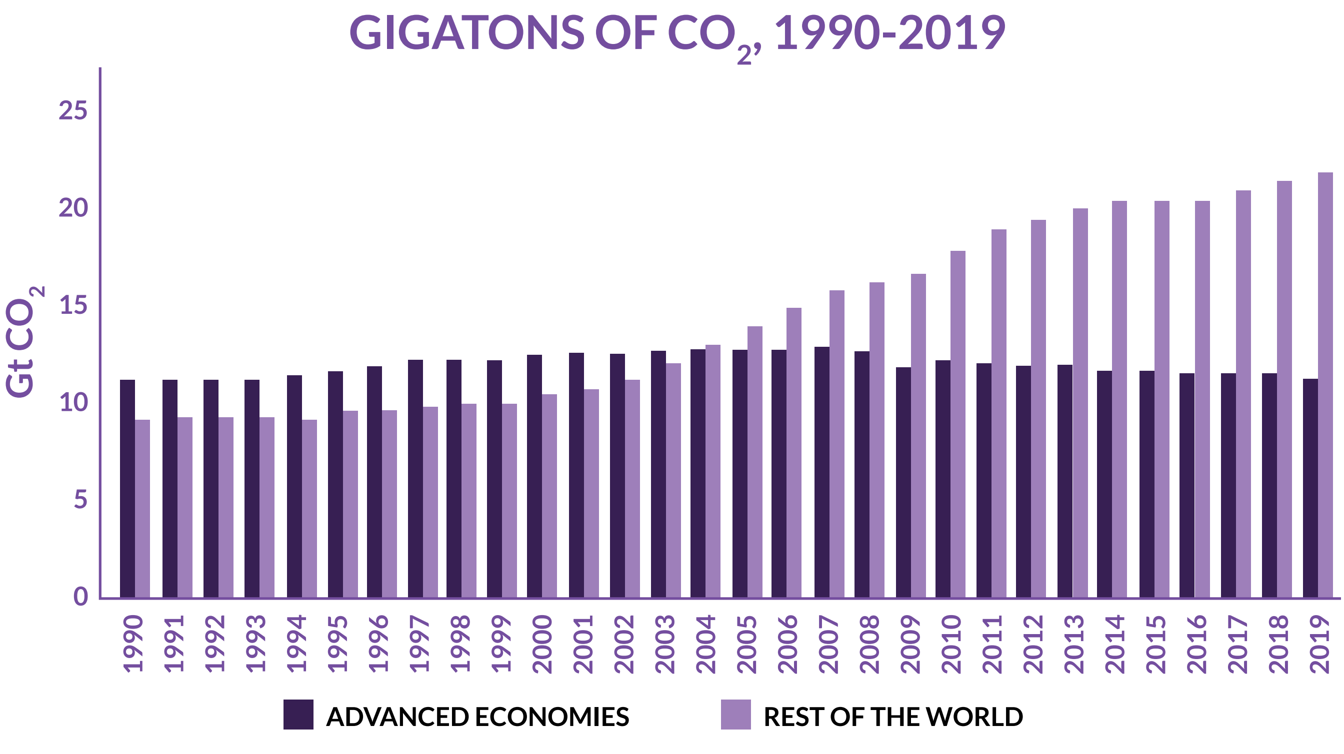


Figure 58: Global energy-related CO_2 emissions for 1990-2019 Source: IEA, 2020.

As countries everywhere grapple with the complexity and enormity of this issue, developing countries are rethinking their growth and development pathways. Observed and projected impacts of climate change on their economies are forcing planners to look for strategies that support needed energy investments while confronting changed climatic conditions.

With many others, Kenya is a party to the United Nations Convention on Climate Change (UNFCCC) the primary mechanism for international cooperation on climate change action. Having also signed and ratified the 2015 Paris Agreement on Climate Change (UNFCCC, 2015), Kenya is committed to addressing the climate challenge. A raft of policies, plans and laws have been designed to reduce greenhouse gas (GHG) emissions that cause global warming, and also helping the country adapt to the impacts of climate change (Republic of Kenya, 2016a, 2016b, 2013a, 2010).

While the 1997 Kyoto Protocol expected advanced economies, but not developing countries, to reduce their GHG emissions, the 2015 Paris Agreement is different. It obliges all countries to reduce future emissions regardless of their level of development. Each country sets the emissions reduction goal it wants to achieve, known as the NDC, 'Nationally Determined Commitment'. This commitment, and the experience of climate change, are forcing Kenyans to keep future emissions of greenhouse gases as low as possible.

Limiting future greenhouse gases will not be easy, however, as energy is at the centre of Kenya's long-term Vision 2030: the aspiration to build a newly industrialising, middle-income country by 2030, offering all citizens a high quality of life in a clean and secure environment (Republic of Kenya, 2008). This ambition is central to the medium term, 5-year (2017-2022) development plan and to the Big 4 Agenda supporting manufacturing, food security, affordable housing, and universal health coverage (Republic of Kenya, 2018a).

All these plans depend on adequate, competitively-priced energy based on electrical power, as shown in Figure 59 below. The government's 2018 Least Cost Power Development Plan (LCPDP) 2017-2037 is designed to meet these energy ambitions (Republic of Kenya, 2018b).

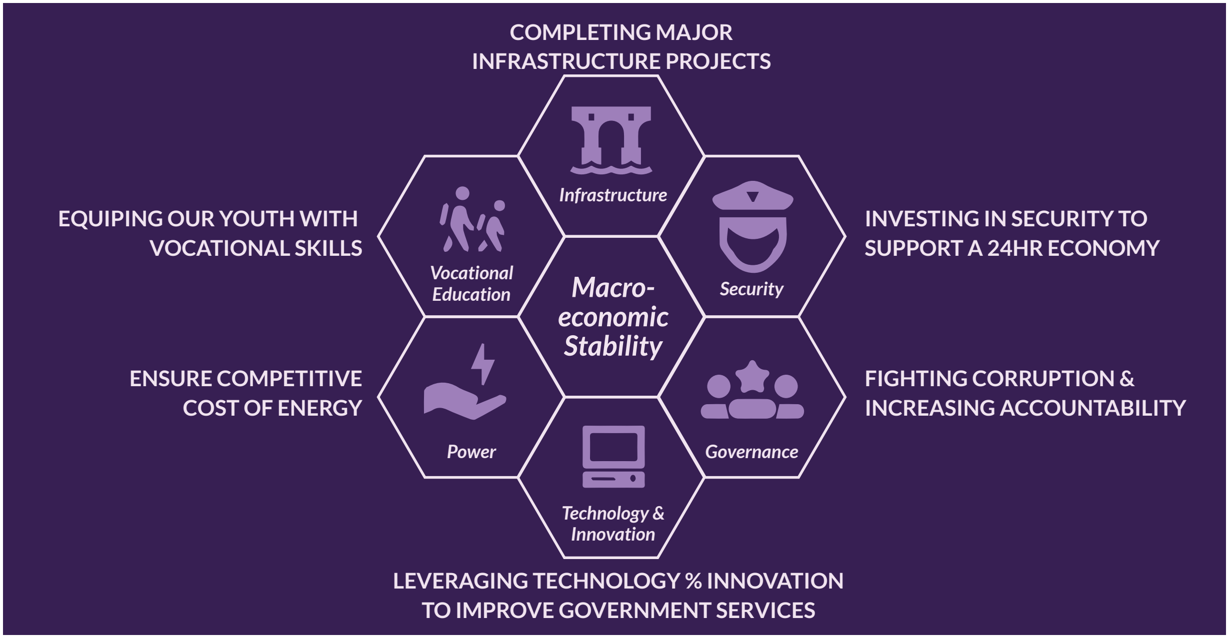


Figure 59: Enablers of the Big 4 Agenda

Kenya's development plans are based on increasing energy use for industry and households, but do not obviously include greater energy demand due to changes in the climate. For example, hotter weather might increase demand for air conditioning, while more unpredictable rains could require more energy to power pumps on new irrigation systems or deeper wells.

Instead, Kenya's energy plans follow the historical development path which relied on new industries powered by fossil fuels, including their greenhouse gases. Unfortunately, Kenya's ambitions are being realised just when all economic development and energy plans need to include responses to climate change as numerous authors have suggested.

Today's development plans need to adapt to rises in average temperatures and sea level, changes in rainfall amounts and patterns, and be prepared for more extreme weather events. (Cynthia Brenda Awuor et al., 2008; Parry et al., 2012; Republic of Kenya, 2013b). Kenyans must also anticipate carbon pricing or other economic rules designed to limit greenhouse gas emissions.

All this will be different from what was experienced in the past. Kenya's energy investments must now reflect climate science, climate impacts, local needs and Kenya's international climate commitments. If large energy investments cannot cope with a changing climate or have high GHG emissions they might fail, bringing losses with dire economic, social and political consequences.

To avoid these risks, the country needs a deeper understanding of the climate-energy nexus within sustainable development. The balance of this paper compares the government's energy and climate policies, including implementation, to current and projected impacts of climate change in Kenya. It concludes with policy recommendations to reconcile the competing demands of industrial development and climate change.

KENYA'S ELECTRICITY POLICIES

The role of electricity in climate change and energy policy

Although biomass supplies most of the energy used in Kenya, government's energy policy is largely dedicated to increasing the supply and distribution of electricity. When government documents talk about energy investments, they put electricity at the centre of their thinking as seen in various policy documents:

- *Third Medium-Term Plan (MTP-III) to achieve Kenya's Vision 2030 (Republic of Kenya, 2018a);*
- *2018 Kenya National Electrification Strategy;*
- *2017-2037 Least Cost Power Development Plan (LCPDP);*
- *National Nuclear Energy Policy.*

This paper considers the effect of climate change on three aspects of electricity development: i) demand and use of electricity; ii) electricity generation/production; and iii) transmission and distribution. This is followed by a review of Kenya's energy policies and plans to see how government has responded to observed and projected climate change as reported in the scientific literature. The advice from the scientific literature is then compared to the government's policies and strategies. Finally, some primary data were re-analysed to make a case for or against some current 'policy' proposals for energy development in Kenya.

Supply & demand: Generate more renewable power

The 2018 Kenya National Electrification Strategy identified the balance of supply and demand for electricity, noting that more power was produced than was used by its customers. Generation capacity was 2,670 megawatts (MW) with peak demand at 1,841MW.

By June 2018, renewable energy provided 78% of total electricity generation (~7.9 terawatts [tWh]) (Republic of Kenya, 2018c) By December 2019, that share rose to 90% with an additional 50.7 MW (KNBS Economic Survey, 2019) from the Garissa Solar Plant (Bordoloi, 2019). About 40% of total generation comes from low-carbon geothermal energy, in which Kenya is a global leader.

Despite the 2018 surplus of electricity, the Big Four Agenda of the Third Medium-Term Plan (MTP-III) prioritized generating more power to achieve Vision 2030, up to a total of 5,221 MW of power by 2022. Table 10 shows the variety of projects that would add another 3,133 MW to current generation for a total of 5,221 MW, designed to support new industries.

Priority Power Generation Projects in Kenya 2018-2022

MTP-III Projects for:	*Amount (in MW)*	*Proportion*
Hydro power	93	3%
Geothermal power	913	29%
Wind power	800	26%
Biomass power	157	5%
Solar power	442	14%
Coal power	328	10%
Imported power	400	13%
Total	**3,133**	**100%**

Table 11: Priority projects to increase Kenya's installed power capacity in the period 2018-2022

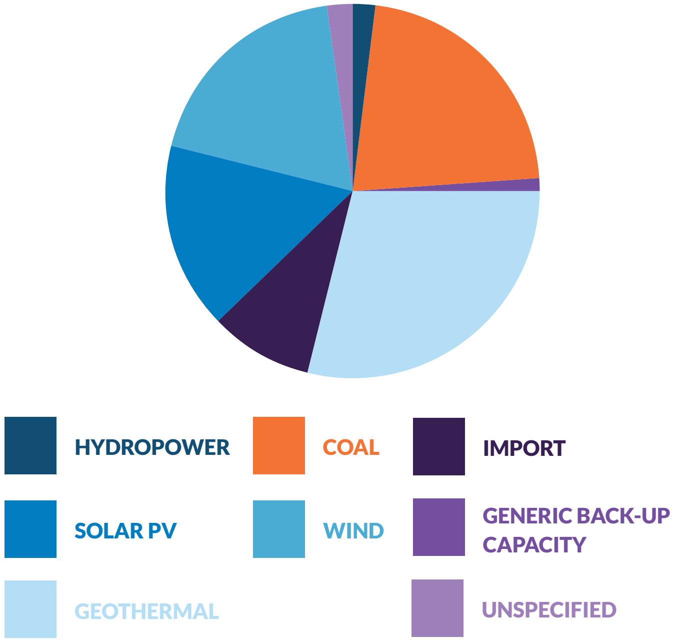


Figure 60: Percentage contribution of committed projects for 2017-2024 Source: LCPDP 2017-2037

Plans for nuclear power are still in their infancy and not included in the priority projects. However, the MTP-III includes developing an appropriate legislative and regulatory framework (e.g. the National Nuclear Energy Policy), capacity building, and public education and advocacy.

Although Kenya frequently boasts of a remarkable and evolving 'low-carbon, affordable, and diverse energy mix' to create a green energy system by 2020 (African Review, 2018; Wood, 2018), Table 9 somewhat contradicts this ambition as does the 2017-2037 Least Cost Power Development Plan (LCPDP).

This plan expects coal to fuel 22% of Kenya's new electricity (see Figure 60 below), illustrating a lack of alignment in climate change and energy policies.

Power transmission and distribution

Kenya aimed to achieve 80% electrification by 2020 and universal electrification by 2022, providing all households and businesses with access to electricity, either from grid or off-grid options (IRENA, 2018).

That requires not just more power, but better transmission, distribution and reliability of electricity supplies, as summarised in Box 2: Medium Term Plan III Aims.

Box 2

PRIORITY TARGET OBJECTIVES OF MTP III - MEDIUM TERM PLAN.

- Construct 5,121 km of power transmission lines.
- Build 77 high voltage substations.
- Erect an ultra-modern National System Control Centre.
- Construct transmission lines in off-grid townships to connect them to the national grid.
- Construct regional interconnector transmission lines.
- Build 116 new primary distribution substations with a distribution capacity of 2,809 Megavolt-Ampere (MVA) and 1,244 km of associated 66 and 33 Kilo Volts (KV) lines, 20 new bulk supply substations.
- Install 336.5 Megavolt-Ampere Reactive (MVAR) power compensation equipment in 15 transmission substations.
- Connect 5 million new households, 15,739 public facilities (barring primary schools) to electricity; complete public street lighting project; and reduce cost of off-peak power to heavy industries by 50% - in the Last Mile Connectivity Project.
- Improve power supply reliability by at least 20%.

- Compiled from MTP III 2018-2022

ENERGY PLANS AND CLIMATE CHANGE

Section 11 of LCPDP considers the implication of its projects for national climate change objectives, but avoids a clear statement that the country's energy plans could undermine Kenya's climate change mitigation goals. For example, the LCPDP notes that "limited use of coal and no use of natural gas" is needed to meet GHG mitigation targets (Republic of Kenya, 2018b, p. 221).

However, is not clear what this means in practice, given the LCPDP plans to use coal. The Lamu Coal Power project was withdrawn in 2020, but coal is still on the table.

In effect, the government faces a dilemma: how can they achieve industrial development when climate change facts and agreements are limiting the use of fossil fuels?

CLIMATE CHANGE IMPACTS ON KENYA'S ENERGY

Kenya's vulnerability to climate change is not contested. Rising temperatures, erratic rainfall, sea-level rise, declining water availability, extreme events such as drought, storms and floods, all have direct implications for the country and its energy sector. Between 1960 and 2003 Kenya's average annual temperatures increased by 1°C. By 2100, Kenya could see further increases anywhere from 1°C to 5°C. While a hotter climate in Kenya will increase the energy demand for cooling, perhaps the most significant impacts will be on rainfall and water supplies.

Water & energy

Despite the large area of Kenya that is arid or semi-arid, important water towers support the rivers and catchments where dams currently generate enough hydropower to provide between 30 and 40% of Kenya's installed capacity, depending on the weather. The current 826 MW from hydro power is a fraction of the potential, estimated at 3000 MW to 6000 MW (KNBS, 2020)

It is harder to gauge the impact of climate change on this hydro power potential. In some areas, Kenya's rainfall is projected to increase dramatically, but droughts are also expected to be more severe and could last longer. Where rainfall does increase, it may come in heavy downpours that quickly run off rather than being absorbed over several weeks, and it may damage hydropower infrastructure. Changing and more erratic rainfall are likely to affect hydropower production. While heavy rains usually improve hydro electricity production and affordability, droughts reduce the water available in hydroelectric dams for electricity generation, often increasing the cost to consumers.

Not all of Kenya's water or hydro power comes from Kenya. Some of Kenya's water flows from Ethiopia and Uganda, along with imports of power from both countries. In Ethiopia, construction has begun of the five Gibe hydroelectric cascade dams along Omo River, which includes the controversial Gibe III dam (see Avery, 2018). Uganda is also planning to build more hydropower. However, increased energy and water demand in Uganda and Ethiopia might mean less for Kenya just when climate change requires more imports.

Irrigation

In certain arid and semi-arid land (ASAL) areas of Kenya, climate change might mean that water for irrigation and animals will need to be pumped over longer distances, requiring even more energy.

Competition for using water

As a water-stressed country, competition for water between energy production and other uses is almost certain in the future as climate change meets increased population. Rural areas, for example, may want to divert water into irritation rather than use it for hydropower.

Urban areas are regions of high consumption of both water and energy, but may find increasing the use of one reduces supplies of the other. More frequent and severe heat waves in the country, and increased temperatures in the coastal cities, might further increase the demand for electricity; at the same time, these heat waves are likely to strain water supplies used to produce that power.

Clean water

Energy is also needed to ensure water supplies are clean, but this can be costly. In a recent meeting in Bomet with members of the Water Services Providers Association (WASPA) Dr. Barchok, the Governor of Bomet County, proposed that "water companies should also be encouraged to adopt the use of solar energy to power their treatment plants as a cost cutting measure" (Kimutai, 2020).

Bioenergy/Biofuels

Biomass is the most commonly used fuel in Kenya, largely as firewood in households. However, if climate change reduces the natural production of firewood, charcoal and wastes, then prices will rise. In some cases, energy poverty will increase in Kenya, while others will search for new fuels.

Biomass is also expected to power about 5% (157MW) of Kenya's energy generation in 2018-2022, but production of crops like sugarcane for energy is controversial. It could increase water stress and food insecurity in the country, although a different crop, like cassava, might be less harmful.

Sea water desalination

If water supplies per capita are reduced with climate change, sea water desalination may be needed in swampy or coastal areas. However, desalination requires immense energy supplies to convert salty or brackish water into fresh water. The MTP-III highlights this as an emerging issue, but the LCPDP only makes note of it.

Water & industry

The interconnectedness of water and energy is certain in other ways: energy is used for pumping and transporting potable water and wastewater, while water is used to cool many thermal and geothermal power plants.

On average, 1 kWh needs about 95 litres of cooling water. If there is a substantial preference for new power plants that require large volumes of cooling water, hydro-power development plans might need to be cut back to divert water to non-hydro power plants that require large water withdrawals as temperatures rise.

Extreme events, sea level rise and energy infrastructure

Extreme events such as tropical storms and cyclones are a major concern for coastal countries like Kenya. As Gannon et al. (2018) observe, storm damage to electricity infrastructure, electricity distribution equipment (e.g. transmission lines, transformers), power plants, storage facilities, equipment and fuel delivery infrastructure (including roads, ports, fuel pipelines etc.) can massively disrupt energy production and distribution. Coastal energy infrastructure is also vulnerable to sea level rise which also exacerbates storm surges.

Billions of dollars are likely to be lost in Lamu and Mombasa as the sea level rises, including the US$1 billion pipeline to the Port of Lamu, to be completed by 2025.

Transport & infrastructure

Roads, railways and marine transportation that move large amounts of oil and coal are also vulnerable to climate change. In late 2019, Tullow Oil suspended an early oil pilot scheme (EOPS) in Kenya due to "severe damage to roads caused by adverse weather," and held off trucking until all "roads are repaired to a safe standard" (Tullow Oil plc, 2020). This was a setback in Kenya's ambition to export 0.5 million barrels of oil. Kenya already loses hundreds of billions of shillings annually from damaged roads and their repairs (Omondi, 2018). In 2018, the government allocated about KES 19 billion (US$190 million) to repair rain-damaged roads (Kanamugire and Kiprop, 2018; Nation Team, 2018). In 2019 a similar sum was needed following more heavy rains (Alao, 2019; Munyao, 2019; Mutai, 2019; Njuguna, 2019).

Damaged and/or flooded roads also result in fuel station shortages and price hikes when lorries cannot get through. As noted by Murphy and Harris (2014), damages "equivalent to at least 11 per cent of GDP, including Ksh 62 billion in damage to transport infrastructure" were caused by the 1997-98 El Niño floods. Such events are likely to be more frequent and intense. Energy and transport development plans need to factor this in.

Impact on wind power

Wind speed, cloud cover, and renewable energy: Kenya's 5-7 peak sunshine hours and average daily insolation of 4-6 kWh/m^2 are taken for granted as investments in solar and wind power grow. However, climate change could increase cloud cover, reducing the potential for photovoltaic installations, currently estimated at 23,046 TWh/year (GET.invest, 2020). Recent investments in wind power assume a reliable strong wind, with the potential to produce reliable amounts energy, depending on turbine capacity (GET.invest, 2020). However, wind speeds and reliability might change, both positively and negatively, with rising temperatures and new climate patterns* while potential wind damage to turbines and infrastructure is also possible.

New social and economic forces

Quite apart from the effect of climate change on water, agriculture and infrastructure, with all their links to the energy system, the response to the global climate emergency is already changing social and economic rules. There is growing support for climate action coming from young people and others around the world, as well as increased private investment in solar, wind and geothermal heating or cooling systems, both domestic and commercial. Economically, there is also growing interest and participation in carbon trading schemes, in the USA and elsewhere. The European Emissions Trading Scheme (ETS) is already the largest in the world.** These schemes put a price on carbon, making fossil fuels more expensive. Governments may start putting tariffs on imports produced with high carbon energy, or put a tax on carbon to help pay the debts used to manage the COVID-19 pandemic. If the costs of using high carbon energy increase, that would affect Kenya's energy future. It could give the country a competitive edge with its significant use of renewable electricity generation.

(See the following chapter on carbon trading and pricing by Robert Ddamulira.)

* *The impacts of climate change on wind and solar power is still a developing area of research. Difficulties related to modelling wind and cloud cover changes at the essential spatial scales have proven formidable and hampered progress in this research area to date.*

** *See this EU description of ETS: https://ec.europa.eu/clima/policies/ets_en*

ENERGY POLICIES AND CLIMATE CHANGE

The absence of climate change in Kenya's energy plans

While Kenya's climate change policies include significant references to energy,* the same is not true of the government's energy policies and plans. They rarely factor in either observed or projected climate change risks, despite requirements to mainstream climate change in all decisions and policies, including energy. Energy infrastructure is critical infrastructure, so its protection from climate-related damages is essential. Although this should start with the planning process, there is little sign that is happening, despite potential support from wealthier nations.

The Paris Agreement & support for developing countries

The Paris Agreement pledges to support developing countries like Kenya to implement their climate commitments by offering technical assistance, capacity building, technology development and transfer, and climate finance. Kenya's promise to achieve 30% lower emissions compared to business as usual (BAU) is hinged on this 'international support.'

However, in order to tap into such assistance, Kenya's energy development policies need to demonstrate awareness of climate change impacts and offer plans to address it.

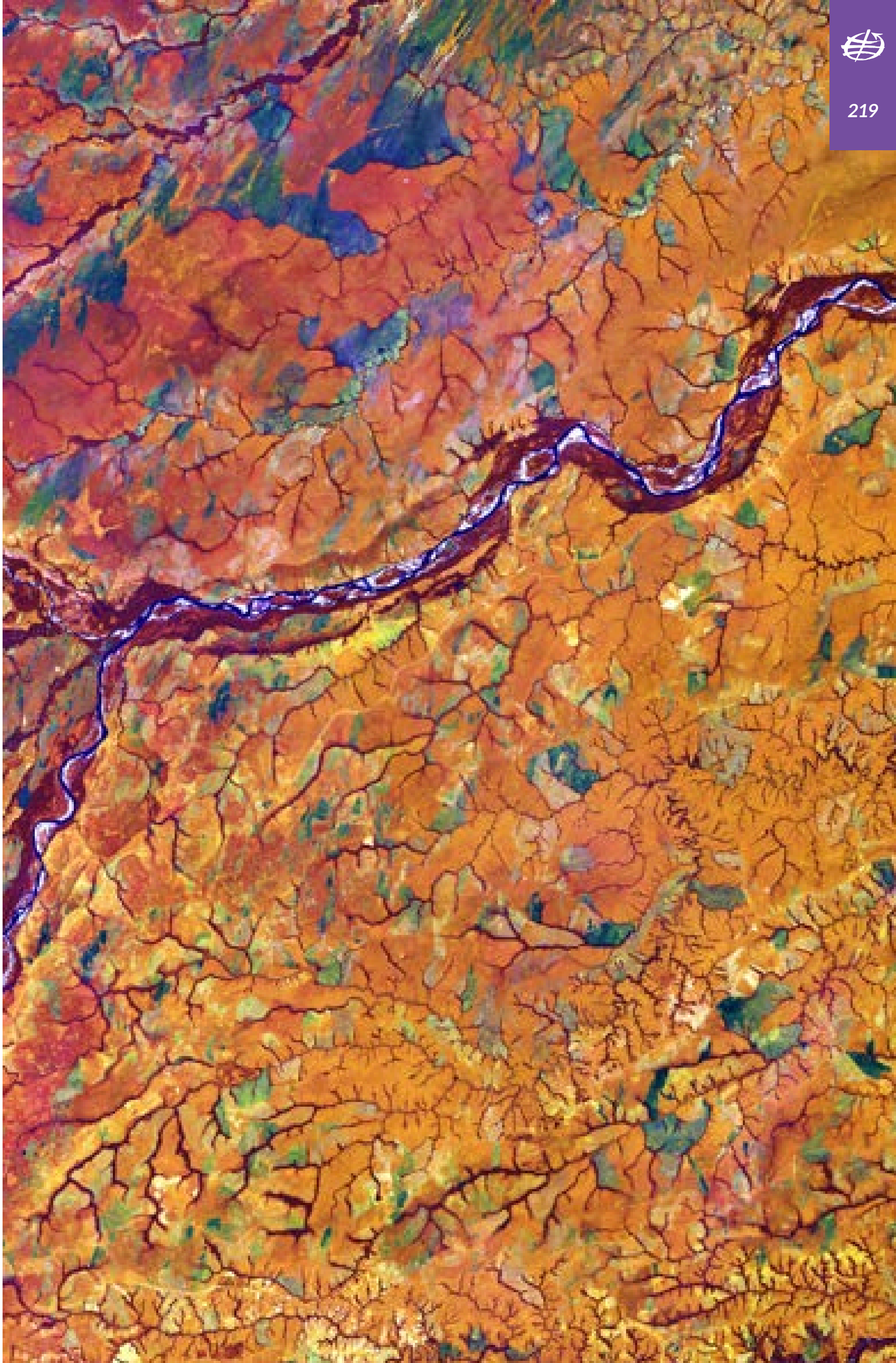
For instance, the country is set to receive UK support to develop solar farms. Kenya could also benefit from a £30 million investment in affordable energy-efficient housing to construct 10,000 low-carbon homes for rent and sale. This would "support the creation of new jobs in Kenya's green construction industry and help tackle climate change" (GOV.UK, 2020; UK Government, 2020). Other funds are also available, as international support for renewable energy helps developed countries meet their obligations to support developing countries under the Paris Agreement.

* *Climate change discourse has triggered planning and policymaking in Kenya (Munene et al., 2019) as well as in government. See Government of Kenya, 2018b.*

CONCLUSIONS

Kenya has many policies and plans for climate change and energy development. However, these are not always aligned and conflict among them is often evident. While climate policies and Kenya's commitments under the Paris Agreement talk of clean energy pathways, energy plans and actions on the ground tell a different tale. The policies are not always fully implemented, enforced, or evaluated. Some progressive regulations have been repealed even before implementation, such as the solar water heating regulations in 2018.

To be fair, planning for energy and climate resilience requires quality data which is not readily available, and this makes planning more difficult. Nonetheless, Kenya stands to lose billions of dollars if climate change impacts are not considered, especially as current energy sources and infrastructure still need adequate climate proofing.



POLICY RECOMMENDATIONS

The following recommendations should enhance the resilience and sustainability of Kenya's energy developments under a changing climate.

Update plans and strategies

As plans and strategies are updated, they need to align climate change (e.g. NDC, NCCAP) and energy (e.g. LCPDP, KNES) thinking to ensure coherence. They should be depoliticised as much as possible and always conducted transparently. Moreover, harmonisation and consolidation of the relevant climate and energy policy instruments is needed to avoid confusion. Relevant agencies should fully implement and enforce policies, evaluating and changing them as necessary without repealing the successes.

Strengthen policies & incentives

Strengthen policies and financial and fiscal incentives for climate change and energy development. Encourage local investment and address the issue of energy technology dumping. Develop an effective framework to protect and encourage energy innovations by Kenyans.

End corruption

Corruption in the energy sector hinders potential investments by both local and foreign investors while creating room for 'energy developments' that are not climate-smart. This needs to end.

Increase energy efficiency

Energy efficiency campaigns are necessary to increase consumer awareness and demand for energy-efficient products and systems. This will expand the market for energy efficiency in the country.

Reconsider the development paradigm

Kenya's current development paradigm is based on the Asian model of industrialisation. This may no longer be appropriate or viable.

Build capacity

Capacity development is required to build strong state institutions with clear mandates and the ability to lead the development and implementation of climate-compatible energy policies. Effective coordination among the various agencies (e.g. KRA, KBS, ENC, EPRA) is needed to avoid duplication of efforts and waste of scarce resources. The capacity of non-state stakeholders also needs to be improved so they can effectively monitor and evaluate climate and energy policies, while contributing to the development of a climate-compatible energy system in Kenya.

More research on the impacts of climate change

Further research on the impacts/effects of climate change on energy demand, production, and distribution in Kenya is recommended. Reliable data on energy and climate change need to be available to policymakers, investors and energy users.

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CHAPTER TWENTY-ONE: CARBON PRICING & REDD+ AGAINST CLIMATE CHANGE:

EXAMINING POLICY OPTIONS FOR KENYA

ROBERT DDAMULIRA

EXECUTIVE SUMMARY

This article studies the policy options on carbon pricing and REDD+ mechanisms in addressing climate change impacts in Kenya. We start by providing a brief background about carbon pricing (emission trading systems and carbon taxes) and REDD+. Our study then examines two policy mechanisms that use pricing by analysing lessons from two specific case studies.

First, the Regional Greenhouse Gas Initiative (RGGI) in the United States, which is a voluntary emissions trading system regulating greenhouse gas emissions from power plants across 10 U.S states. Second, we examine lessons from The International Small Group & Tree Planting Programme (TIST). TIST is a REDD+ supported initiative providing financial incentives in exchange for forest conservation activities by approximately 100,000 smallholder farmers organized in 15,000 groups. More than half of these farmers are in Kenya. TIST also has similar activities in Tanzania where it started, as well as Uganda and India.

The RGGI and TIST case studies provide us not only with powerful insights on the structures, policies, and mechanisms for carbon pricing and REDD+, but also useful policy experiences on how to leverage market-based tools for addressing global climate change.

Our study also includes a brief analysis of the current state of carbon-pricing and REDD+ policy and practice experiences in Kenya. Against this background, the study concludes by providing policy recommendations on how Kenya could strengthen and design better carbon pricing and REDD+ mechanisms for a more climate-resilient future.

BACKGROUND

In Ernest Hemingway's famous novel, ***The Sun Also Rises***, Bill asks, "How did you go bankrupt?" "Two ways," Mike says. "Gradually, then suddenly." A similar trend seems to have happened with respect to global climate change.

Until the dawn of the industrial revolution in the late 1700s, humanity had co-existed nearly harmoniously with natural systems, balancing the carbon stored in land systems with carbon released into the atmosphere. However, once the Industrial Revolution began around 1750, this delicate balance was thrown out of harmony; first gradually and now suddenly.

DESTABILISING FORCES

There are two destabilising forces responsible. On one hand, there is the accelerated production and consumption of fossil-fuels (mainly coal, petroleum and natural gas) which had been safely kept underground. On the other is the gradual reduction in forests and healthy soils which remove excess carbon dioxide from the atmosphere. Today, energy-related CO_2 accounts for more than two-thirds of global emissions growth (IEA, 2019). Since 1990, the world has lost 178 million hectares of forests and every year we continue to lose a net area of 5 million hectares, reducing the planet's ability to absorb CO_2. These interactions are summarized in Figure 61.

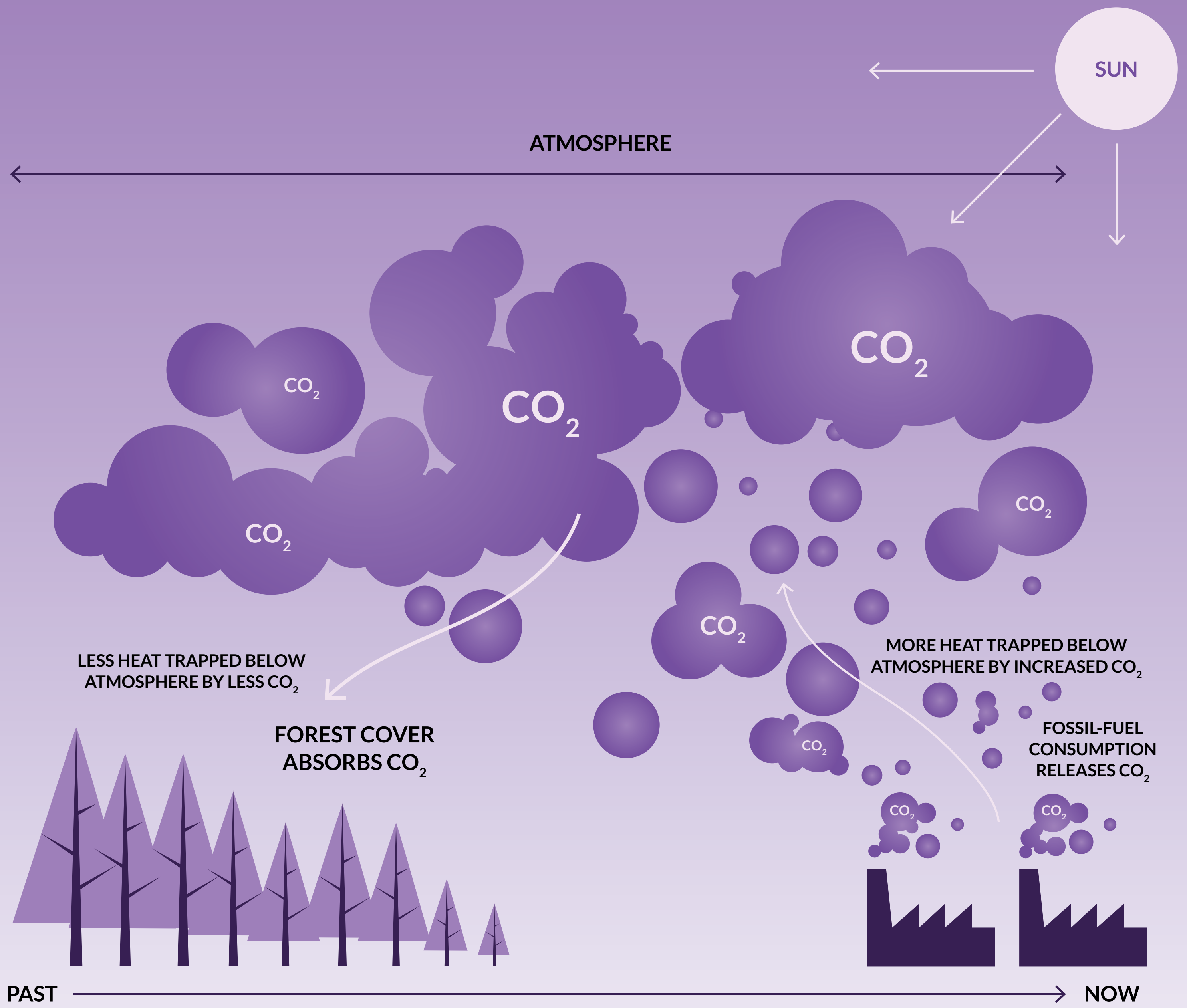

Figure 61: Two big drivers of climate change: use of fossil fuels and loss of forest cover.

This illustration shows how, overtime, global forest cover declined just as fossil fuel consumption increased through industrialization, allowing more CO_2 to accumulate in the atmosphere.

Fossil-fuels are extracted from reservoirs of carbon which have been safely stored in the ground for millions of years. When these are burned to generate energy in factories, cars, buildings or power stations, the CO_2 that results is more than what the earth's systems can handle, so it remains in the atmosphere for hundreds of years.

Forests, on the other hand, naturally remove CO_2 from the air and store it in their soils and trees. As a result, there is more carbon stored in forest soils and biomass than there is in the global atmosphere (Schoene et al., 2007).

However, the accelerated loss of forest cover (deforestation) driven in part by population growth, agricultural and infrastructure expansion has reduced the capacity of forests to store CO_2 resulting in more CO_2 emissions accumulating in the atmosphere.

These two forces, use of fossil fuels and loss of forest cover, are underpinned by a number of indirect factors including among others the rapid growth of the global population, which has accelerated the demand for infrastructural and agricultural expansion.

Other important factors are the public policies focused on limitless economic growth, which give minimal attention to the long-term environmental implications for natural capital or social equity (Geist & Lambin, 2002; Hosonuma et al., 2012; Kissinger et al., 2012). The net result of all these factors is a gradual accumulation of CO_2 in the atmosphere, leading to global warming and climate change.

By the early 21st century, global mean temperatures have risen by approximately 1.0°C above the level of 1900 (IPCC, 2018). This has triggered major changes in global precipitation patterns, sea-level rise, and increased the number and severity of extreme weather-related disasters. These impacts have damaged major natural ecosystems and reversed decades of human development in many places around the world (IPCC, 2018).

TWO EXPERIMENTAL TOOLS

This study examines two experimental economic tools which seek to restructure global markets by addressing the two primary driving forces highlighted above. We first examine carbon pricing policies designed to reduce the amount of CO_2 emitted into the atmosphere by fossil fuels through the example of an emissions trading scheme in the USA. Second, we look at REDD+ which aims to increase global forest cover, mostly in developing nations, in order to remove excess CO_2 from the atmosphere. The study then examines these two economic experiments from the perspective of Kenya by highlighting what lessons have been learnt so far and how such tools can be made more effective in addressing climate change in Kenya.

Carbon pricing seeks to ensure that those industries responsible for the highest levels of CO_2 emissions pay more for their emissions while those which reduce their emissions are rewarded. REDD+ on the other hand, incentivizes farmers in developing nations to maintain and expand forest cover on their land. This in turn improves the removal of excess CO_2 from the global atmosphere. The expected net result from both measures is a gradual reduction in atmospheric CO_2, mitigating climate change. This relationship is illustrated in Figure 62.

Figure 62 shows that through a carbon pricing mechanism like cap and trade policies (e.g. RGGI discussed below), excess emission from fossil-fuel consumption can be mitigated and reduced. At the same time, by providing farmers in developing countries with financial incentives, forest cover can be increased and excess carbon can be removed from the global atmosphere. The net result is reduced emissions of CO_2 and the removal of excess CO_2 emissions from the atmosphere. This could gradually lead to less global warming and reduced impacts from global climate change.

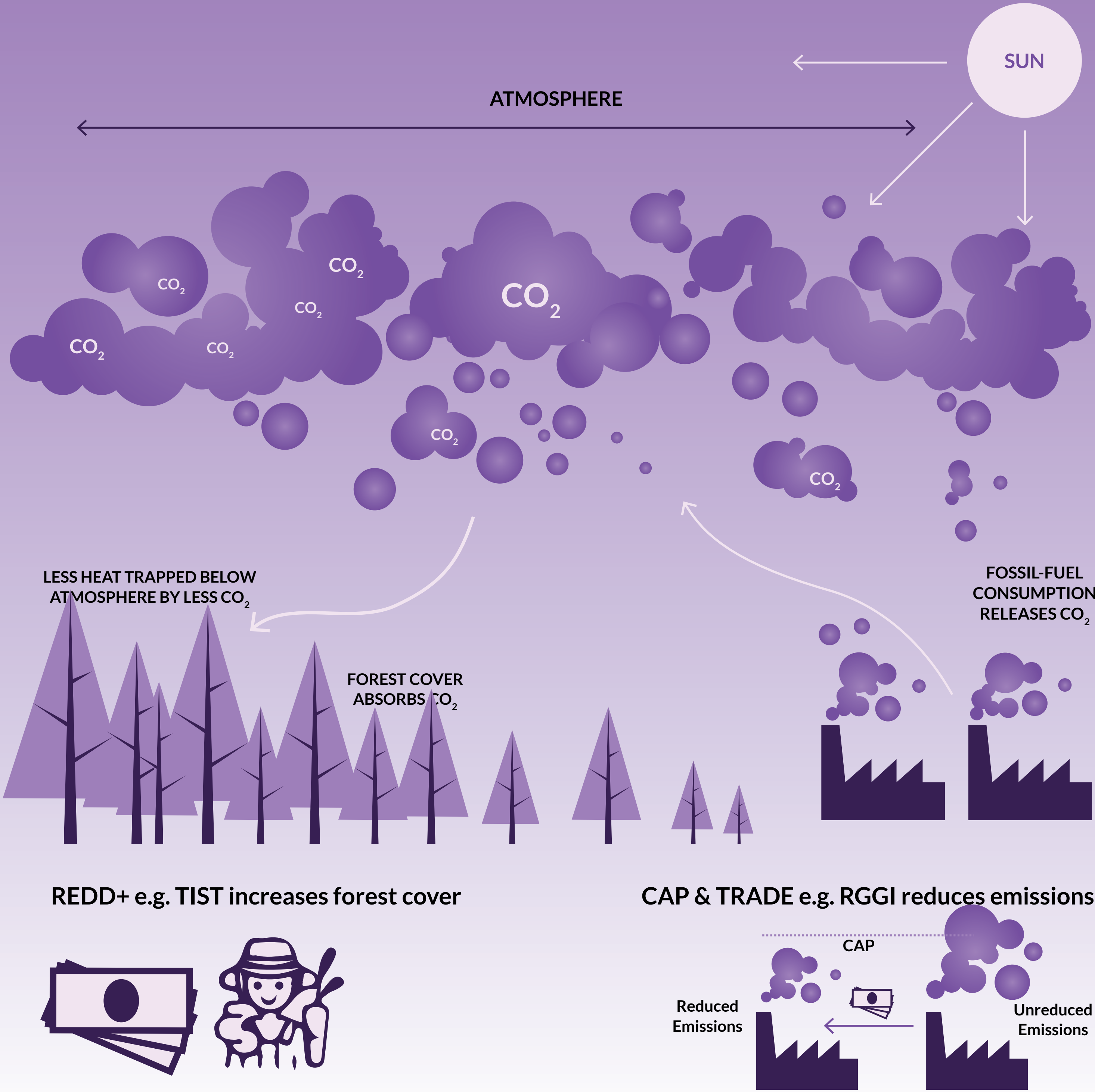

Figure 62: Carbon pricing to reduce emissions with REDD+ to increase sequestration of CO_2

Carbon Pricing: What Have We Learned So Far? Carbon Pricing Mechanisms

Carbon pricing policy mechanisms seek to regulate the amount of CO_2 from fossil-fuel consumption emitted into the atmosphere. They internalise both the environmental and societal costs of greenhouse gas emissions, meaning the company producing the emissions has to pay for some of the damage they cause.

To avoid paying, companies invest in low-carbon technological innovations; this also fosters national development through multilateral co-operation and creates synergies between human development, energy and climate policies (IEA, 2020).

At the time of writing, there are 61 carbon pricing initiatives currently operational around the world, including 31 Emission Trading Systems (ETS) and 30 carbon tax initiatives (Haites, 2018; World Bank, 2020). These policy frameworks cover some 78 jurisdictions, ranging from national, regional to international jurisdictions around the world (Haites, 2018; World Bank, 2020).

A carbon tax is a straightforward tax on the amount of greenhouse gases emitted and the revenue goes straight into a government's treasury. It is effectively a penalty for polluting. An emissions trading system, on the other hand, has a more limited role for government, but offers companies a chance to be rewarded for reducing emissions, as well as penalising them when their emissions are too high. This article will focus on emissions trading.

There are very limited experiences with carbon pricing in Africa, either as a tax or a trading system, so we need to learn from initiatives started elsewhere. In this section, we will explore the example of one carbon trading scheme, RGGI, in the USA.

EMISSIONS TRADING SYSTEM CASE STUDY: THE REGIONAL GREEN HOUSE GAS INITIATIVE (RGGI)

The Regional Greenhouse Gas Initiative (RGGI) in the USA is a cooperative market-based programme designed to cap and trade carbon dioxide (CO_2) emissions from fossil fuel power plants across 10 U.S Northeastern and Mid-Atlantic states (DEPNJ, 2020; RGGI, 2020).* In 2014 RGGI member states accounted for 13.1% of the US population and 16% of US GDP (EDF, 2015). RGGI took about two years to develop between 2003 and 2005. The policy goal of RGGI is as follows:

> ***To create a cap-and-trade program [sic] aimed at stabilizing and reducing emissions in participating states, while remaining consistent with overall economic growth and the maintenance of a safe and reliable electric power supply system.***
>
> Source: EDF, 2015.

How does RGGI work?

Collectively, the RGGI states establish an annual regional limit (cap) on carbon dioxide emissions from all their electric power stations. The total allowed emissions are then divided into allowances, with each allowance representing one ton of emissions. The fossil fuel power plants in each state participate in auctions to buy allowances for their annual carbon dioxide emissions. Funds from the RGGI auction are typically invested in energy efficiency, renewable energy, direct energy bill assistance and other greenhouse gas reduction strategies to support the region's clean energy economy and create local green jobs (DEPNJ, 2020). To lower emissions the following year, the cap is set at a lower total and another auction is held.

Emissions Trading Systems (ETS) like RGGI are more popular among companies than carbon taxes because they allow for flexibility in how to reduce emissions. Power utility companies in RGGI may, for example, choose to reduce their emissions through technological improvements or by purchasing emissions allowances in the market from a company that doesn't need all the allowances it bought. ETSs are also more equitable – i.e. the higher your emissions profile, the higher the cost. Compared to a carbon tax, these systems require limited direct government intervention beyond setting the cap and monitoring and managing the auction processes. See Appendix to this chapter for more details on key structures and mechanisms which underlie the RGGI system.

* *RGGI includes the following states: Connecticut; Delaware; Maine; New Hampshire; New Jersey; New York; Vermont; Massachusetts; Rhode Island; and Maryland.*

What are the key outcomes of RGGI?

Since its establishment in 2005, RGGI has realized a number of outcomes including: $2 billion in lifetime energy bill savings, and 4.6 million short tons* in avoided CO_2 equivalent emissions (RGGI, 2020). In addition, energy efficiency makes up 38% of 2018 RGGI investments and 56% of cumulative investments. Programmes funded by these investments in 2018 are expected to return about $1.2 billion in lifetime energy bill savings to over 115,000 participating households and 1,200 businesses in the region, while avoiding the release of 1.4 million short tons of CO_2 pollution (EDF, 2015).

Apart from energy efficiency savings, 19% of 2018 RGGI investments and 14% of overall cumulative investments went into clean and renewable energy projects. RGGI investments in these technologies in 2018 are expected to return about $600 million in lifetime energy bill savings (EDF, 2015). Greenhouse gas abatement makes up 20% of 2018 RGGI investments, and 9% of cumulative investments and are expected to return over $200 million in lifetime savings. Direct bill assistance makes up 16% of 2018 RGGI investments and 15% of cumulative investments (EDF, 2015).

What are RGGI's key constraints?

Despite its overall positive outcomes, RGGI continues to face some serious constraints. First is the lack of an overall federal policy on climate change for the USA. The withdrawal in 2017 of the U.S from the 2015 Global Paris Climate Accord further constrained state level as well as global climate action and ambition (Dai et al., 2018) after Trump took office as president of the United States.

RGGI also faced a constraint related to its non-binding nature. Participating states have the option to exit the programme which triggers adjustment for overall cap commitments for all states and regulated utilities. In addition, RGGI also faces a constraint of GHG leakage. Studies show that some participating states are increasing their share of imported electricity from neighbouring states to remain compliant, since power imports are not covered under the RGGI framework (EDF, 2015).

* *A short ton has 2000 pounds,, equivalent to 907.18474 kilograms. It is the American definition of a ton, rather than the metric definition which has 1000 kilograms or 2205 pounds.*

REDUCTION OF EMISSIONS FROM DEFORESTATION & FOREST DEGRADATION (REDD+)

REDD+ policy mechanisms seek to reduce the loss of forest cover which is crucial for removing CO_2 from the atmosphere. The REDD policy initiative was an outcome of the UNFCCC Bali Action process in 2007. In 2008, the initiative was expanded to recognize the co-benefits and contributions of the REDD process towards biodiversity conservation, pro-poor community development, and overall sustainable management of forests, hence the addition of the "+" to become REDD+ (CIFOR, 2020). Today the REDD+ initiative is led by a $4.5 billion partnership with Norway and France supporting various REDD+ projects around the world (CIFOR, 2020).

REDD+ is a market-based mechanism, like carbon taxes and subsidies. It provides incentives to landowners and managers to reduce GHG emissions from land use change by encouraging the conservation of the environment and natural resources.

REDD+ has emerged as a key climate change mitigation strategy within the United Nations Framework Convention on Climate Change (UNFCCC);today over 40 countries either include REDD+ or forests as part of the mitigation strategy in their Nationally Determined Contributions (NDCs**). The central role of forests in climate change mitigation, as recognized in the Paris agreement, makes it increasingly important to develop and test methods for monitoring and evaluating the carbon effectiveness of REDDþ. Over the last decade, hundreds of subnational REDDþ initiatives have emerged, presenting an opportunity to pilot and compare different approaches to quantifying impacts on carbon emissions. In order to understand how REDD+ works in practice, we assess one case study of the International Small Group & Tree Planting Programme (TIST), presented below.

** *Nationally Determined Contributions (NDC) are the goals set by countries who signed the Paris Accord and agreed to state the quantity of greenhouse gas emissions they would avoid producing or reduce in a stated period of time.*

REDD+ CASE STUDY: TIST

TIST, The International Small Group & Tree Planting Programme, was created in 1993 by the Clean Air Action Corporation, a US-based non-profit working on clean air and led by a husband and wife team, Ben and Vannesa Henneke. The Hennekes started TIST while serving as Christian missionaries in 1998 with Bishop Simon Chiwanga of the Diocese of Mpwapwa in central Tanzania (TIST, 2017). Within five years, the TIST initiative had expanded to include small group farmers in Kenya, Uganda and India. Today TIST is comprised of 95,000 subsistence farmers organized in 14,700 small groups (CAAC, 2020).

How does TIST work?

The TIST initiative is designed around small farmer groups of 6-12 individuals who together collaborate and coordinate forestry and reafforestation activities on their land to meet environmental, social and economic needs (TIST, 2017). The programme grows through a trainer-of-trainers programme, where individual members help to establish new groups (TIST, 2017; USAID, 2014). What makes TIST unique is its rigorous and transparent monitoring and evaluation system. This system is powered by individual field assistants who regularly measure each individual tree within the programme area and post geo-coordinates in a live online database (CAAC, 2020).

What are the key outcomes of TIST?

TIST has directly planted about 20 million trees through a network of about 100,000 smallholder farmers organized in about 15,000 farmer groups. This has helped to sequester an estimated six million metric tons of CO_2. This is in addition to other environmental and socio-economic benefits such as job creation, access to sustainably produced fuelwood, and soil and water protection services. One special attribute of this programme is its focus on smallholder farmers. While most REDD+ initiatives have been criticized for focusing on industrial scale forestry and reforestation programmes, TIST has demonstrated how REDD+ can be harnessed to support smallholder farmers. The initiative is also increasing the application of technology through GPS recording and live maps, which should make it easier to reach more people at an even larger scale.

The TIST programme in Kenya includes 53,000 subsistence farmers who have planted more than seven million trees. These trees have been verified by condition and location with mobile phone-based software. Most of the TIST farmers are located around Mount Kenya and have earned nearly $20 million from a TIST-facilitated carbon market. TIST members receive annual cash payments to compensate them for planting and nurturing their trees for long-term growth. This incentive encourages the farmers to care for trees during the critical years while they are small, before they provide other valuable benefits. TIST farmers receive 70% of the profits on the sale of carbon credits on the global carbon markets (TIST, 2020b). TIST provides diverse benefits to participants who planted trees, practiced conservation farming, and used improved cook stoves. The members reported an average total added income of $433 per member over the course of their participation (USAID, 2014). This is estimated to be about 21% of the average annual income per capita in Kenya (Statista, 2020).

What are the key constraints of the TIST approach?

One key constraint of the TIST approach and common to most REDD+ projects is its focus on tree cover without enough attention paid to other intangible aspects of sustainable forestry, such as cultural and biodiversity benefits. The net result of this approach is that commercial and often exotic tree species are preferred by most farmers, which leads to overall loss in forest biodiversity and a gradual decline in the ecological and socio-cultural functions of forests in participating areas (Ddamulira, 2020).

Without significantly compromising the economic benefits, initiatives like TIST could do more in promoting the cultural and biodiversity benefits of forests by integrating incentives for indigenous trees and forest ecosystems of cultural importance. One approach would be to create a premium incentive service where farmers who restore indigenous forest receive a higher financial incentive or access to low-cost credit services, compared to those who plant exclusively exotic species.

Another key challenge with TIST, similar to other REDD+ initiatives, is the time delay between when forest carbon commitments are made by farmers, and when payments are received. TIST provides a small pre-payment to each farmer who joins the programme, however, the first REDD+ payments are only made after five years.

Thereafter these payments are made annually. Even then, the payments are relatively small; a total of about $20 for every 1,000 trees (1 acre) planted and maintained per year (TIST, 2020a). While these amounts can be life-changing for poor communities, there is also a high opportunity cost as TIST recommends that trees (rather forest land) within the programme should remain in place for at least 30 years. This reduces the land available for the subsequent generations, especially in areas of high population growth.

POLICY & PRACTICE OF CARBON PRICING & REDD+ IN KENYA

Kenya's total greenhouse gas (GHG) emissions are relatively low, standing at 73 $MtCO_2e$ in 2010. The emissions are also predominantly land-based, with 75% of all total emissions coming from land cover, land-use change and forestry (LULUCF), and agriculture sectors. The LULUCF emissions are largely driven by the large proportion of the population who rely on traditional wood fuel for cooking, especially in rural areas. A rising population, and the increasing demand for agricultural land and urban development, are also important factors. Kenya's other significant GHG emission sources include the energy and transport sectors, while waste and industrial processes contribute negligible amounts (GoK, 2018a).

For nearly three decades, Kenya has been actively involved in international and national policy initiatives to address climate change. The Kenyan Government has long recognized the adverse impacts of global climate change on the country's human and natural environment. Some estimates predict that the continued annual burden of extreme climatic events could cost the Kenyan economy as much as US$500 million a year. This is equivalent to approximately 2.6% of the country's GDP with implications for long-term growth (GoK, 2013a).

The 1998-2000 drought alone was estimated to have caused an economic loss of about US$ 2.8 billion resulting from the loss of crops and livestock, forest fires, damage to fisheries, reduced hydropower generation, and industrial activity (GoK, 2013a). These climate change impacts are further compounded by local environmental degradation, primarily caused by habitat loss and conversions, pollution, deforestation, and overgrazing. Between 1960 and 2010, Kenya lost 50% of its forests, with forest cover reducing from 12%in the 1960s to 6% (GoK, 2013a).

It is against this background that the Kenyan government has established various policy mechanisms of relevance to carbon pricing and REDD+. Kenya's long-term development plan, the Kenya Vision 2030, clearly articulates an environmental goal of ensuring a clean, secure, and sustainable environment by 2030 (GoK, 2007) and includes relevant carbon pricing and REDD+ practice provisions. Kenya's Third Medium Term Plan for 2018-2022 (MTP III) specifically seeks to address climate change through the promotion of low carbon development approaches, including strengthening climate change governance and coordination, monitoring, reporting and verification (MRV), capacity building and public engagement, and formulation and implementation of Green Economy Strategy and the National Climate Change Action Plan.

The MTP III also sets a goal of reducing the country's GHG emissions by 30% by 2030 relative to the business-as-usual scenario of 143 metric tons of carbon dioxide equivalent (MtCO2e). The plan outlines several priority sectors, including the environment, agriculture, forestry, energy, waste management, health, water, infrastructure, manufacturing, tourism, and disaster risk management (GoK, 2018b).

Amongst other measures to address climate change, Kenya's carbon credit schemes fall under two categories. First are the schemes under the compliance market, which is defined by treaties and laws and sometimes referred to as mandatory carbon markets. The Clean Development Mechanism (CDM) is an important compliance market mechanism. Second, there are the schemes that operate under the Voluntary Carbon Market (VCM) which is defined through negotiation and practice more often than treaties and law. The carbon pricing described in this article and REDD+ spans these two types of carbon markets.

CLEAN DEVELOPMENT MECHANISM (CDM) PROJECTS

The CDM market is outside the scope of this paper, but enables wealthier industrialised nations to meet part of their emission reduction targets by investing in emission reduction projects in developing countries (Mwania, 2020; Voigt, 2008). Effectively, this creates an international market for carbon trading. Kenya's participation in the global CDM mechanism has enabled the country to realise a clean pathway to development by attracting investors in Kenya's renewable energy resources. The CDM has also facilitated and accelerated technology transfer from developed nations to developing countries, another important benefit.

VOLUNTARY CARBON MARKETS

Within the voluntary carbon market any individual, business or another "GHG emitter" may voluntarily choose to reduce their GHG emissions by purchasing carbon credits through certified voluntary carbon market platforms (Mwania, 2020). Many of the national carbon pricing and REDD+ initiatives would qualify for this category. Voluntary carbon markets have been accelerated through respective regional or national carbon pricing policies such as RGGI. The advantage of voluntary carbon markets is that they avoid the stringent requirement of CDM mechanism while providing actors with the flexibility to participate at levels that are most convenient. It is important to recognize that voluntary carbon markets and their respective attributes have been shaped in large part by the mandatory CDM frameworks discussed above; however they are also more open to abuse as they are less regulated.

Comparatively, much of the carbon pricing and REDD+ policy experience in Kenya has been through voluntary carbon markets. Even then, Kenya's current carbon market is heavily characterized by forestry projects and renewable energy carbon credits, which together comprise 97% of all projects (Mwania, 2020). These projects tend to generate the highest number of carbon credits per unit of investment. Table 10 below highlights some of the ongoing projects in Kenya.

On-going REDD+ Projects in Kenya

Project name	*Sector*	*Comment*
Kasigau Corridor REDD Project (Rukinga Sanctuary)	Forestry	This project is managed by Wildlife Works, which protects over 200,000 hectares of dryland forest. Forest impacts: 13,936,339 tonnes of GHG emissions avoided to date; 11,000 wild elephants; 20 species of bats; over 50 species of large mammals; over 300 species of birds (WildlifeWorks, 2020).
International Small Group & Tree Planting Programme (TIST)	Forestry	Starting in Tanzania in 1998, TIST is now benefiting more than 95,000 farmers in Tanzania, Uganda, Kenya and India (TIST, 2014, 2020b). The TIST programme in Kenya includes 53,000 subsistence farmers who have planted more than 7 million trees.
Aberdare Range/Mt. Kenya Small Scale Reforestation Initiative	Forestry	This project is part of the Green Belt Movement (GBM) on behalf of community forest associations in partnership with Kenya's Ministry of Environment and Natural Resources and Kenya Forest Services.
Mikoko Pamoja Mangrove	Forestry	This is the world's first blue carbon project. Mangroves store 50 times more carbon in their soils by surface area compared to tropical forests, and 10 times more than temperate forests (Plan Vivo, 2020). The project is operated by Mikoko Pamoja Community Organization and financed via Plan Vivo's voluntary carbon market, which began in 1994 in Mexico. As of 2019, the project had 117 ha of mangrove forests under its management benefitting some 700 households.
Kenya Agricultural Carbon Project	Soil carbon	Implemented by a Swedish NGO, Vi Agroforestry, with support from World Bank's Bio-Carbon Fund.
Kenya Airways Carbon Offset Program	Aviation	In cooperation with the International Air Transport Association (IATA) the airline can offset its own emissions using voluntary emission reductions (VERs) from geothermal projects in Kenya.

Table 12: Examples of carbon pricing and REDD+ experiences in Kenya

CONCLUSION

Kenya's current policies and practices provide important opportunities for developing and expanding carbon pricing and REDD+ policy initiatives. Carbon pricing and trading, along with REDD+, are still largely experimental initiatives in the global policy framework to address climate change.

Kenya's National Policy on Climate Finance (2016) provides the most explicit provisions for carbon pricing and REDD+ initiatives, however, this policy has not been operationalised with regulatory guidelines.

There have been early attempts by both national and international actors to start REDD+ related projects, but these initiatives are run independently, without any consistent effort to coordinate their activities or create a coherent national level policy and community of practice.

Given this context, we recommend that Kenya develops and implements operational guidelines for specific carbon pricing instruments, whether these be an ETS, carbon tax, or national level REDD+ based incentive mechanism.

The impact of climate change in Kenya is unmistakable. Across many areas, rainfall has become irregular and unpredictable; extreme and harsh weather is increasing in frequency and severity; some regions experience frequent droughts during the long rainy season while others experience severe floods during the short rains (GoK, 2013a). These impacts are expected to get even worse in the foreseeable future as the global climate warms and Kenya's population expands, possibly to as many 77 million people by 2050 (GoK, 2013b).

The combination of a harsher climate and a much larger population underscores the need for carbon markets in Kenya. These markets can be important tools in building a human development pathway which is also more resilient to the impacts of climate change in Kenya.

POLICY RECOMMENDATIONS

Several policy recommendations emerge from the carbon pricing and REDD+ experiences discussed above. These policy options could provide useful insights for Kenya as it explores designing and expanding its carbon markets. Some of these options include the following.

Where feasible, a regional approach on carbon pricing is more effective than an exclusively nation-state approach, one country at a time:

This is a key policy lesson we draw from the RGGI case study discussed above. The U.S. has gone through several political administrations, with some directly hostile to climate change regulation (Dai et al., 2018) after Trump took office as President of the United States. However, RGGI has persisted and in fact expanded from an initial seven U.S. members in 2005 to currently ten members. In addition, a regional approach provides greater flexibility for regulated GHG emitters by providing a wider market through which they can meet their emission reduction requirements. Our study therefore highly recommends that Kenya should seek first to engage member states within the EAC to establish a regional ETS policy mechanism.

Reinvest carbon market proceeds to support sustainable energy solutions:

There is always a temptation within developing countries like Kenya with a huge human development deficit to reallocate proceeds from climate action towards general human development projects such as health and education. This could, however, delay the transition to a sustainable energy future which is more resilient to the impacts of climate change. Similar to RGGI, Kenya too should reinvest the proceeds generated from carbon markets to support a sustainable energy transition through financing renewable energy projects, energy efficiency and access to modern energy to provide clean cooking and solar PV. These investments would provide new jobs while also improving health and education and accelerating the transition to a more climate resilient and sustainable energy future.

A sector by sector approach is necessary:

What we learn from the case studies above is that carbon markets work best when they are focused on a sector by sector approach. For example, the RGGI policy initiative is focused on regulating GHG emissions from fossil-fuel electric utilities of a specific size. In considering carbon markets, Kenya too should take a sectoral approach whether at a national or East African Community (EAC) level. A sub-regional approach for example for the petroleum-based transport sector within and around Nairobi Metropolitan area could even be feasible in this regard. This could provide additional air quality improvement and traffic regulation outcomes. Carbon markets for petroleum-based transportation provide a feasible strategy largely because Kenya is a net petroleum importer. It would also establish a helpful framework for carbon markets from the oil production which is expected to commence soon in the Turkana area (EBSU, 2018).

A long-term policy commitment is necessary:

Kenya's policy actors need to acknowledge that the establishment and proper functioning of carbon pricing and REDD+ policies typically take a long time. This long-term perspective has been reported elsewhere as a core part of the policy process not only regarding payment for ecosystems services, but also for policies on family planning and HIV/AIDS (Heinzen, 1997). For a long-term view, Kenya would need to develop policies and institutional structures designed to withstand unforeseen changes in political contexts, both national and international, which have often characterized global climate change policies. The RGGI initiative required two years to formulate, and even 15 years later it is still undergoing development. A regional multi-country approach may seem more complex to negotiate, but it could provide the institutional structures to support a long-term approach.

Carbon markets, green jobs and other co-benefits:

Experience demonstrates that carbon markets can also stimulate green economic growth more broadly, by stimulating new green jobs as well as co-benefits related to reduced air pollution, improved water and soil conservation. Experiences with RGGI and TIST above show that carbon markets can serve as catalysts for accelerated expansion of the green jobs sector especially in renewable energy, energy efficiency and carbon offset project development. To take full advantage of these co-benefits especially in the green jobs sector, Kenya would need to integrate green jobs curriculum into its higher education curriculum, as well as training artisans and skilled or specialized workers. These green jobs may expand employment opportunities in various sectors, such as solar PV, wind energy, sustainable bioenergy and energy efficiency, in the use of new process technologies such as artificial intelligence.

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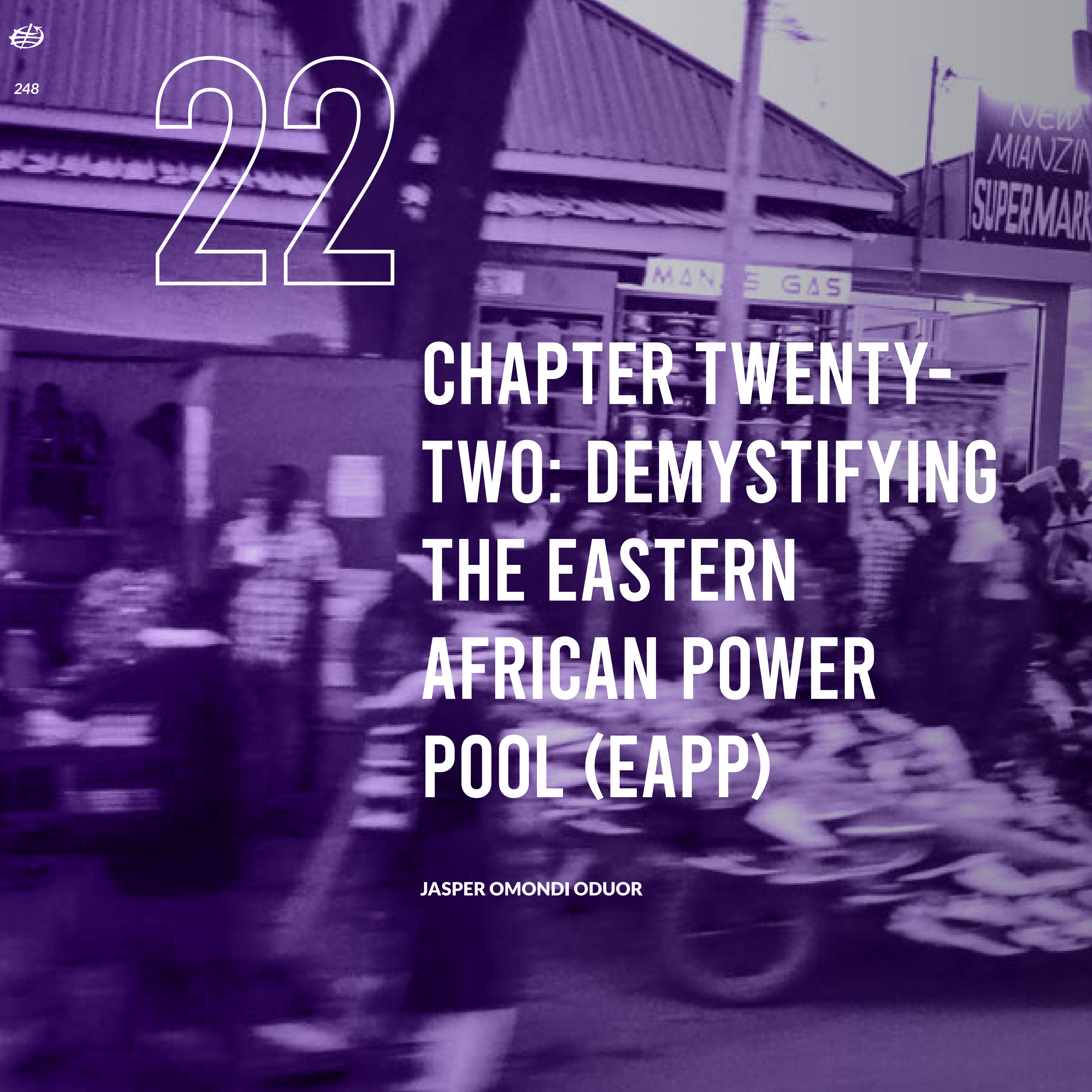
APPENDIX A: KEY FEATURES OF THE REGIONAL GREENHOUSE GAS INITIATIVE (RGGI)

FEATURE	DETAIL
Goals	• To create a cap-and-trade program aimed at stabilizing and reducing emissions in participating states, while remaining consistent with overall economic growth and the maintenance of a safe and reliable electric power supply system
Policies	• RGGI consists of three-year compliance periods, the first of which ran from 1 January, 2009 through 31 December, 2011. The MOU set the states' overall emissions budget at 188 million short tons of CO_2 (170 million tCO_2) for the first compliance period. For the second compliance period, which began in 2012, the annual emissions budget was adjusted down to 165 million short tons of CO_2 (150 million tCO_2) in order to account for New Jersey's withdrawal from the programme (EDF, 2015)
Institutional Structures	• Free allowances, auctioning, use of offsets (up to 3.3%), three year compliance period (EDF, 2015) • A cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont to cap and reduce power sector CO_2 emissions. • RGGI is composed of individual CO_2 Budget Trading Programs in each participating state. • Each state's CO_2 Budget Trading Programme limits emissions of CO_2 from electric power plants, issues CO_2 allowances and establishes participation in regional CO_2 allowance auctions. • A CO_2 allowance represents a limited authorization to emit one short ton of CO_2 from a regulated source, as issued by a participating state. Regulated power plants can use a CO_2 allowance issued by any participating state to demonstrate compliance in any state. They may acquire allowances by purchasing them at regional auctions, or through secondary markets. • RGGI CO_2 cap represents a regional budget for CO_2 emissions from the power sector this has ranged on a reducing scale from 188 million in 2009-2011 to 80 million allowances in 2019.
Key Activities	• Allowances are offered through quarterly, regional CO_2 allowance auctions. These auctions are sealed-bid, uniform price auctions, which are open to all qualified participants. They result in a single quarterly clearing price. • In addition to purchasing allowances at auction, entities are also able to trade allowances on secondary markets, via over-the-counter trades. • States are able to reinvest the proceeds from these CO_2 allowance auctions in consumer benefit programs to improve energy efficiency and accelerate the deployment of renewable energy technologies. • For tracking and compliance; RGGI CO_2 budget sources are required to possess CO_2 allowances equal to their CO_2 emissions over a three-year control period.

Table 14: Key features of regional emissions trading scheme, RGGI, in eastern USA. Sources: EDF, 2015; RGGI, 2020



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CHAPTER TWENTY-TWO: DEMYSTIFYING THE EASTERN AFRICAN POWER POOL (EAPP)

JASPER OMONDI ODUOR

EXECUTIVE SUMMARY

The Eastern Africa Power Pool (EAPP) was set up by regional initiatives to meet the power needs of the region, at least cost. This will be achieved by optimizing the development and operation of the region's own power resources in a good energy mix, and then linking these resources using interconnecting power transmission lines.

The EAPP has developed four frameworks to enable a viable setup and operation which rely on a regional master plan, regional coordination, interconnection standards, regional market rules and regional operational rules. The region consists of Burundi, Egypt, Eritrea, Ethiopia, Djibouti, DR Congo, Kenya, Libya, Somalia, South Sudan, Sudan, Tanzania, Uganda and Rwanda.

EAPP has developed a strategic roadmap to ensure the systematic development of the pool. Together with the Gap Analysis tool, all the countries and relevant institutions should be adequately prepared to bridge the identified gaps between present achievements and future goals.

To achieve this, the EAPP needs institutional strengthening and capacity building so that appropriately trained people can work in a strong institutional setting. The master plan has identified the generation and transmission projects that are necessary for interconnectivity for regional power trade. Many of these projects are under implementation and all the countries; the exceptions are Eritrea, South Sudan and Somalia, which are expected to be interconnected by 2021.

INTRODUCTION: THE LOGIC BEHIND THE EASTERN AFRICA POWER POOL - EAPP

The thinking behind the Eastern Africa Power Pool began in the early 2000s. Since then, considerable work has been done to make it a reality. What, however, was the logic behind establishing this very ambitious energy infrastructure?

What is a power pool and why is it needed?

The Eastern Africa region has long suffered from an inadequate, unreliable and costly electrical power supply.* This has a negative effect on economic growth in the region. The lack of reliable power limits the success of businesses and manufacturing. It also weakens health and education services, which use power for lighting, sanitation and equipment, even though better health and education improve the ability of East Africans to participate in a modern economy. The EAPP is not expected to replace biomass fuel used in many households, but will help to build a stronger economy by ensuring an adequate, reliable electricity supply.

* *Professionals in this field often refer to electricity as "power" and we will do the same. However, readers should remember that electrical power is not the same thing as energy. Power comes from a variety of primary energy sources (like oil, coal, geothermal, solar, wind and hydro) while electricity is the form in which that primary energy is used in society. Strictly speaking, energy is a broad category and is defined as the "capacity to do work." (Walking, for example, uses human energy for moving from place to place.) Electricity is what flows through lines and cables to make devices work. It is the 'carrier' that puts energy to use. While a primary energy source, like wood, has only a few direct uses (heat and cooking),electricity can be used for heating, cooking, lighting, charging and many other functions.*

PROJECTS	PROGRESS
Libya-Egypt (220kV)	***
Egypt-Sudan (220kV)	**
Tanzania Backbone	***
Ethiopia-Kenya	**
Kenya-Tanzania	**
Kenya-Uganda	**
Uganda-Rwanda	**
Burundi-Rwanda	**
Tanzania-Zambia	**

*** - *Completed* ** - *Ongoing* * - *Under preparation*

As noted by the New Partnership for Africa's Development (NEPAD) (Energy for Africa, 2019), the energy sector requires efficient regional integration to exploit the potential of Eastern Africa's existing primary energy resources, such as hydro power, geothermal, natural gas, solar and wind. One way to achieve that is to convert primary energy into electricity and establish power pools to share the electricity produced. Power pools are agreements between different power producers to share and trade the power they generate, often across national borders, using electrical transmission lines. In 2019, there were seven connected systems, as shown in Figure 63, creating seven power pools in Eastern Africa. These power pool agreements work to coordinate the development of energy resources and facilitate regional sharing of power.

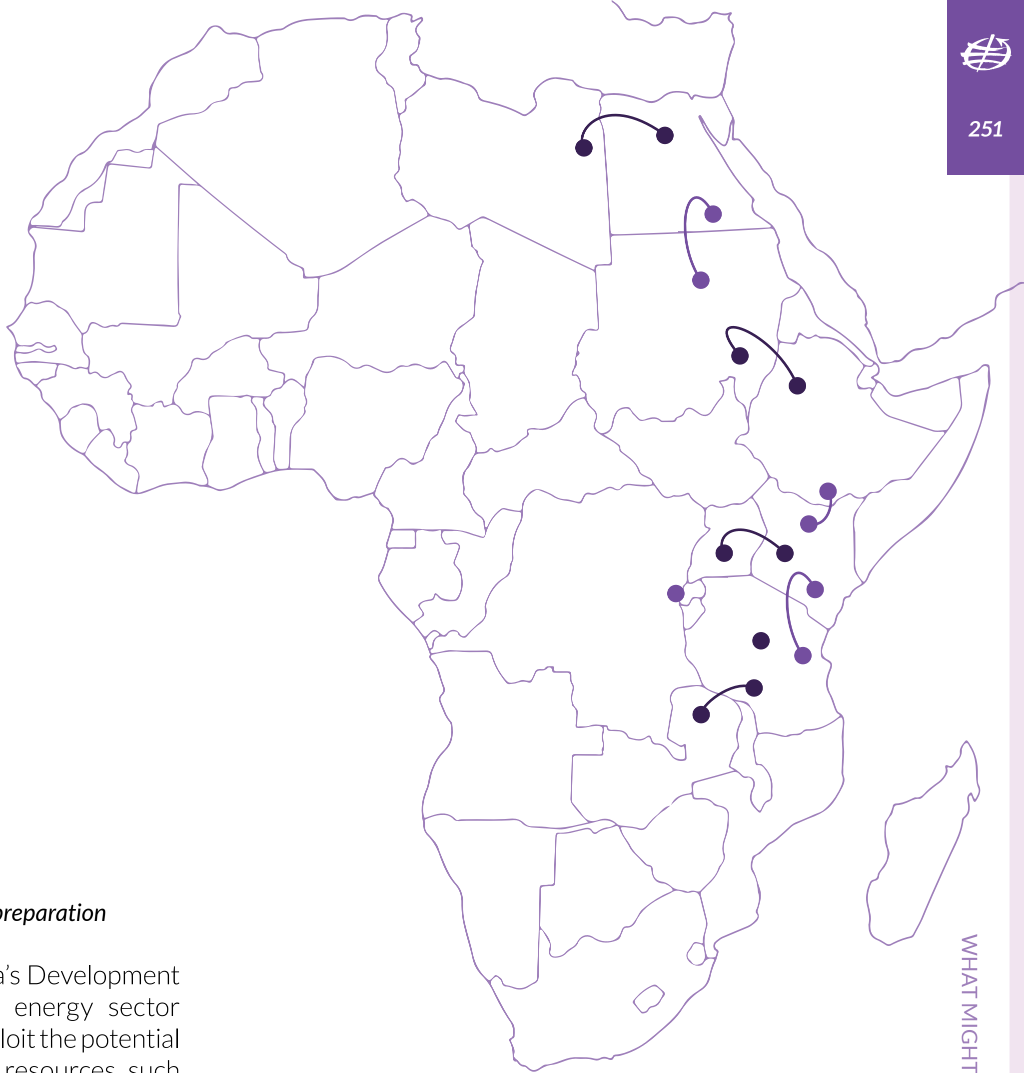

Figure 63: Status of interconnected power systems in Eastern Africa (Changullah, 2019).

Pre-requisites for power pools

There are three main pre-requisites for the successful establishment and operation of a power pool. First, there must be trust and confidence between member countries. Second, members need to set up agreed frameworks (policy, legal, regulatory and institutional) that all members respect. Third, there needs to be a ready energy market in which supply can satisfy demand at an affordable price to users.

Benefits of a power pool

There are several benefits to a power pool. When a number of power pools are linked in a larger system, the economies of scale allow members to reduce their own investment and operation costs in a national energy system. In a larger network, members from lower costs for power dispatch and the management of reserve power. Members also have greater access to clean, renewable, and sustainable power while enhanced cooperation improves supply reliability and security, making it easier to coordinate system expansion. Figure 64 shows the balance of benefits and costs under different systems for the EAPP (See Appendix B).

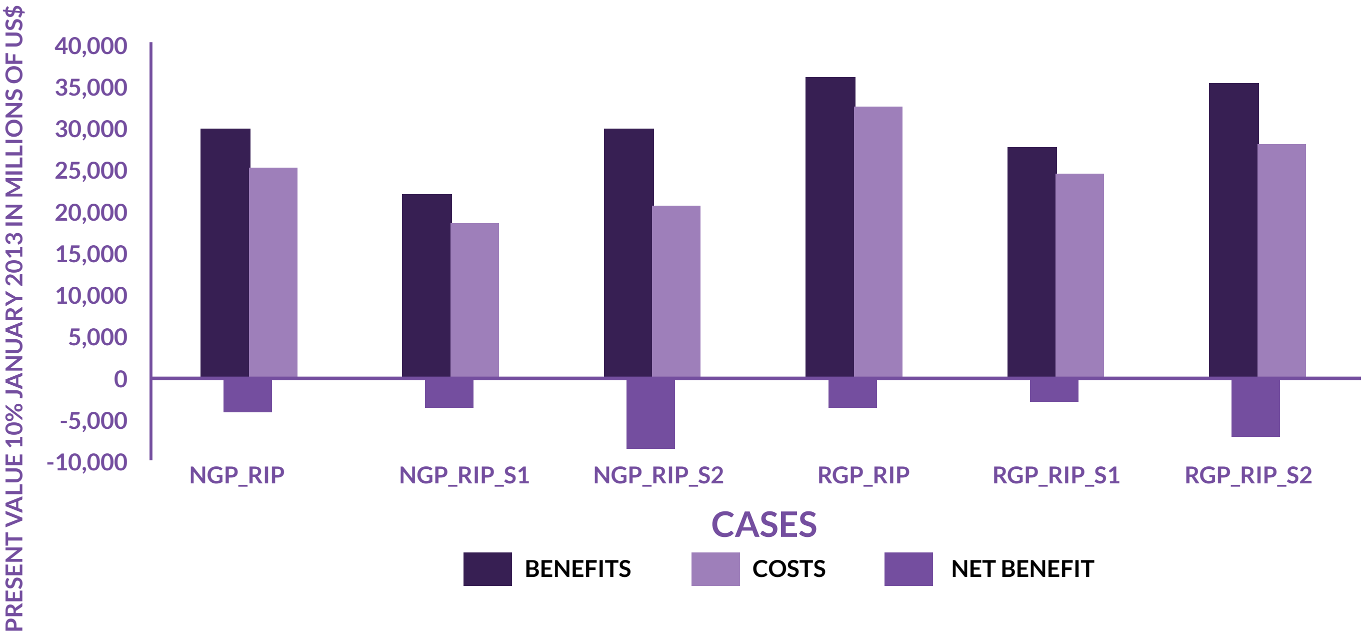

Figure 64: Benefit-cost analysis present values in Millions of US$ (EAPP, 2011).

Risks of a power pool

There are risks involved in joining a power pool, however. Partners may disagree over how the power pool should work and could suddenly withdraw. There are new overhead costs in the coordination and management of a more complex electricity system. Bigger networks also run the risk of bigger systemic failures; a small problem in one area could rapidly spread through the whole network if it has not been well-designed and maintained. Because large-scale power projects are capital-intensive, there is an additional risk that funds are mismanaged, requiring investment in an independent regulatory board of some kind. These risks, however are seen to be outweighed by the benefits of a power pool.

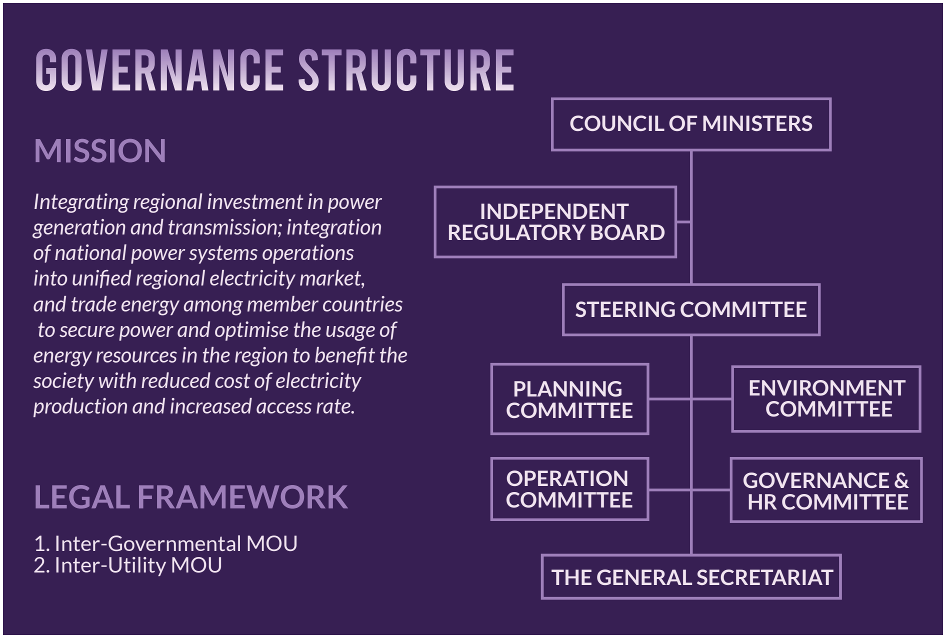

Figure 65: EAPP governance structure

Figure 66: EAPP organisational structure

HISTORY & GOALS OF THE EAPP

Founding agreements

The EAPP was conceived in May 2003 under the guidance of several power producing organisations in Africa: the Union of Producers, Transporters and Distributors of Electrical Power (UPDEA), now known as the Association of African Power Companies APUA-ASEA (ASEA is the French acronym); the African Energy Commission (AFREC), a subsidiary specialised organ of the African Union (AU) in charge of coordinating energy resources on the African continent; the United Nations Economic Commission for Africa (UNECA); and the Common Market for Eastern and Southern Africa (COMESA). In the beginning, the goal was to plan how to address, in the short and long term, the challenge of inadequate power in the region.

The EAPP was formally established with the signing of an Inter-Governmental Memorandum of Understanding (IGMOU) in Addis Ababa in February 2005 and in Cairo in May 2005. The original signatories were Burundi, Democratic Republic of Congo (DRC), Egypt, Ethiopia, Kenya, Rwanda and Sudan. In November 2006, the EAPP was adopted by COMESA at a summit meeting in Djibouti as a specialized institution to foster power system interconnectivity across the region. During a 2008 summit, a tripartite agreement was reached between the East African Community (EAC), Southern African Development Community (SADC), and COMESA to harmonize the relevant power master plans. The EAPP was tasked with handling this harmonisation.

Vision and goals

The enduring vision of the EAPP is to secure power supplies for member countries in Eastern Africa at low cost by optimising the development of energy resources in the region and easing residents' access to affordable power supplies.

To achieve this vision, the EAPP set itself an important goal: to develop a master plan to promote power exchange, including coordination of various initiatives in power production and transmission. Three other goals aim to:

1. optimize usage of existing and potential resources;
2. reduce regional electricity costs; and
3. facilitate regional development of electricity markets.

To make any of this happen, the EAPP seeks to create a conducive investment environment for regional power generation and transmission integration projects within the NEPAD framework which facilitates and coordinates continent-wide programmes and projects.

GOVERNANCE STRUCTURE

A project as complex as building an Eastern Africa Power Pool requires a strong governance structure, as shown in Figure 65, and an effective organisational structure, Figure 66. In addition, a clear understanding of members' rights, privileges and responsibilities was laid out in the two Memoranda of Understanding signed in 2005.* Operationally, the EAPP functions under four frameworks namely: Policy, Legal, Regulatory and Institutional.

The three Technical Sub-Committees deal with specific issues relating to the operation and development of the EAPP:

1. Sub-Committee on Planning shall be the organ responsible for the co-ordination of master plans and development programmes of member utilities;
2. Sub-Committee on Operation shall be responsible for the definition of the operating and maintenance rules of power plants and networks involved in the EAPP. Other specific tasks will be defined in the "Operation Agreement";
3. Sub-Committee on Environment shall be responsible for the environmental impact assessment and mitigation measures on the electrical installations within EAPP.

* *The governance structure and the responsibilities of the technical sub-committees is extracted from the Intergovernmental Memorandum of Understanding (IGMOU) and the Inter-utility Memorandum of Understanding (IUMOU) (EAPP, 2005).*

EAPP'S RECORD SO FAR

Activities to date

In the 15 years since the first agreements were signed, the EAPP has moved forward on a number of important fronts, with the support and approval of governments and development partners. These efforts have prepared the region for power interconnectivity and trade by strengthening institutions and building capacity, preparing master plans (EAPP 2011 and 2014), developing the Regional Power Trade Project (RPTP), and conducting the Comprehensive Basin Wide Study (CBWS).

Considerable progress has also been made on agreeing the operational and market rules, drafting strategic roadmaps to manage the development of necessary infrastructure, and setting interconnection standards and the grid code. The EAPP's database and communication infrastructure support these functions.. Finally, the EAPP has conducted gap analysis to identify what has been achieved and what still needs to be done in order to close the gap between them.

Financing

These achievements have been possible thanks to the funds raised by the EAPP. The New Partnership for Africa's Development Infrastructure Project Preparation facility (NEPAD-IPPF) managed by AfDB provided 1.7m US$ to finance the EAPP 2011 Power Master Plan Study and the preparation of the Grid Code. The African, Caribbean and Pacific and European Union (ACP-EU) facility offered 2.7m Euros to pay for the Technical Assistance and Capacity Building project. The Ministry of Foreign Affairs of Norway provided 2.2m US$ to finance the Regional Coordination Centre and Regional Regulation project.

UNDESA provided finances and arranged for Power Pool study tours and trainings for EAPP-PS personnel. The US Agency for International Development (USAID) provided 2.4m US$ in financing for the Powering Progress project which focussed on the establishment of the power transmission interconnection standards, development of the Gap Analysis Tool, and putting in place sample power purchase and power trade agreements.

Everything that has been done and achieved so far prepares the EAPP for enhanced regional power trade with greater interconnections by 2021.

Coordinating activities

With so many partners and interests involved, the EAPP has needed considerable coordination at three levels: within the EAPP itself; with other regional organisations; and with development partners.

- **Within the EAPP,** the coordination of activities is vital to ensure efficiency of the outputs and use of funds provided for projects. Good coordination also takes advantage of the benefits of synergy by harmonizing project timelines, identifying gaps and overlaps, providing a forum for African power pools, identifying risks and future needs, and allowing for timely execution of the strategic roadmap.
- **Regionally,** through its coordination with other regional organisations, the EAPP encourages harmonisation of national master plans with the EAPP Master Plan. To that end, the EAPP has signed MOUs and established working relationships with other power pools and regional organisations.
- **More widely, development partners** (such as the African Development Bank, World Bank, USAID, The United Nations Department of Economic and Social Affairs, Foreign Affairs of Norway) have pledged financial support for the development of EAPP. This financing is additional to EAPP members' contributions through annual subscriptions, which pay for running the EAPP-PS (Eastern Africa Power Pool Permanent Secretariat). The Secretariat is responsible for organising meetings for the Steering Committee and the Conference of Ministers, as well as for the technical sub-committee meetings.

All these activities, partnerships and projects have to be well coordinated to avoid duplication or overlooking any item identified within the strategic roadmap.

RESULTS OBTAINED

- **Governance:** Thanks to the work of the past 15 years, the policy, legal, regulatory and institutional frameworks are in place and a governance structure for the EAPP has been set up. The Permanent Secretariat has been established in Addis Ababa and key staff employed. Technical sub-committees have been set up successfully, and a number of plans and designs have been completed. The following are currently in place: a master plan for regional power development; a regional market development road map to 2025; and a regional power market design to initiate electricity market rules.
- **Institutional strength and capacity:** The necessary institutional setups are being put in place and training carried out in institutional strengthening and capacity building. The Gap Analysis Tool is also being used by member countries to assess their readiness. A number of rules and regulations have been put in place, including: operational rules; interconnection codes and standards; capacity building programs for member state utilities; gap analysis tools; and plans to bridge the gaps that have been identified.
- **Infrastructure:** There has also been progress in the development of the physical infrastructure, both for generation and transmission of power, but most of the infrastructure development is on-going. The last connections, between Ethiopia and Kenya, and between Kenya and Tanzania, are on-going. It is expected that all the countries shall be interconnected by 2021.

Photo by Lidia Daskalova from shutterstock.com

PLANNED ACTIVITIES

Future activities involve financing the EAPP, continued technical development and training, refinement of market rules and operations, as well as continued development of the infrastructure. These will be implemented with an approved road map, strategic plan, and 3-year action plan, progressing towards full power pool operations by 2021.

Finance: To finance the EAPP, a World Bank $10m grant from the IDA International Development Association (IDA) has been made available and is being managed by the EAPP Permanent Secretariat. In addition, a grant has been established through the Project Implementation Unit (PIU) for the International Development Association, as a World Bank (IDA) grant. In July 2018, the EAPP attended a Development Roundtable in Zanzibar to apprise development partners of EAPP's progress. There are hopes that continuing work to solicit financial assistance for EAPP activities will succeed following that effort. The Multi-Donor Trust Fund (MDTF) has also financed hiring technical advisors to support EAPP. Some of the funds have been received, e.g. from the World Bank, and capacity building is continuing.

Technical development and training: Technical development and training, financed in various ways, are very important. The World Bank and the Multi-Donor Trust Fund (MDTF) are providing a team of technical experts and engaging consultants for special assignments. Power Africa Initiative, financed by USAID, has provided technical support in operational and market preparatory activities in several ways, including the development of the EAPP Planning model. Other technical assistance from the Power Africa initiative includes implementing an interconnection code compliance programme involving Ethiopia, Kenya, Tanzania, Uganda and Rwanda (EKTUR). This measures compliance gaps and implements migratory (continually changing) measures. Power Africa also supports capacity building at the General Secretariat and Technical Committee levels in order to enhance effectiveness and efficiently run the power pool. A consulting firm has been engaged to assist EAPP in operational readiness. A project called Operation Excellence is working on the interconnection code (IC) compliance programme and a study of the operational readiness of an interconnection between EAPP and the Southern African Power Pool (SAPP). Finally, in order to assess the solar energy potential in the region, the Energy Sector Management Assistance Program (ESMAP) is funding a solar measurement campaign project in Tanzania, Uganda and Kenya. This project will collect accurate information on the potential for solar energy at selected sites.

Marketing: Marketing and trading electrical power between members of the EAPP is another major challenge and the focus of helpful donor support. The MDTF provides technical support to EAPP for operational and commercial readiness in regional power trade. Power market development is also in the plans, including market design, market rules, pilot trade, and a commercial readiness study of the impact of an interconnection between EAPP and the SAPP. Procurement of a commercial readiness consultant to help in setting up the regional market is also in progress. For these markets to work effectively, the Independent Regulatory Board (IRB) needs to be fully operationalized for effective regulation of the regional power trade. As part of the efforts to create the power pool market, long-term power purchase agreements (PPAs) have been signed between Ethiopia and Kenya as well as between Kenya and Rwanda. Ethiopia and Tanzania's PPA negotiations are on-going.

Infrastructure development: The necessary infrastructure is also continuing to grow with the construction of transmission lines between Ethiopia and Kenya, Kenya and Tanzania, Uganda and Rwanda, as well as transmission lines between Tanzania and Zambia, as shown in Figures 67 and 68.

THE REGIONAL INVESTMENT PLAN

- Priority Interconnectors and generation plants are identified
- Priority set on the basis of lead-time and cost
- Master Plan justifies all ongoing interconnection projects

a. Interconnection Projects, Justified for Implementation in 2012-2017

Connecting	Voltage (kV)	Capacity (MW)	Expected Date
Ethiopia-Kenya	500 DC	2000	2016
Tanzania-Kenya	400 AC	1520	2015
Ethiopia-Sudan	500 AC	2 * 1600	2016
Egypt-Sudan	600 DC	2000	2016
Rusumo HPP Transmission System	220 AC	-	2016

Figure 67: Key Transmission Projects, Source: EAPP 2011 and Oduor, J., 2011.

THE REGIONAL INVESTMENT PLAN

b. Identified Regional Generation Projects - NGP_RIP

Country	Plant Name	Type	Inst. Cap (MW)
Eastern DRC	Ruzizi III	Hydro	145
	Ruzizi IV	Hydro	287
Ethiopia	Mandaya	Hydro	2000
	Gibe II	Hydro	1870
	Border	Hydro	1200
	Gibe IV	Hydro	1468
	Karadobi	Hydro	1600
Rwanda	Kivu I	Methane	100
	Kivu II	Methane	200
Tanzania	Stieglers Gorge (I, II, III)	Hydro	1200
Uganda	Karuma	Hydro	700
	Ayago	Hydro	550
	Murchison Falls	Hydro	750

Figure 68: Key Generation Projects, Source EAPP 2011; Oduor, J., 2011.

CHALLENGES AND FAILURES

Despite the many achievements of the EAPP, a number of challenges remain.

Institutions & capacity

If the EAPP is to be ready to commence regional power trades by 2021, the EAPP needs to ensure that strong institutions and a well-trained staff are firmly in place.

Reliable trading system

The regional power trading system needs to be implemented in a timely way, after testing its reliability and its rules.

Equipment & technology

All the necessary equipment, such as hardware and software for power planning, power trade, power operations and their supporting databases, needs to be in place, tested and manned by competent staff.

Risk assessment & response

As with any organisation, the EAPP needs to be able to assess the risks and threats it might face and be prepared with mitigation measures.

CONCLUSIONS

Financing development

There is a major challenge facing the EAPP in raising the funds needed for the EAPP to be further developed. Power infrastructure projects are naturally capital-intensive and the COVID-19 pandemic has put additional pressure on all budgets. That makes it unusually difficult for governments and utilities to raise the necessary funds. This was already challenging because:

1. Electricity tariffs in eastern africa are very low, usually below cost recovery;
2. Access to power lines is limited so the number of customers, with their sales and revenue, is relatively small;
3. Governments face serious foreign currency pressures;
4. Governments have multiple priorities e.G. Health, education, agriculture, etc. Which compete with the eapp for support.

National cooperation vs competition

The EAPP is based on cooperation among neighbouring states. However, national and sovereign interest is usually placed above regional benefits. This results in delays or rejections of study reports leading to delays in implementation which mean the benefits of the EAPP are not seen. Without experience of the benefits of the power pool, there is no visible reason to continue supporting it.

There are clear benefits to having an Eastern Africa Power Pool. It reduces risks, lowers electricity costs to government and consumers, and helps to integrate the region economically. If Eastern Africa, including Kenya, are to develop as modern states using clean energy systems, the EAPP could well help to achieve that ambition. The EAPP has also made significant progress in the 15 years since the first agreements were signed. Many necessary institutions have been put into place, some of the infrastructure has been built, and there is a growing staff of well-trained people on board. EAPP is ready to start power marketing and power trading in line with the Strategic Roadmap.

EAPP will continue concentrating on grid power as this is the mode of electric power production and transportation that can be interconnected. It allows for efficient utilization of the region's varied power generation technologies and primary energy sources for the generation and transportation of electrical energy. This will be very beneficial for industrial development and enhanced commerce.

However, there are serious challenges facing the EAPP, from the availability of money for continued investment to the capacity of staff to manage a complex electricity trading system with its infrastructure and market rules. As a project designed to support development, the EAPP is largely invisible to most people. If it is not supported until it can function independently, it could become another white elephant of development's daydreamers. That would be very unfortunate and would waste everything that has been achieved so far.

POLICY RECOMMENDATIONS

For the EAPP to realise its full potential as a source of energy for Eastern Africa, the following policy recommendations should be considered:

1. Full commitment by regional players to implement the Master Plan and the strategic roadmap;
2. Harmonisation and implementation of regional transmission Interconnection Code and Standards is required to expand trade;
3. Progressing capacity building and institutional strengthening until commencement of regional power market;
4. Gap Analysis and closing the gaps in ability to trade in each country;
5. Full and timely establishment of the Coordination Centre (Regional Market Operations Centre);
6. Full establishment of an independent regulatory board (IRB).

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APPENDIX B

This table looks at different ways the EAPP might develop, as indicated under "cases." It considers the generation costs (investment plus operations/maintenance), then it adds the interconnection costs (transmission line costs) to know the total cost. The benefits are derived by comparing each scenario to the base case (NGP_IEC) which is defined as national generation expansion planning without regional coordination and the power pool. The bar chart in Figure 64 is derived from this table.

Alternative ways the Eastern African Power Pool might expand.

CASES	*NATURE OF CASE*
NGP_IEC	National generation expansion planning without regional coordination.
NGP_RIP	National generation planning and regional interconnector expansion planning.
NGP_RIP_S1	National generation planning and regional interconnector expansion planning. with limited imports capacity of Egypt.
NGP_RIP_S2	National generation planning and regional interconnector expansion planning from 2023 with double the interconnection costs but greater flow of power.
RGP_RIP	Coordinated regional generation expansion planning and regional interconnectors expansion planning.
RGP_RIP_S1	Coordinated regional generation expansion planning and regional interconnectors expansion planning from 2016.
RGP_RIP_S2	Coordinated regional generation expansion planning and regional interconnectors expansion planning with doubled cost for interconnections.

Table 15: Each case is a different way the Eastern African Power Pool might develop

Benefit vs costs of participating in Eastern African Power Pool, millions US dollars.

Cases	Generation Cost			Interconnector Cost	Total Cost	Benefit		
	Investment	O&M	Total	Cost	Cost	Gross[1]	Net[2]	Yearly[3]
NGP_IEC	107,318	247,666	354,984	0	354,984	0	0	0
NGP_RIP	107,318	218,006	325,325	4,465	329,790	29,659	25,194	969
NGP_RIP_S1	107,318	225,872	333,190	3,458	336,648	21,794	18,336	705
NGP_RIP_S2	107,318	217,998	325,316	8,812	334,128	29,668	20,856	802
RGP_RIP	100,980	217,758	318,738	3,795	322,533	36,246	32,451	1,248
RGP_RIP_S1	103,593	223,929	327,522	2,698	330,220	27,462	24,764	952
RGP_RIP_S2	101,267	218,382	319,649	7,311	326,960	35,335	28,024	1078

Table 16: Benefit-cost analysis of each case, using 2011 values in millions of US$. Source: EAPP, 2011.

[1] *Total generation cost of each scenario less scenario NGP_EIC*
[2] *Gross benefit less interconnection cost*
[3] *Net benefit divided by 26 years*

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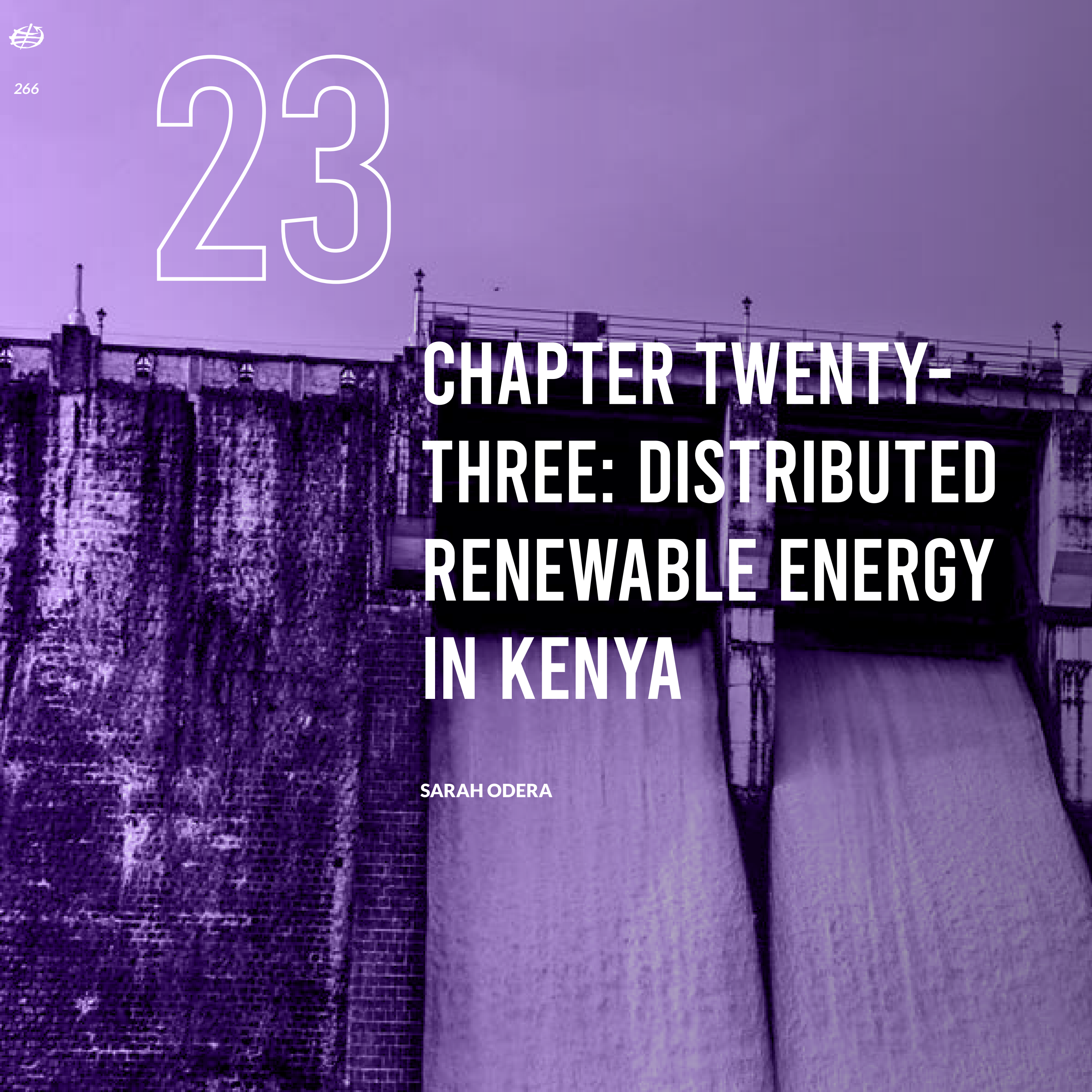
CHAPTER TWENTY-THREE: DISTRIBUTED RENEWABLE ENERGY IN KENYA



SARAH ODERA

EXECUTIVE SUMMARY

Distributed renewable energy technologies are used to provide energy close to the point of consumption. They use renewable resources like solar and wind as primary sources of energy and fall into two categories: 1) commercial industrial systems using large rooftop solar PV systems; and 2) off-grid solar home systems and mini-grids. Both types of systems have been growing. The commercial industrial sector has been driven by falling solar PV costs compared to high electricity costs from the grid, where the supply can be unreliable. This growth poses a threat to the national utility, Kenya Power, as the commercial market has been responsible for approximately 80% of their revenue. The utility company must develop new business models to ensure its survival.

The growth in solar home systems has come with the pay-as-you-go (PAYG) business model which increased pro-poor access to energy as the cost is lower than a grid connection. Mini-grids, on the other hand, while most appropriate for areas with lower population densities, have higher tariffs than grid electricity because of higher construction and operational costs. Subsidies directed at consumers or mini-grid developers will therefore be useful to provide connections to low-income consumers. For poorer populations, both off-grid and mini-grid systems, provide co-benefits including job creation, improved healthcare services and climate change mitigation. However, to be realised, these co-benefits require other inputs to be realised, such as access to finance and qualified.

INTRODUCTION

Distributed renewable energy (also known as DRE) systems can be defined as energy which is generated close to the point of consumption. They are typically smaller in capacity compared to their centralised counterparts. As the name implies, these systems use renewable primary sources of energy like solar and wind. They can be grid-connected or off-grid systems (Vezzoli et al., 2018). In this chapter, two categories of DREs will be described, starting with commercial-industrial systems which are used in the commercial sector for own consumption.

Companies investing in these systems are responding to the high cost of grid electricity compared to lower cost solar PV. Some of these systems are grid-tied such as Strathmore Universities 600kW solar PV system.

In the second category are mini-grids and solar home systems used for off-grid electrification. These systems have been lauded for their capacity for rural electrification. For example, the Energy Access Outlook states that DRE systems such as mini-grids and solar home systems are the most economical solution for providing electricity access to the 70% of the rural population in sub-Saharan Africa currently without electricity (IEA, 2017).

OBJECTIVE

The objective of this chapter is to discuss the impact of the DRE sector on livelihoods in Kenya. A literature review helps to understand the distributed renewable energy sector, including a review of policy and an overview of the DRE sector in Kenya, with special focus being given to their ability to provide pro-poor access. The impact of the sector is then discussed through a focus on the co-benefits of energy access, such as job creation, education, and health care, among others.

POLICY FRAMEWORK

The distributed renewable energy sector is managed by the Government of Kenya through the Ministry of Energy. In 2010, after a national referendum, governance in Kenya was devolved and 47 counties were created with county governments to undertake local administration. These counties, which were operationalised in 2013, now have the mandate of developing and implementing energy policies within their localities. The distributed renewable energy sector is governed through policies such as the Energy Act 2019, and Solar PV Regulations 2012. Other policies in draft include Draft Solar PV Regulations 2020 and draft Mini-grid Regulations 2020. The following is a review of these policies.

ENERGY ACT 2019

The Energy Act 2019 was ratified with the goal of aligning the energy sector with the 2010 amendments to Kenya's constitution and with emerging energy technology. It considered the role of County Governments in energy governance as stated in the Kenyan Constitution, giving them the authority to manage energy planning and distribution. Counties also have to develop and implement energy policies in their specific localities and have an opportunity to promote the utilisation of distributed renewable energy systems locally. Using their energy plans, they can attract investment into their counties. However, countries do not always have the required skills to execute their mandates, so the Ministry of Energy and its development partners are currently executing several projects towards capacity building of county government officers.

The Energy Act 2019 also allows for multiple distributers of electricity. This creates competition in the electricity market by allowing private companies to sell electricity directly to consumers. In the previous regime, private companies had to sell electricity to Kenya Power who would then sell it to consumers. This new dispensation has created a market for private companies that might have constructed DRE systems for own use only but may now consider selling excess power to nearby consumers.

The Energy Act 2019 also introduced net metering into the energy sector. Net metering allows consumers with solar systems to sell their excess electricity to the grid and purchase power from the grid when they need more. At the end of a pre-determined period, the consumers' electricity bill will show that the utility pays them when they generated more power than they consumed, or they pay the utility for the power they used, but did not generate themselves. An implementation framework for this new market paradigm needs to be created to allow this policy to function optimally.

The Energy Act also established the Rural Electrification and Renewable Energy Corporation (REREC), formerly the Rural Electrification Authority (REA). This corporation's mandate now includes spearheading rural electrification and promoting the use of renewable energy technologies in Kenya. This includes the establishment of capacity building energy centres within counties. Combining these mandates with a new relationship with county governments may promote the utilisation of renewable based off-grid technologies for electrification in Kenya (GoK, 2019).

KENYA NATIONAL ELECTRIFICATION STRATEGY

Published in 2018, this strategy has the goal of identifying least-cost electrification technologies for Kenya. The strategy compares grid expansion to decentralised solutions like solar home systems and mini-grids to see which increases electrification in Kenya's homes and businesses. This plan highlights the instrumental role of solar home systems and mini-grids. It shows that the most cost-effective way to electrify 35,000 households is to establish 121 mini-grids. Mini-grids are optimal solutions for areas with sparse population densities far from the national grid, making grid extension economically unviable.

The strategy also projected that 1.96 million connections will be undertaken using solar home systems. These systems are required to provide at least four hours of lighting per person and to keep a mobile phone well charged. This is classified as tier 1 electrification according to ESMAPS multi-tier framework which recognises that energy access happens in phases.

The results of this strategy have been used to inform electrification projects such as the Kenya Off-grid Solar Access Project (KOSAP) which seeks to introduce off-grid DRE systems in 14 under-served counties of Kenya.

County Governments will also receive capacity building to ensure that they can play their role in facilitating the implementation of these systems. Beyond construction of mini-grids, the sale of solar home systems is to be subsidised through a results-based monitoring fund. This project aims to increase productive energy use through digging of boreholes with solar water pumps to provide water for irrigation and domestic use (Ministry of Energy, no date and Ministry of Energy, 2018).

DRAFT MINI-GRID REGULATIONS

The draft mini-grid regulation provides a licensing and operation framework for mini-grids up producing up to 1MW of power in Kenya. It considers the role of county government, national government through the Ministry of Energy, local communities, and mini-grid developers in the establishment of mini-grids. The goal is to harmonise the roles of county governments and national government in licensing mini-grids. It further provides clarity in the sector by stipulating the procedure for licensing mini-grids in the country.

Notably, local communities are key actors in this regulation, with mini-grid developers having to undertake community engagement as part of their pre-feasibility study.

Evidence of engagement is to be submitted through meeting minutes signed by community members. These signed minutes, together with pictures of the minutes, are to be submitted to the Ministry of Energy as part of an expression of interest. This expression of interest is also to include a letter of no objection from the county government and evidence of alignment with the Kenya National Electrification Strategy and the Integrated National Energy Plan (an amalgamation of Kenya's sectorial energy plans including the county energy plans).

Upon approval of the expression of interest, mini-grid developers are to submit tariff approvals to the Ministry of Energy, including a feasibility study. If the electricity is to be sold directly to the community, developers must also submit a community contract signed by community representatives and the mini-grid developer, and a distribution license, a way leave agreement for the distribution network, as well as evidence of land acquisition, financing, and company registration.

At the time of writing in early 2021, these regulations were in a review stage. Once ratified, it is anticipated that they will create efficiency and bring clarity to the sector (EPRA, 2021a).


Photo by Jen Watson from shutterstock.com

SOLAR PV REGULATIONS 2012 AND DRAFT SOLAR PV REGULATIONS 2019

The solar PV regulations govern the sector by providing guidelines for quality and occupational standards to be used in the sector. The solar PV regulations of 2012 were introduced to tackle the problems of market spoilage due to poor quality products, and installations undertaken by technicians without the required skills. The new regulations require that all technicians, vendors, contractors, and manufacturers in the sector be registered by the Energy and Petroleum Regulatory Authority (EPRA), previously the Energy Regulatory Commission (ERC). Manufacturers, vendors, and contractors of solar PV products have to have licensed technicians as part of their team or staff. These regulations also stipulate the qualifications technicians must have, and require them to be examined by EPRA before licensing. Licenses must be renewed every year.

The regulations have been credited with creating a cadre of well-trained individuals capable of undertaking design and installation of solar PV systems. They motivated individuals to receive training from institutions that utilise the nationally accredited curriculum in order to qualify for a licence. Donors supported the growth of institutions that produced the training individuals required.

The draft solar PV regulations of 2020 are currently under review and have yet to be ratified. Their goal is to align the sector's regulatory framework to the Energy Act 2019 and align sector licensing to technology trends. As solar PV panels become larger with greater capacity, the licensing will need to reflect that (Energy Regulatory Commission, 2012; EPRA, 2021b).

TAX REGIME

The tax regime governing solar PV has largely been unstable. Starting in 2014, solar PV products benefited from zero rating on import duty and VAT (Gogla, 2021). However, in 2020, VAT was charged on off-grid solar PV products, before being exempted in 2021.

The instability of VAT in the solar PV sector has a long history. In 1986, VAT amounting to 45% was removed. This taxation was restored in the 1990s, but in 2002 it was removed again. In 2013, VAT was returned, but this time at a rate of 16% (Byrne and Mbeva, 2017). This instability makes it hard for businesses to plan.

THE DRE SECTOR IN KENYA

Growth of the DRE sector has primarily been driven by the reduction in price of solar PV observed in the last decade (Lakshmi and Ellen, 2021). In Kenya, this growth was initiated by donors as early as the 1980s when they funded solar PV projects for lighting and institutional use in hospitals and schools. This created local value chains and proved that the technology was useful (Rapid Transition Alliance, 2018).

Today, DRE technologies have increased electricity access, particularly in areas underserved by the national grid whose limitations are shown in the map of the transmission and distribution network in Kenya.

As Figure 68 shows, the grid is not evenly distributed throughout the country, just as Kenya's population is unevenly distributed, making DRE technologies cost optimal for certain areas. Kenya's national electrification strategy therefore identifies mini-grids and solar home systems as the most cost-optimal solutions for electrifying underserved areas with sparse populations.

Because the national electricity supply is considered unreliable and expensive, even in urban areas, both domestic and commercial urban consumers also utilise distributed systems. The following discussion reviews the status of DRE systems in Kenya and the technologies being used. Although decentralised systems can be fossil fuel based, using for example diesel generators, renewable based systems, particularly solar PV, are on rise as costs come down.

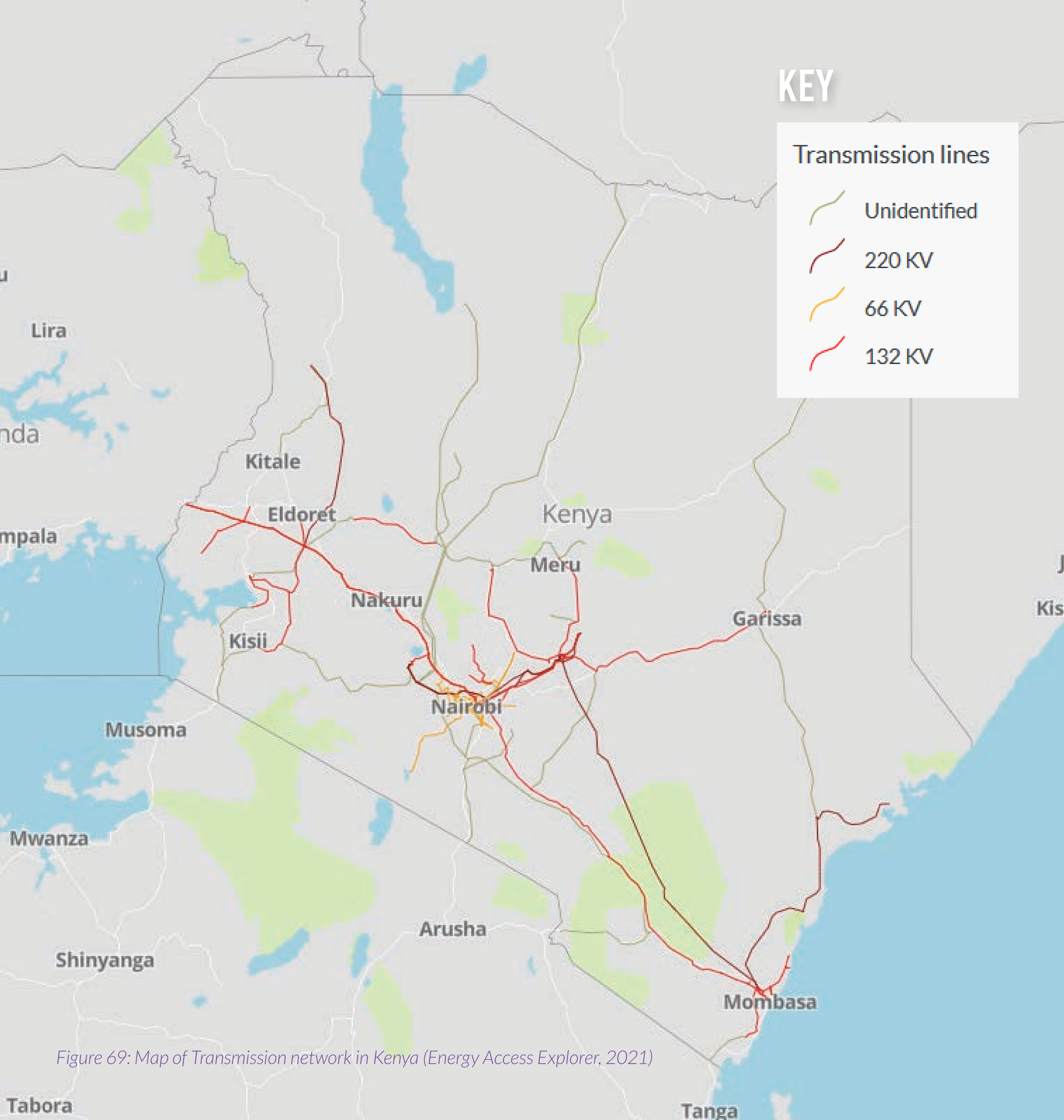


Figure 69: Map of Transmission network in Kenya (Energy Access Explorer, 2021)

Solar lanterns and solar home systems

Solar lanterns are single lighting points used for illumination. Solar home systems on the other hand are larger and consist of a solar panel, and a combination of bulbs, radio, and mobile charger (Stojanovski, Thurber and Wolak, 2016). They sometimes can include television sets and refrigerators. Solar home systems in particular have been identified as electrification solutions for areas with low population density, which would make utilisation of a grid or mini-grid commercially unviable. They are also used by consumers that are grid-connected as back-up systems.

The growth of this market in Kenya has been enabled by the implementation of the pay-as-you-go (PAYG) business model. This credit-based model utilises remote sensing technology and mobile money referred to locally as MPESA. End users give a down payment to distributers, and then pay the rest at a pre-agreed frequency using mobile money. The distributers can switch off the technology using remote sensing technologies if the consumer defaults on their payments (Sanyal et al., 2016).

Kenya is currently the largest market for solar home systems in the world. It was estimated that there were 10 million Kenyans using solar home systems in 2018, compared to less than 1 million in 2009. However, the market is currently saturated, so distributers are moving into untapped geographies such as the northern part of Kenya which has historically been marginalised. Expansion into this market, which also contains humanitarian areas, will require establishment of distribution lines and creation of local value chains, including capabilities for operation and maintenance (Wagner et al., 2021).

Solar lanterns and solar home systems have also been identified as electrification solutions that are 'pro-poor.' A study by Acumen indicates that the average cost of a basic solar home system is $120, much more expensive than a simple solar lantern. End users utilising the PAYG business model typically must pay a down payment of up to one-third of the total purchase price.

This price is much lower than a grid connection, as rural consumers in some regions cannot afford a grid connection even after subsidies reduced the cost to $150. For people living below the poverty line, both systems are too expensive, but they can purchase solar lanterns enabling a transition from kerosene. Seventy percent of households that bought solar lanterns used kerosene lamps prior to purchase. Households living below the poverty line made up 36% of the customer base of five solar companies in Kenya (Acumen, 2017; Lee, Miguel and Wolfram, 2020).

The PAYG business model is not without its challenges as some consumers are unable to keep up with the payments and end up having their 'lights' switched off, causing a return to kerosene. Data tracking default rates on payments is scarce. Some studies also indicate that some consumers do not understand the credit terms upon purchase which causes disgruntlement upon payment. They may end up abandoning the system all together (CGAP, no date).

Figure 70: Picture of a solar home systems kit (Collings, 2016).

Mini-grids

Mini-grids are defined as small scale electricity generating and distribution technologies that supply a localised group of consumers. They can vary in size connecting a single building, villages, group of villages or an island (Bhattacharyya, 2018) practical application and policy interventions required to support mini-grids. Through a review of available literature, this paper explores whether mini-grids can be a solution for the base of the pyramid (BoP). The Kenyan Government through the Rural Electrification and Renewable Energy Corporation (REREC) owns the largest share of mini-grids in the country, but mini-grids can also be owned by the private sector or communities. Ownership may also involve hybrid combinations of owners.

These mini-grids have been used to electrify areas like the sparsely populated north of Kenya, but have higher costs than those charged by the national grid elsewhere. However, where the mini-grids are owned by REREC and operated and maintained by Kenya Power, customers are charged the same national grid tariff, thanks to rural electrification levies imposed on national grid consumers. These levies subsidize the operational costs of the mini-grids. Mini-grids owned by REREC have predominantly been diesel powered, although a project is currently being implemented to hybridise them with solar PV to reduce operational costs (New Climate Institute, 2017).

Private sector owned mini-grids have witnessed recent growth due to the favourable policy environment created by the Energy Act of 2019. These mini-grids are typically solar PV systems with storage, as the costs of solar technology are lower than diesel. With the ratification of the mini-grid regulations, growth will continue as mini-grid developers are better able to obtain financing (USAID, 2019).

These private mini-grids however must charge higher tariffs than the national grid to survive. Mini-grids have tariffs of up to KES 80 per unit of electricity (kWh) while the grid costs rate between KES 15 and 20 per unit. These costs can make electricity inaccessible for poor people. Evidence indicates that recent grid based connections in rural areas are consuming less electricity because of the cost. Increasing the tariff for these consumers would completely inhibit consumption (Fobi et al., 2018). Mini-grid developers therefore must obtain grants to provide services to these consumers. Projects such as KOSAP which provide financing to mini-grid operators will be instrumental in growing the number of mini-grids nationally (ESMAP, 2017).

Figure 71: Picture of solar lantern (D.light, no date).

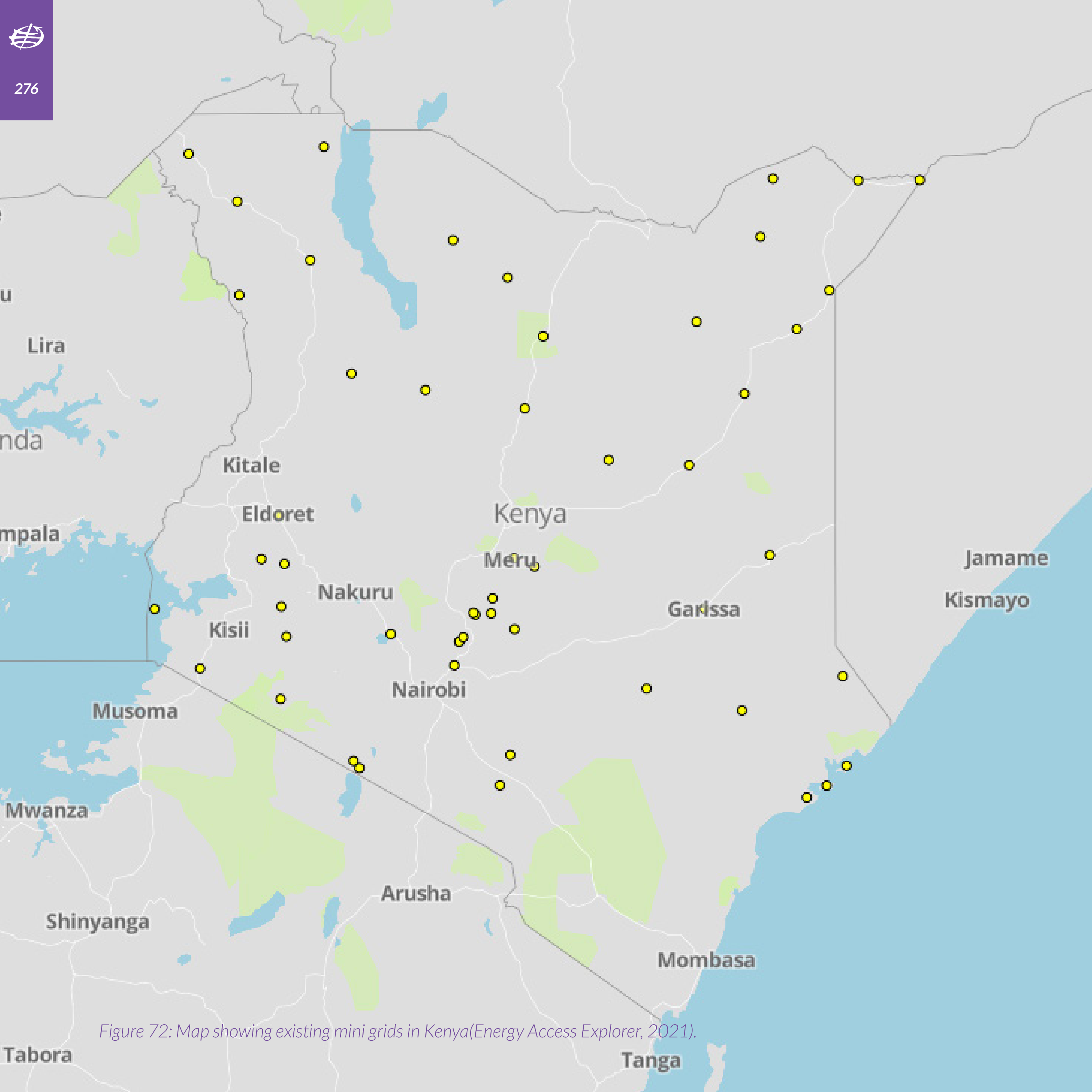


Figure 72: Map showing existing mini grids in Kenya(Energy Access Explorer, 2021).

Commercial-Industrial (C&I) Systems

This segment consists of companies and institutions within the private sector that utilise distributed energy, typically rooftop solar. They include malls such as Garden City in Nairobi, institutions like the International Centre of Insect Physiology and Ecology, ICIPE, and Strathmore University, both in Nairobi, and flower farms. The majority of these systems are connected to the grid as the companies' objectives are to displace electricity consumed from the grid during the day. Their motivation is to obtain reliable electricity supplies or to reduce expenditure on electricity consumption. Some of these entities have signed power purchase agreements, and thus sell electricity to the grid (Lakshmi and Ellen, 2021).

It is currently estimated that C&I systems stand at 40MW in Kenya. The growth of this sector has also created a local industry around engineering, procurement, and construction (EPC) of solar PV systems. It is estimated that 50% of these EPC companies operating in Kenya are Kenyan owned (Lakshmi and Ellen, 2021).

Even though most connections in Kenya are domestic, the commercial industrial sector consumes most of Kenya's electricity and is responsible for approximately 80% of Kenya Power's revenue. The growth of self-generation through solar PV currently being witnessed is a threat to the already cash strapped utility (Lakshmi and Ellen, 2021). The ratification of the Energy Act 2019 has further improved the policy environment for distributed generation allowing this market segment to sell directly to other consumers, essentially becoming retailers and distributers of electricity. Kenya Power may need to adapt to the new competitive environment to survive. Media companies have reported that Kenya Power wants to join the market of solar PV installation in both domestic commercial/industrial settings to increase its revenues (Business Daily, 2021).

Photo by Sebastian Noethlichs from shutterstock.com

CO-BENEFITS OF DRE SYSTEMS

The phrase "co-benefits" as used in this article refers to the positive impacts associated with the utilisation of distributed renewable energy systems. They include the benefits of climate change mitigation, improved livelihoods through job creation, improved healthcare services, and improved education.

Jobs

Distributed renewable energy systems have been lauded for their potential to create jobs. A study undertaken in 2019 by Strathmore University and Power for All indicated the DRE sector in Kenya provided an estimated 10,000 formal jobs, 15,000 informal jobs and 65,000 productive use jobs during the calendar year 2017-18. Formal jobs are defined by contractual relationships between the companies and the employee, while informal jobs do not have contractual relationships. Seventy percent of these jobs originated from solar home system companies. In addition, jobs created by mini-grids are set to rise because of the policy support and financing instruments being used to create an enabling environment for the sector. It is currently estimated that for every 1MW of mini-grids constructed 800 jobs are created (New Climate Institute, 2017). It is worth noting that Kenya Power, the national utility, employed approximately 11,000 people during the study period (Shirley et al., 2019).

Photo by Lidia Daskalova from shutterstock.com

Healthcare

Improved energy access increases the ability of hospitals and clinics to provide better healthcare. They can function at all hours, utilising equipment to provide critical care for patients, and storing medicine under refrigeration. The need for energy access in hospitals had been highlighted during the Covid-19 pandemic, as available vaccines need to be stored at low temperatures. A study undertaken by the World Resources Institute indicated that a group of clinics which received financing to purchase back-up solar PV systems was equipped with reliable power supplies and able to purchase more equipment and serve more patients. Anecdotal evidence indicates that the number of women who received maternal care from these clinics increased by between 10% to 50%.

Energy access also improves wellbeing. DRE's have enabled the transition from kerosene lighting to electricity. Emissions from kerosene are responsible for indoor air emissions which contribute to respiratory illness. Roughly 67,000 people die from illnesses associated with indoor air pollution annually in Kenya.It is worth noting that for the co-benefits of energy access to be realised, other inputs are often required. For example, better healthcare will require qualified staff and medical inputs. These institutions will often need financing to purchase these systems. Education is an important component for jobs. Some companies working in the DRE sectors report that they struggle to recruit managers in the sector because of a lack of qualified talent in the country. Because energy is service interlinked to other sectors of the economy and society, policies need to include non-energy inputs to provide holistic development (Chen et al., 2020).

Climate change mitigation

Distributed renewable energy systems aid in climate change mitigation as follows. First, they do not rely on the process of fossil fuel or biomass combustion to generate electricity. As such, they do not emit any carbon dioxide or other gases responsible for global warming during electricity generation. Biomass may be a renewable fuel if sustainably grown, and can generate energy through combustion. Currently, because the trees that provide biomass will absorb CO_2 in their lifetimes, biomass is referred to as a net zero emitter. However, some caution is needed, as the biomass needs to regenerate and absorb CO_2 at a similar rate to which it is burned, emitting CO_2.

RECOMMENDATIONS: THE DRE SECTOR FOR PRO POOR ENERGY ACCESS

Better distribution

Studies indicate that even people living below the poverty line can access solar lanterns and transition away from kerosene. Although at a very small scale, these micro-systems are vital for pro-poor access to electricity, so increasing their distribution at affordable prices is important.

Continue subsidies for rural electrification

Distributed renewable energy systems can also bring electricity to low population areas the national grid can't reach, often marginalised regions with high poverty rates. However, while mini-grids are optimal for use in such areas, their costs and tariffs are higher than low-income consumers can afford. In such cases subsidies, either to the consumers directly or through financing for mini-grid developers, could make electricity access more affordable for marginalised communities.

Continue policy support

Overall, the recommendation is to continue supporting the introduction of distributed renewable energy systems and the companies that supply them. In addition to providing electricity access, DRE systems also offer co-benefits, including improved delivery of health care services, job creation and climate change mitigation. In addition, their operational costs are lower than fossil fuel alternatives, such as diesel generators and kerosene lamps, which they can replace.

Educate consumers and monitor overall costs

The credit-based business model termed pay-as-you-go has also increased access to electricity through solar home systems. It has proven useful for both domestic and business consumers who want to reduce their electricity costs and/or have a more reliable supply. However, challenges with this business model include the inability of consumers to complete payments due to financial stress and poor consumer education, leaving consumers unsatisfied with the payment mechanisms. Companies should therefore endeavour to better educate their consumers before they purchase the products, and undertake consistent follow ups to ensure their consumers understand the product and the payment mechanism. Growth will continue so long as there is high-cost grid electricity and a policy framework which increases the number of companies capable of conducting technical DRE work.

Prepare for disruption to the national utility, Kenya Power

The commercial-industrial sector utilise DRE systems, particularly solar PV, for their own consumption, with some companies selling excess power to the grid. This sector has witnessed unprecedented growth in the last decade, driven by falling technology prices, rising costs of grid power and/or a need for a reliable power supply. This sector's growth is proving to be disruptive because it is taking demand away from the national utility, affecting their cash flow as growth in demand slows down. Kenya Power needs to prepare for this disruption both as a challenge and an opportunity, as a growth in commercial DRE can reduce transmission and distribution losses experienced in the sector, and reduce the need to construct large power plants for electricity generation.

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Passy Amayo Ogolla is currently serving as a Program Manager leading the implementation of the Sustainable Energy Futures for Eastern Africa Programme at the Society for International Development (SID). The publication, Energy for Whom? Scenarios for Eastern Africa stands as one of the landmarks of the programme; and the Africa Network Weaver for the Next Generation Foresight Practice at the School of International Futures (SOIF). She is a nature lover and eco-activist working with various local and international youth networks in reimagining and shaping a desirable future for next generations. She is the Regional Focal Point for East and Southern Africa at the SDG 7 Youth Constituency of the United Nations Major Group for Children and Youth (UNMGCY), the Policy Advocacy Lead at the Kenya Environmental Action Network (KEAN), and a member of YOUNGO, at its representative at the UNFCCC TEC Taskforce on Collaboration and Stakeholder engagement. Passy uses her writing to share her perspective on themes related to environmental sustainability including sustainable energy, climate action, impact of COVID19 on youth while also actively participating in local community actions in order to spur and influence behavioural and policy change for a sustainable future for all. She is recognized by the Nation Media Group as one of the 2021 top 30 under 30 women inspiring Kenyans and shaping the future of the country.

BARBARA HEINZEN

Barbara Heinzen is a long-term strategist and scenario planner with a successful 35-year practice working with companies & civil society, usually in non-Western countries in Africa, Asia and Latin America. She has been working on energy issues since the mid-1980s and with SID in East Africa since the late 1990s.

CHARLES WANGUHU

Charles is the Platform Coordinator at Kenya Civil Society Platform, he is passionate about Governance and Human Rights with broad experience in Oil and Gas and management of natural resources. He has previously served as Board Member Africa Centre for Open Governance, as well as Governing Board Member for Natural Resource Governance Institute

PROF. IZAEL DA SILVA

Professor Da Silva is a renewable energy specialist with over 20 years of experience in research and academic leadership. Currently, he is a Professor and the Deputy Vice-Chancellor for Research and Innovation at Strathmore University.

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A qualified engineer, he is a member of several engineering societies both within and outside Africa. He is also an Accredited Energy Auditor with Kenya's Energy and Petroleum Regulatory Authority (EPRA), and a Certified Energy Manager with the Association of Energy Engineers (AEE), based in Atlanta, Georgia.

DAVID MAINA NJUGI

Mr. David Njugi, is the CEO of Clean Cooking Association of Kenya (CCAK).

He is a mechanical engineer by profession with considerable experience in project management, renewable energy technologies (solar/biogas/small hydro), green growth economy, business and technical advisory experience to SMEs.

ENERGY FOR WHAT?

CONTEMPORARY ENERGY ISSUES & DILEMMAS IN KENYA

For decades, even centuries, countries around the world have transformed themselves from agricultural to industrial societies with the help of investments in fossil fuels, hydropower and large-scale complex energy technologies. However, as societies in Eastern Africa prepare to join their ranks, global conditions have changed economically, socially and especially environmentally. Since the end of World War II in the mid-1940s, the growth of human societies and consumption has accelerated to the point where we are now hitting critical planetary limits, including the risk of catastrophic climate change. These limits pose multiple dilemmas for leaders around the world, with an unusually difficult challenge for East Africans who can no longer pursue a path of 'development as usual', especially in energy. In this situation, what energy choices now exist to modernize the economy and improve peoples' lives? How will important energy choices be made? Kenya's Compendium of Energy explores the details of today's energy challenges y, using statistical graphs, diagrams and photographs as illustrations. This Compendium is organized in six parts and is a follow up publication to SID's 'Energy for Whom? - Scenarios for Eastern Africa' which explored possible energy futures for Eastern Africa through to 2050.

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