ENERGY POLICY IN KENYA: BARRIERS TO ELECTRIFICATION AND POLICY SOLUTIONS FOR MORE EQUITABLE AND SUSTAINABLE GRID DEVELOPMENT

An Honors Thesis Presented

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ABSTRACT

While Kenya has become a top five world generator of renewable energy, the country's goal of universal electrification has not yet been realized. In line with UN sustainable development goal 7, access to affordable, reliable, sustainable and modern energy for all has been increasingly prioritized in the landscape of global development. Public policy and associated policy mechanisms are now regarded as the most effective means of achieving this goal. The two literature reviews of this thesis identify the most pressing barriers to electrification in less developed economies, as well as potential policy solutions. This structure was then applied directly to Kenya, allowing an improved understanding of the unique barriers to electrification and guiding policy mechanisms there. Seven of the most pressing barriers were outlined specifically as they exist in both the global context and Kenya. National policies guiding the Kenya electricity sector were then studied to understand government response to these barriers. Through this project, policy mechanisms used to bolster renewable energy generation in Kenya are better understood. This holds promise for such policy mechanisms to be replicated and improved upon in proliferating renewable energy elsewhere. Additionally, the policies guiding Kenya's electricity sector are characterized by their shortcomings in achieving universal access to electricity. This project identifies policy shortcomings and offers potential solutions in the Kenyan electricity sector. A newly informed perspective of this issue in the Kenyan context offers insight well beyond the countries of sub-Saharan Africa, to all nations currently struggling to achieve sustainable electricity access for all.

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1. INTRODUCTION

Equality has become a driving motivation within the landscape of global development, namely as it pertains to such concepts as race and gender. In this thesis, equality has been studied specifically as it applies to electricity access in the republic of Kenya. The positive association between electricity access and socioeconomic status has been well documented in the literature [10]. By this strong positive correlation, it is reasoned that individuals without connection to electricity suffer in their upward economic mobility. In developing economies around the globe this discrepancy is cited to cause significant loss of opportunity and status for those people without electricity access [27]. By evaluating the most pressing barriers to electrification in Kenya, this thesis seeks to better understand the limiting factors in providing equal and sustainable electricity access to all Kenyans.

Having become a top five world leader in the development of renewable energy, Kenya has seen unprecedented growth in its electricity sector through recent history [10]. Since the 1970's Kenya has worked to rapidly develop its energy sector, now bringing power to 75% of Kenyans, up from 2.3% in 1994 [29]. This progress has not only resulted in a wider accessibility to electricity, but also in an elevated standard of living for those Kenyans with connection. Additionally, investments in generation based on overzealous demand projections have resulted in a demand constraint, meaning that Kenya's capacity to generate electricity currently exceeds demand [5]. Despite this momentum, the benefits associated with electrification are still out of reach for many of the nation's poorest and most vulnerable citizens. Under this pretext Kenya has now found itself in the midst of an electricity equality crisis, disproportionately affecting the rural and inner urban poor [2,9]. In order to better understand the challenges in providing an equitable distribution of electricity services, this project seeks to understand those issues which have prevented Kenya from achieving its goal of universal electrification. By studying these issues in tandem with government policies which attempt to address them, this project aims to better understand recent progress and ultimately identify which challenges have yet been most difficult to overcome.

After identifying the shortcomings of Kenyan government policies in responding to these issues, this project will advocate for policy mechanisms that have been proven successful in addressing such challenges within other developing economies. In the midst of a global clamor to guarantee universal electricity access, this research offers a more progressed understanding of Kenya's dynamic electricity sector as well as its many difficulties.

In addition to a better understanding of the unique challenges faced within the Kenyan electricity sector, this project also seeks to describe potential policy mechanisms for equitable electricity access going forward. The evolving challenges of electricity equality and their respective solutions in Kenya offer insight well beyond its formal borders. As most utilities in sub-Saharan Africa struggle to meet operation costs with current revenue [11], a better understanding of Kenya's electricity sector and policy strategies has potential to elicit stronger regional collaboration and development going forward. This will be extremely important if Kenya hopes to fully embrace its role as an emerging leader in sustainable development and economic growth in East Africa. Facing high rates of both population growth and urbanization, Kenya has also grappled with many questions of sustainability within its continued development [9]. In response to these growth conditions Kenya has dramatically increased electricity production from renewable sources since 2013, now contributing more than 80% of the nation's generation capacity [31]. The unique combination of these development factors now makes

Kenya an extremely valuable case study for policy makers and sustainable development projects throughout developing economies. As technology progresses and ubiquitous connection becomes increasingly attainable, the case study of Kenya will provide valuable insight for energy development projects around the globe. The framework of this thesis provides a clear outline of the major challenges faced in providing electricity equality in the global context and in the scope of Kenya. From each of those challenges and their respective remedies there is much to be learned from the perspective of a policymaker. In studying the success as well as failure of the Kenyan government in combating these challenges through policy mechanisms, future development projects may be able to better adapt to those challenges and streamline solutions for electricity equality.

2. BACKGROUND

Kenya's electricity sector is dominated by three parastatal companies, the Kenya Electricity Generating Company (KenGen), the Kenya Electricity Transmission Company (KETRACO), and the Kenya Power and Lighting Company (KPLC). KenGen is based in the generation of electric power and is responsible for producing about 80% of all electricity in Kenya [33]. The remainder of Kenya's electricity is sourced from privately owned, independent power producers (IPP's) [32]. Following generation, KETRACO serves as the transmission system operator on the Kenyan grid, responsible for substations and high voltage lines of 132kV or more [34]. Amongst the three giants of Kenya's electricity sector, KPLC is the entity responsible for electricity distribution on the central grid [5]. As the primary provider of electricity service to Kenyans, KPLC serves as the direct link between grid customers and their electricity [2].

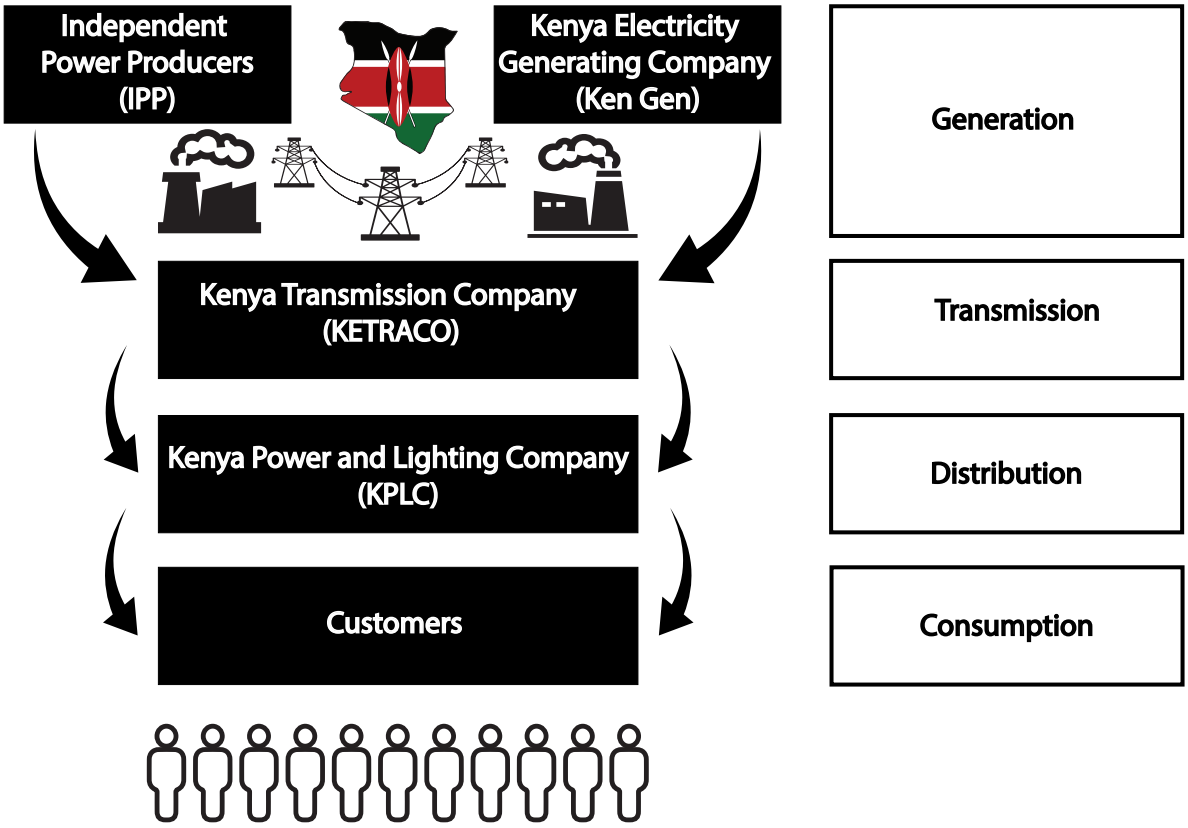

Figure 1. Flowchart of grid-based electricity provision in Kenya

Following a recent corruption scandal and the subsequent imprisonment of KPLC officials, confidence in the grid and its management has been significantly harmed [15]. This corruption in addition to longstanding disorganization and unclear political priorities have been exacerbated through the COVID-19 pandemic [25]. In light of these evolving challenges, Kenya has yet been unable to successfully address electricity inequality through policy mechanisms.

The primary challenges associated with achieving equitable and sustainable electrification in Kenya within this project are conceptualized from the prospective of the utility provider. In the scope of Kenya this includes the national government, as well as the three major parastatal companies involved in the provision of electricity.

3. LITERATURE REVIEW

3.1 - Barriers to electrification and sustainable electricity provision in developing economies

The seven barriers on which this project is focused were chosen following a review of existing literature. These barriers and the research to follow were driven by the primary research question as stated below.

What are the most pressing barriers to electrification and the sustained provision of quality electricity services in developing economies?

The question stated above can be interpretated from the perspective of many different actors and stakeholders within the electricity sectors of developing economies. For the purposes of this project, this question will be addressed from the perspective of those agencies involved in providing electricity services. These agencies vary in their public or private ownership, yet all have struggled in achieving sustainable and equitable electricity access in their home countries. Each of the challenges described through this thesis are direct limitations on the ability of such agencies to provide for electrification and the sustained provision of quality electricity services. The varied structure of these challenges reflects the multi-faceted and complex nature of our worldwide struggle for improved electricity services. This review of existing literature on the challenges to electricity equality addresses the global implications of each challenge before addressing implications specific to Kenya. Specific implication of these barriers in Kenya have been included in the results section.

Financial accessibility

Previous research has identified financial accessibility as a universal barrier to electrification and electricity equality, appearing in countries of varied economic development [38][42]. However, the challenges associated with financial accessibility are particularly prominent for electricity providers in less developed economies as they move towards ubiquitous connection [27]. Financial accessibility can be understood as a barrier to electrification in its prevention of both initial access and continued connection. From the perspective of electricity providers this presents a major problem, as physical infrastructure is rendered a costly burden if people cannot afford initial or continued connection.

Repeated studies from Latin America have shown that lower income households are far less likely to have access to electricity [42]. Poor access to credit and financing options are now understood as major contributors to this discrepancy [2]. While establishing initial connection holds obvious importance in providing access to electricity, insufficient funds for continued electricity services prevent many people from accessing electricity who have already achieved initial connection [1]. Those who are no longer able to afford connection face shut-offs from their electricity providers, preventing them from accessing the benefits of their initial investment in connection. Apart from limiting benefits allowed from connection, providers also suffer in their public perception when forcefully pursuing shutoffs [27]. This phenomenon has been well identified within the literature, known to occur prominently in such countries as South Africa [39]. Low-income groups across the globe have seen improved access to electricity in association with low energy prices, national governments have championed this as a tool to alleviate poverty [37]. Despite this understanding, many countries still struggle to achieve low energy prices in a fiscally sustainable manner.

Cost recovery, energy use, and affordability

A major challenge in providing universal access to electricity relates to funding the costs of operating the grid and supplying electricity to consumers. These costs are typically passed on to consumers through tariffs charged for electricity usage. If connected households do not have sustained usage and are unable to pay their bills, then the utility does not generate enough revenue to pay for the costs of electricity provision. This challenge can be identified widely, in many countries of Africa and South America [40][42]. Once connected to the grid, consumers pay a monthly electricity bill to fairly compensate the grid for its service and contribute to its continued operation. However, what happens when the operating costs of the grid repeatedly exceed consumer payments for their connection and monthly bill? This is exactly the question being asked throughout sub-Saharan Africa, where most utilities are unable to meet operating costs with their current revenue stream [11]. At the root of this challenge is an inability for many people to interact with their billing system, as has been evidenced throughout South Africa [27]. Not only do poor billing strategies limit new connections, but they also discourage increased usage from existing customers. This characterizes a problem of financial viability for electricity providers, causing many to doubt the worthwhile benefits of connecting more households. While this challenge has been noted throughout developing economies of many African Countries, recent data has showed that Benin and Rwanda have struggled in particular [40].

Although many grids struggle to encourage increased energy usage amongst their customers, it should also be noted that energy use in many countries is constrained by grid capacity to produce electricity. The World Bank found that energy demand amongst developing economies nearly doubled from 2000 to 2015, correlating with a fourfold rise in GDP [19]. Despite this demand growth seen alongside a rise in GDP, many people are constrained in their energy use by energy availability from the grid [19]. In Ethiopia studies have shown that 87% of connected households lack the electricity to use more than four lightbulbs at a time [41]. Countries who face this challenge will need to improve generation capacity in order to foster electricity mobility amongst their consumers. With improved generation capacity, consumers will be able to progressively increase electricity consumption and experience the associated benefits [18]. This priority will not only facilitate initial connection and the associated economic benefits, but will also encourage additional connections through a more stable and accessible price. Such a development would allow improved financial security for the grid, encouraging improved quality of electricity and connection.

Grid management and expansion

The challenge of grid management and expansion has been grappled with throughout the globe, in economies of all strengths and sizes. Clear and comprehensive guidelines to organize the operation of electricity grids take many years to develop. Unique design considerations in each country demand careful planning of the grid in order to provide for continued growth and success. Unfortunately, many African nations still struggle with electricity grids which were hastily modeled by colonial powers [9]. These models tended to lack nuance and neglect the specific needs of native communities, which are still marginalized as a result [9]. Apart from having to make up lost ground for poor grid modeling, the logistical difficulties of grid management present a challenge all its own. Specifically, the logistical challenge of grid management is one which requires operators to assess generation and demand in real time to avoid outages [7]. Through recent years this challenge has become particularly apparent in developing economies as they attempt to rapidly develop their electricity sectors [19]. Emerging electricity grids often have difficulty keeping up with increasing demand, particularly when

faced with a growing population and increasing economic activity. The growth pattern of Senegal's electricity grid exemplifies this trend, with their investments in transmission lines and power plants falling dramatically behind increasing demand [27]. The Electric Power Authority of Nigeria has also been hindered by poor grid modeling, recently ceasing operation of a new 1200MW thermal station after lagging behind expected demand [28]. These two instances exemplify the difficulty found in modeling growth in consumer demand when expanding the grid, often leading to substantial financial losses [5].

Besides the challenge of accurately modeling consumer tendencies with limited resources, grid managers also face the formidable task of designing, implementing, and monitoring their systems. As was mentioned in the challenge description of energy usage, an improved billing system will be essential in order to allow higher participation on developing grids. Additionally, improved electronic billing systems have the potential to include valuable technology updates to monitor the grid in real time [7][45]. Poor monitoring and design in the expansion of Nigeria's grid contributed to a 35% loss of electricity generated in 1988, up from 18% in the mid 70's [28]. Disorganization in the provision of electricity in South Africa has resulted in over 185 different distributers, each differing in their financial status. This overabundance of providers has resulted in significant price disparities between customers there [27]. Each of these grid development phases offers the opportunity to increase efficiency in grid management and operation, leading to significant cost savings for the utility [5]. While each grid will prioritize these considerations somewhat differently based upon their individual circumstance, there is a documented need for utilities to focus on transparency and equality within their development [16]. Prioritizing these objectives will result in the more coherent and equitable development of electricity grids in years to come.

Policy uncertainty, political priorities, and development policies

The challenges associated with political uncertainty have been well documented to hinder grid development, especially in those countries with developing economies. Poor communication and understanding between legislators, utilities, and citizens has contributed to growing animosity towards government-funded utility projects across much of Africa [3]. In Tanzania and Mozambique this has been noted to discourage cooperation with government utilities, who are widely known to charge heavily for connection and offer less compensation for lost or damaged property [3]. Additionally, stakeholders in the electricity sectors of both countries noted that there was an overall lack of political priority to improve electricity access [3]. This challenge is more often than not characterized by a low value for equality in the provision of electricity. This phenomenon has been displayed through the ongoing struggle to fully electrify India. One recent study at the London School for Economics found that even when controlling for income, lower caste households in India are 15% less likely to have electricity than upper caste households in the same community [51]. Liberia has also been noted to devalue equality in grid development, having rerouted rural power plants to better serve the capital city of Monrovia. A subsequent failure to provide improved production and transmission infrastructure in those rural areas has neglected the electricity needs of people there, particularly those of less means [16]. While there are many difficulties associated with this challenge, the most pressing is that of consumers being less willing to cooperate with grid management. Seeing as legislators, utilities, and citizens all play vital roles in supporting the grid, there is a need for policy makers to encourage participation through clear goals and benchmarks within development policies [17].

Beyond the challenges of policy uncertainty and unclear political priorities, neocolonialism has retained a strong presence in the development policies of many developing economies [9]. These development policies have largely been reproduced from models of more developed economies. The superposition of these models has been particularly notable over the countries of sub-Saharan Africa, lingering from colonial times [9]. Such action has disregarded the unique development needs and nuance of each individual country and their people. In many developing economies these models have neglected such vital considerations as resource constraints, informal economies, and supply shortages [17]. In addition to reinforcing the presence of neocolonialism, these development policies have also muddled political priorities, leaving consumers without trust for the grid and its developers. In order to successfully respond to this challenge there is a need to better manage and represent political and development priorities to all stakeholders, especially consumers [5].

Electricity reliability

While issues with electricity reliability can be caused by localized conditions such as geography and weather, unplanned outages are often caused by lacking infrastructure or grid mismanagement [28]. When addressing grid reliability amongst developing economies, a glaring challenge is met in providing for the grid's structural integrity. This challenge has been overwhelming in Nigeria, where outages of major system components have typically lasted between one and four years [28]. Such long-lasting outages have been extremely problematic for electricity providers, discouraging new customers from connecting to the grid and causing revenue to suffer. Many people have cited electricity providers as being unwilling or unable to supply necessary investments in stable electricity infrastructure [20][27]. Whether it be due to high costs or tensions with community members, this difficulty highlights the overwhelming need for community-based investments in electricity services to improve reliability.

A less obvious but equally limiting challenge for grid reliability has been the overwhelming need for improved modeling systems to increase outage planning and predictability [17]. Tanzania has long struggled with this difficulty, losing over 4% of their GDP in 2007 from power outages alone [40]. Without an accurate understanding of where and when routine maintenance is required, utilities are missing out on a valuable opportunity to improve the reliability of their system. Poor reliability across much of Africa has left many electrified households unable to access utility from their connection, characterizing extreme grid inefficiencies [18]. As recent technological innovations have improved our ability to mitigate unplanned losses, utilities need to prioritize increased electricity quality for their consumers. Not only will this strategy bring increased economic stability to the most vulnerable consumers, but it will also foster consumer trust in the utility, encouraging a higher rate of connection [7].

Illegal connections

Illegal grid connections have been widely observed in rural as well as urban areas, however, this challenge has been overwhelmingly identified in the inner-urban poor. The widespread use of illegal connections has been readily identified in the inner-urban areas of Thailand, Brazil, Argentina, India, and many other countries [27]. Illegal connections offer electricity services to people who would not be able to afford a grid connection otherwise. Despite this, illegal connections are often at the cost of compromising reliability and safety due to inadequate installation [9]. With limited resources illegal suppliers will often install haphazard

connections, burying wires in shallow ditches, or improvising supports with small sticks and local debris. As a result, many illegal connections in Ghana have caused severe electrocution and even death to consumers [17]. In addition to safety concerns of the consumer, illegal connections can also compromise the safety of utility workers while attempting to dismantle makeshift electrical work. Moreover, the high concentration of illegal connections in inner-urban areas makes utility personnel a target for frustrated consumers when attempting to disrupt their connection [27]. These factors have resulted in a worsening divide and decaying sense of trust between the utility and illegally connected citizens.

Rather than being an inherent barrier to electrification, illegal connections have been facilitated by poor trust in the grid along with limited consumer finances [27]. In order to solve the problem of illegal connections and bring about universal grid connection, policy makers and utilities will need to better understand the needs of their poorest citizens. Countries like South Africa are in particular need of such improvement, having lost over US$1.4 billion due to illegal connections in 2016 alone [48]. Such immense financial losses for electricity providers indicate a glaring need for change in order for grids to remain financially viable. By formalizing a presence in the poorest communities, electricity utilities can bring infrastructural investments to areas of desperate need. This sort of action would help create electricity and economic mobility for the most vulnerable members of society, while also allowing improved financial stability for the grid.

Development of renewable energy resources

With many developing electricity grids facing an energy supply constraint, heavy interest has been paid towards renewable energy as a means of meeting increased demand [4]. As international development goals have progressed in stride with renewable energy technologies, efficient and sustainable energy systems have become paramount in the landscape of international development [19]. In recent years this shift has helped to reorient development goals, attempting to strike a healthier balance between ambitions of sustainable grid development and universal access. Despite criticisms of their ability to provide energy and economic mobility, the integration of stand-alone solar systems and photovoltaic panels will be essential in providing electricity access to rural areas [5]. Furthermore, renewable energy resources have shown immense promise outside of rural or otherwise isolated areas, providing an affordable safeguard to customers who may struggle with the reliability of their existing grid connection [20]. Indonesia now stands as one of the many countries with high potential to benefit from renewable development, possessing a vast means of untapped potential in photovoltaics and biofuels [54]. With extremely limited natural resources, the development of renewable alternatives in Indonesia has become imperative as the country has found an increasing financial burden since in its net import of crude and refined oil products [54]. Capable of sustainably supporting increased grid demand, the integration of renewable energy systems will be pivotal in the expansion of electricity access and reliability in counties like Indonesia going forward. By ensuring a sustainable and cost-effective means of providing electricity access, countries can improve connection rates while also providing for the long-term stability of the grid with renewables.

3.2 - Known Policy Mechanisms to Mitigate These Barriers

Energy subsidies as a means of improving financial accessibility

Subsidies for energy have become increasingly prominent with a global rise in fossil fuel prices through the early 2010's, led by the Middle Eastern countries of Kuwait, Saudi Arabia, Iran, and Qatar [37]. Subsidies in each of these countries were targeted at producers and reduced energy prices to less than a third of the international average [37]. This strategy has been shown to encourage infrastructural investment by the producer, improving reliability of delivery to the consumer. However, many countries of the Middle East and North Africa have incurred damaging fiscal losses as a result of high energy subsidies to encourage production. Egypt and Yemen have particularly prominent examples of this misallocation, causing an unsustainable fiscal burden in both cases [37].

Consumer subsidies have also been popularized as a means of reducing costs for both initial connection and continued access from the producer. While many countries have worked to implement subsidies for initial connection and monthly energy expenses, these subsidies have often been poorly designed, leading to unintended consequences [20]. These unintended consequences are most often seen in the form of financial losses for the grid. In the case of Bangladesh, a dramatic increase in domestic energy use coupled with an overly ambitious subsidy resulted in a loss of over US$179 million for the grid in 2010 [20]. Other unintended consequences have been observed in countries like Ghana, where cross-subsidization between energy brackets has implicitly discouraged consumers from increasing their energy usage [17]. Existing design considerations for energy subsidies will need to be reevaluated by country in order to address the broad-reaching challenges of financial accessibility in establishing connections and positive habits of energy usage.

Encouraging energy usage with prepaid electricity meters and easy payment methods

Prepaid electricity meters and other easy payment methods have also been noted to help ease financial accessibility to electricity in places like South Africa [27]. The growing popularity of smart phones shows great promise in the continued growth of these easy payment methods, yet this still serves as a barrier for the poorest subset of people. Members of the urban poor in Senegal may hope to meet this challenge with the establishment of micro-credit networks. While this strategy has been utilized in the past to pool resources for social events, researchers have suggested that this could be adopted by residents to share the burden of costs for connection [27].

First introduced in 2009, smart meters have since been utilized in economies of all strengths to better tailor electricity generation to consumption [46]. Besides eliminating the need for periodic meter reading, smart meters also present many benefits to the reliability of grid services. Through remote management of connections and automatic notification of outages, grid managers can reduce unnecessary investments in infrastructure while improving efficiency [7]. Additionally, one of the most striking benefits of smart meters has been in their allowance for electricity utility providers to make immediate and remote updates to tariffs [45]. The success of Korean utility management policies has reflected the importance of this feature in improving grid operating efficiency. Frequent adjustment of tariffs over time to cover actual costs of grid operation helped reduce operating costs by 34% between 1983 and 1988 [28]. In Africa, the implementation of smart meter technology has been led by Botswana and South Africa, reducing losses from inefficiencies at the national level. The utilization of smart meters in most all of Botswana's electrified homes has resulted in extremely low non-technical losses, estimated at around 3% [47].

Legitimizing inner-urban housing to combat illegal connections

While improved mapping of the grid with smart meters can help identify illegal connections, there is a clear need for more direct intervention from grid management and government to alleviate losses associated with those illegal connections [45][9]. At the root of this problem has long been the informal nature of housing and residence for much of the urban poor in countries with less developed economies. Governments in these countries have often been hesitant to provide for infrastructural investments in those areas, as many would see it as legitimizing illegal housing [27]. This hesitation to provide infrastructural investment has resulted in the lack of legal electricity services now noticed through many urban slums of developing economies. As noted in the challenge description of illegal connections, a lack of legitimate electricity services results in illegal and often dangerous electricity connections [9]. This characterizes a serious inequity in electricity provision from the grid, disadvantaging electricity access and safety of the urban poor. In order to meet a housing deficit of over 5.4 million homes, the Brazilian government launched the "Minha Casa, Minha Vida" (My House, My Life) program in 2009. As of 2016 the social housing program had already built over 2.6 million homes throughout the country, offering legitimized housing to over 10.5 million low-income people [49]. An additional commitment from the mayor of São Paulo for 20,000 social housing units in the city center demonstrates the success of this initiative in garnering support to combat this challenge [49].

In 2003 the government of Thailand partnered with the Community Organizations Development Institute (CODI) to implement a secure housing program to help improve access to utilities [27]. By carrying out surveys in the targeted areas, NGO's and localized organizations have involved community members in tailoring solutions towards their needs. Part of this solution has been a temporary registration scheme for low-income households to achieve legal electricity access, supported by reduced tariffs and strong political commitment [27]. This solution works by allowing illegal settlements to register with electricity providers by temporary registration with the state, once provided service the illegal settlements are again unrecognized [27]. Since the implementation of this program, it has been noted that a majority of urban poor households now own both a refrigerator and a television [50]. However, despite the proven success of this program in formalizing housing for the urban poor and improving electricity access, it was reported that around 30% of homes still receive electricity illegally [50].

Community-based policy to assist grid management and expansion

There has been an identified need for bottom-up initiatives to compliment the top-down approaches common amongst electricity providers and grid managers [3]. This would mean working directly with community members to address electricity inaccessibility while continuing to implement strategies targeting grid management at the administrative level. In response to the broad-reaching challenges of grid management, policy makers will be required to better use data-driven projections in developing a more nuanced understanding when expanding the grid [5]. Researchers with the Global Network on Energy for Sustainable Development suggest that a database of demographic characteristics and energy needs of poor populations will help to improve grid management [27]. These efforts would embody a shift towards community-based activism, allowing policy makers to better understand their most vulnerable populations.

Addressing grid reliability and illegal connections with electricity cooperatives

Community-based activism at the national level has proved valuable in Bangladesh, where localized electricity cooperatives have been integrated since the 1980's [20]. These cooperatives have proliferated throughout the country and now serve over 100 million people, raising the average income in electrified households by 250% [43]. These statistics not only demonstrate how localized electricity cooperatives have increased the number of legal connections in Bangladesh, but also how they have improved grid reliability. The government of Bangladesh stipulated that these cooperatives exist as consumer-owned autonomous organizations, fully responsible for construction, operation and management within each system respectively [20]. Electricity cooperatives were first implemented in Bangladesh with the creation of the Rural Electrification Board by the Bengali government in 1978 [43]. The Rural Electrification Board allows consumers within each cooperative to elect a board of directors, these individuals are then responsible for creating and implementing cooperative policies [20]. Although this format was enacted by ordinance of the Bengali government, they did so with assistance from National Rural Electric Cooperative Association International (NRECAI) [43]. This American non-profit organization has worked towards electrification, cooperative development, and community empowerment since the 1960's, finding notable success in partnerships with Bangladesh, Bolivia, and the Philippines [44].

Policy incentives for renewable energy development

A wide variety of policy strategies have been utilized to encourage the development of renewable energy technologies around the globe. The incentives found within these strategies can generally be differentiated by their intention to encourage either supply or demand within the renewable energy sector. Subsidies, tax breaks, and grants are classified as supply incentives, used by governments to reduce the start-up costs associated with renewable energy projects [52]. Alternatively, demand incentives are used to guarantee fair and steady payment for the cleaner energy sourced from renewable technologies over conventional means of energy production. Government contracting of Energy Service Companies (ESCO's) and the use of feed-in tariffs stand as two of the most prominent demand incentives across economies of all strengths [52]. Energy efficiency projects contracted out to ESCO's are financed based on the energy savings achieved through completion of the project, equating maximum energy savings to maximum profit [55]. Contracts for these sorts of projects have been implemented throughout the world, achieving notable profits in the countries of China, India, Brazil, and Indonesia [52].

Feed in tariffs have been championed as an extremely reliable tool to attract investment in renewable energy development, offering guaranteed grid connection, a fixed price on electricity, and long-term contracts [53]. The Indonesian government first implemented feed-in tariffs with sweeping legislation in 2012 and 2013 [54]. However, depreciation of their currency through 2013 has since damaged the financial viability of renewable energy development, preventing Indonesian feed in tariffs from achieving their intended goal [53]. Despite achieving increased investment interest in renewable energy projects, targets have been far from realized with 90% of scheduled energy deployments delayed from renewable power plants [54]. Unclear policies at the national level have been blamed for this discrepancy, along with complex requirements for permits, and continued conflict with local communities over land acquisition for projects [54]. These difficulties characterize several of the barriers described earlier in this

thesis, emphasizing the need for increased community-based activism along with improved clarity in national policies and permitting procedure.

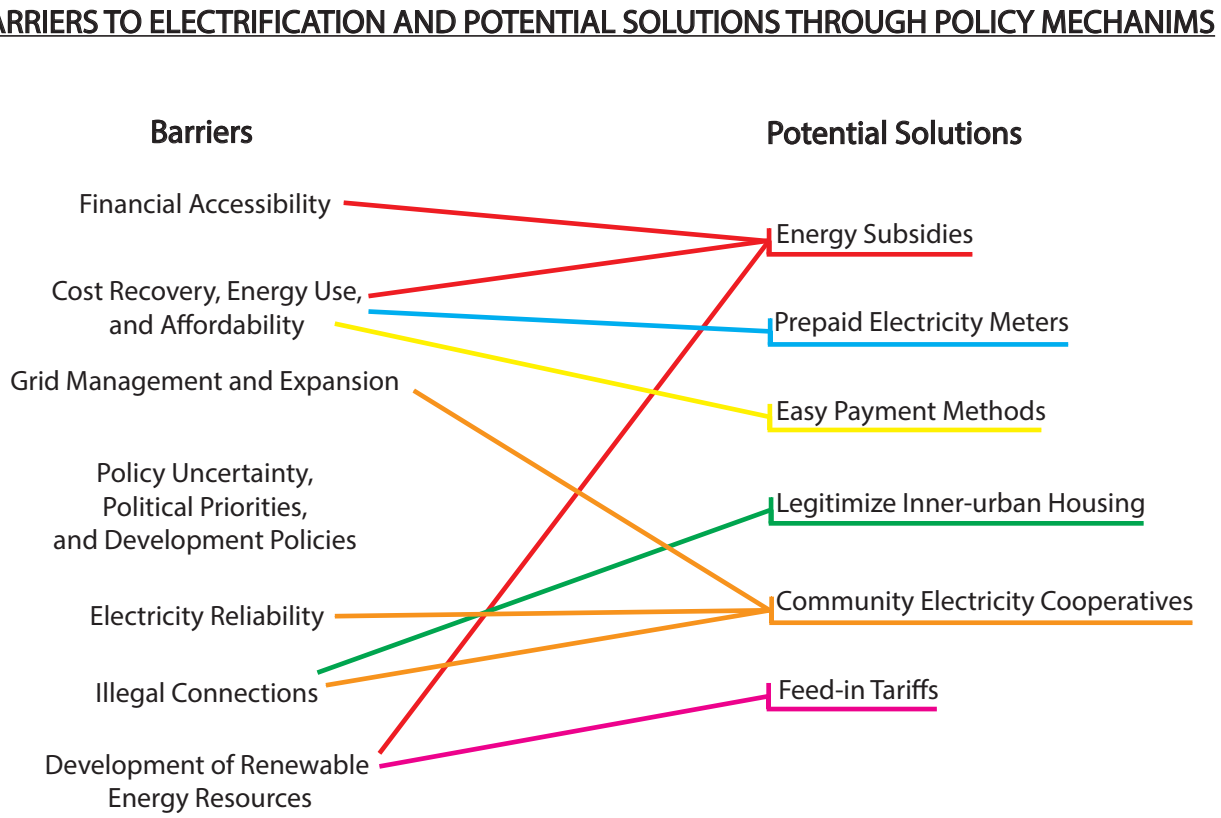

Figure 2. Barriers to equitable and sustainable electricity provision matched with potential solutions through policy mechanisms noted within the literature review

4. RESEARCH QUESTIONS AND METHODS

This project was first approached in the global context, beginning with a literature review of barriers to electrification and equitable electricity access outside of Kenya. Having identified a wide range of challenges in the global literature, this research then focused directly on seven challenges. Challenges were then categorized into those relating to financial accessibility, energy usage, grid management and expansion, policy uncertainty, electricity reliability, illegal connections, and the development of renewable energy resources. Each challenge was carefully chosen to reflect the broad and dynamic nature of the issue at hand. Each of these categories then informed a careful review of existing literature in order to better understand the unique issues of Kenyan electricity inequality in comparison to other developing economies. However, only six

of these challenges were prioritized in addressing the struggle for electricity equality in Kenya. Given Kenya's impressive integration of renewable energy technology, renewable development has been studied through this project as a success rather than a lingering challenge.

Two Kenyan energy policies in particular will be studied in order to evaluate their effectiveness in addressing these barriers to electrification. The first document studied will be the Kenya Energy Act 2019, a comprehensive description of the policy framework and energy sector in Kenya. This policy is currently in force at the national level and details policies of particular relevance to sub-themes of the energy sector [36]. These sub-themes include coal, renewable energy, energy financing, energy efficiency, environment, socioeconomic issues, health and safety issues, and many others [36]. The second document focused on will be the National Climate Change Action Plan, a five-year nationwide plan to guide Kenyan action in response to climate change [35]. This plan particularly addresses priority climate change actions from 2018-2022, along with the policy and legal framework of carrying out those actions [35]. Both released in 2018, these primary sources provide over 200 pages of current development priorities and policies from the Kenyan government. While reading through these documents in their entirety, each section and subsection will be evaluated in how they address one or more of the above barriers. The results section will describe only those subsections of the policies which hold relevance in addressing the seven barriers focused on within this thesis.

1. What is the relevance of each of these barriers in Kenya?

    - This question will be answered through a literature review targeting each of these barriers to electrification in Kenya. While each barrier in the global context is also understood to be pertinent in Kenya, the composition of these barriers is unique within the country. The literature review goes on to articulate the nature of each barrier within the scope of Kenya; this has informed an improved understanding of resulting issues there.

2. What policies have been introduced in Kenya, and what policy mechanisms do those achieve?

    - This question will be addressed through review of the Kenya Energy Act, along with the National Climate Change Action Plan. Each subsection will be read thoroughly, and policy mechanisms will be noted as they relate to each individual policy within the documents. Apart from identifying particular goals within Kenyan policy, the answer to this question will also characterize policy mechanisms in use to achieve said goals.

3. To what extent do Kenyan policies address the barriers listed?

    - An understanding of the policy mechanisms implemented through Kenyan Policy will be essential in order to evaluate how they have addressed the barriers listed. Research on the efficacy of these policy mechanisms in addressing the current barriers to electrification in Kenya is outside the scope of this thesis. The goal of this question is rather to find whether there have been policy mechanisms from the Kenyan government targeted towards the barriers identified. Coding the two

primary sources noted above in their action to address these barriers will yield an improved understanding of their extent in doing so.

The only use of live human beings within this thesis will be through scheduled interviews and meetings over Zoom. As such, the student and Committee Chair believe that no additional specialized training will be necessary.

5. RESULTS

5.1 What is the relevance of each of these barriers in Kenya?

Financial accessibility

Financial accessibility as a barrier to electricity equality in Kenya has become particularly pronounced as the country has pushed to dramatically expand grid access in recent years [9]. KPLC has worked in recent years to reduce costs for connection and continued service with updated billing practices and increased variable tariffs [15]. While such efforts to improve service have been commendable, they have been impeded by disorganization and confusion within KPLC. Consumer backlash over high prices has persisted in light of these slow and disjointed efforts to improve service [15]. Pressure from high electricity costs have been felt throughout the country, but are particularly salient amongst the rural poor. Many unconnected Kenyan communities now fall under the classification of being "under Grid". Meaning that despite being within a low-voltage, low cost connection to the grid, these households have remained unconnected [2]. Households within this category overwhelmingly cite cost as inhibiting their connection, indicating a glaring need for consumer financing options if Kenya is to offer electricity equality and become fully electrified [5].

Cost recovery, energy usage, and affordability

Between the years of 2009 and 2018, electricity usage by the average Kenyan residential consumer decreased by 70% [5]. This low electricity consumption amongst Kenyan households has perpetuated high energy prices and limited socio-economic development, especially as of the past several years [5]. Despite prioritizing universal connection at the national level, this phenomenon has continued to effect newly-connected customers, particularly those in rural areas. While this difficulty has resulted from an influx of customers coming onto the grid, some researchers have correlated those customers' low consumption with Kenya's stunted socio-economic growth [15]. Moreover, low electricity consumption throughout Kenya has even further limited socio-economic growth, characterizing a potential positive feedback loop. Despite the potential existence of a positive feedback loop, there are some questions over the causal link between stunted economic growth and low electricity consumption. The literature has widely shown low socio-economic status to be a limiting factor in electricity consumption, yet researchers and policy analysts at Oxford have characterized low electricity consumption as a constraint to socio-economic development [56]. The later of these two findings would indicate low electricity consumption as seen in Kenya to be a possible symptom of low socio-economic

development rather than a cause. Regardless of the causal relationship there exists a dramatic need to increase average electricity usage in order to achieve a more accessible price per connection. While encouraging positive energy habits amongst grid-users presents many challenges of its own, increased average energy usage will be essential in allowing universal access to electricity [15].

Grid management and expansion

Overzealous projections of electricity consumption in Kenya have caused over-investment in electricity generation. This misappropriation of funds has left Kenya with an electricity infrastructure which is now widely underutilized [2]. Meaning that residential and commercial consumers of energy in Kenya have been unfairly burdened by rising costs [5]. This burden has not only made it more difficult for grid users to stay connected, but has also degraded financially accessible for Kenyans who have not yet connected to the grid. Furthermore, the majority of revenue from electricity infrastructure comes from industrial power users that are increasingly moving off-grid. With each departure of these customers comes an increased electricity price to be pushed onto the average Kenyan consumer [15]. Difficulty retaining high-volume consumers in tandem with poorly planned outages has resulted in continued revenue losses for KPLC, as well as their residential customers.

Policy uncertainty, political priorities, and development policies

In recent decades Kenya has struggled with political uncertainty and has unsuccessfully managed political priorities within their electricity sector. A disjointed approach to regulating import tariffs coupled with a lack of transparency have left mini-grid operators and home solar system distributors struggling to keep up with regulatory requirements [1]. Additionally, environmental justice issues have arisen through the unfair relocation of Maasai communities in favor of energy development projects [23]. These issues harken back to the dark legacies of colonialism in Kenya, fueled by foreign investors with little to no regard for the traditional Maasai way of life. Regulatory procedures will need to be streamlined and more transparent If Kenya is to achieve comprehensive electrification [1].

Electricity reliability

Besides discouraging people from connecting to the grid who would have otherwise joined, electricity reliability issues have caused widespread dissatisfaction amongst current KPLC customers [7]. As to be expected, frustration with the utility has pushed some Kenyans away from the grid. Public perception of KPLC has continued to degrade under this pressure, evidenced by their popular nickname ‘Kenya Paraffin Lamps and Candles’ [15]. Such dissatisfaction has also encouraged some Kenyans to pay for grid connection in addition to a home solar system, the latter acting as a safeguard against widespread and unpredictable outages [5]. Without a reliable grid, Kenyans will continue to burden themselves financially with this costly safeguard for frequent grid outages. If left unaddressed, electricity reliability issues will continue to hinder the economic stability of Kenyan communities, as well the utility itself [15].

Illegal connections

Kenya has long grappled with the challenge of illegal connections onto the grid, contributing to heavy financial losses, safety concerns, and public confusion. This issue has been particularly apparent in the inner urban areas of such cities as Nairobi and Mombasa [6]. Often controlled by violent 'energy cartels', the wide distribution of illegal connections has blurred the distinction between KPLC officials and unlicensed intermediaries [1]. Intermediaries associated with Kenyan energy cartels are quick to move in when KPLC projects are disorganized or don't go according to plan [6]. These 'agents' generally lack the necessary training to safely install electrical components, leaving many of Kenya's poorest residents in dangerous living situations. Furthermore, these 'agents' serve as collectors for cartels following connection; predatory charges from energy cartels have been noted by many illegally connected residents to be in excess of grid fees [1]. This circumstance not only characterizes a serious environmental justice issue, but also a growing electricity oligarchy which threatens to further dismantle the legitimacy of KPLC [9]. While initiatives like the Kenya Electricity Expansion project have attempted community-led approaches to limit these organizations' control, a lack of coordination has reduced efficacy [6]. Going forward there is a clear need for improved communication and community-based education if these projects are to successfully tackle this ongoing injustice [9].

Development of renewable energy resources

Over this past decade Kenya has made major progress with their integration of renewable energy onto the grid. Rather than being driven by environmental concern, this development has been motivated by the desire to proliferate the number of Kenyans with electricity access as quickly as possible [8]. The success of this priority is exemplified through Kenya's exponential growth in electricity access since 2014. By 2018 the percentage of Kenyan's with access to electricity had more than doubled [29]. A prerequisite for this success has been the broad acceptance of stand-alone solar systems as a means of providing electricity access. Such acceptance has been enhanced at the industrial level with the implementation of feed-in-tariffs for wind, biomass, small hydro, geothermal, biogas, and solar energy [4]. While these efforts have certainly enabled a more broad and sustainable access to electricity in Kenya, there is still a long way yet to go in achieving the ambitious goals outlined in 'Kenya Vision 2030'. By coordinating current feed-in-tariffs with other incentives for the adoption of renewable energy, Kenya would have even greater success in providing for equal access to electricity. Poor solutions for energy storage systems should also be noted as a barrier to the integration of renewables both in Kenya and the rest of the world [8]. An effective energy storage system would not only facilitate the wider distribution of electricity, but would also assist with Kenya's demand constraint by allowing electricity to be exported outside of the country for profit.

5.2 What policies have been introduced in Kenya, and what policy mechanisms do those achieve?

Kenya Energy Act 2019

Introduced on March 14th, 2019, the Kenya Energy Act opens with the following statement of purpose.

"AN ACT of Parliament to consolidate the laws relating to energy, to provide for National and County Government functions in relation to energy, to provide for the establishment, powers and function of the energy sector entities; promotion of renewable energy; exploration, recovery and commercial utilization of geothermal energy; regulation of midstream and downstream petroleum and coal activities; regulation, production, supply and use of electricity and other energy forms; and for connected purposes"[57].

A full collection of key passages from the Kenya Energy Act 2019 can be found in table 3, located in the appendices section. The policy mechanisms as found within table 3 and the Kenya Energy Act 2019 have been summarized below.

The majority of policy mechanisms set forth in the Kenya Energy Act seek to establish energy sector entities and outline their respective structures and duties. In total, 11 energy sector entities are outlined, including the Kenya Electricity Generating Company, the Kenya Transmission Company, and the Kenya Power and Lighting Company. As was described in the background section of this thesis, these three companies are the predominant entities within Kenya's electricity sector. The Kenya Energy Act dictates those entities' best practice in managing Kenya's electricity sector. Two additional entities of particular relevance to the aforementioned barriers are the Nuclear Power and Energy Agency, and the Rural Electrification and Renewable Energy Corporation. The Kenya Energy Act outlines the responsibilities of these agencies within their respective fields, each with the intention of further developing Kenya's renewable energy resources.

Beyond outlining 11 entities of vital importance to the Kenyan energy sector, the Kenya Energy Act provides for community development by declaring that five percent of royalties shall be made available to the communities effected by geothermal resource extraction. The act goes on to detail that local communities will have access to these finances through trust funds managed by a board of trustees within each community. The Kenya energy Act also provides funding for electricity infrastructure in rural communities through the Rural Electrification Program Fund. Included within this clause is the ability for the cabinet secretary to impose a levy of up to five percent on all electricity consumed in Kenya to support the program fund. A renewable energy feed in tariff is also described in the act, intended to encourage growth in Kenya's renewable energy sector and offset greenhouse gas emissions. These financial mechanisms are further strengthened with the authorization of net-metering agreements for qualified applicants to help reduce their electricity bills.

Some of the most important policy mechanisms of the Kenya Energy Act are set forth through several passages which describe the requirements of licensee's, along with punishments for unlawful behavior. These mechanisms are accompanied by the universal requirement for meters to be used in quantifying the amount of electricity used. Furthermore, the act stipulates that the retailer shall be responsible for supplying and installing meters to monitor customer electricity usage.

Kenya National Climate Change Action Plan 2018-2022

The Kenya National Climate Change Action Plan 2018-2022 took effect on January 1st of 2018, the following is an excerpt from the plan's executive summary.

“The National Climate Change Action plan (NCCAP) 2018-2022 aims to further Kenya's development goals by providing mechanisms and measures to achieve low carbon climate resilient development in a manner that prioritizes adaptation”[58].

The Kenya National Climate Change Action Plan 2018-2022 sets forth a wide range of policies aimed at helping Kenyan society adapt in the face of rapid climate change. Strategic objectives three, six, and seven are of particular relevance to the focus of this thesis. The tables below describe these strategic objectives of the NCCAP, as well as the policy mechanisms associated with each strategic objective as included in the NCCAP.

Strategic objectives of the Kenya National Climate Change Action Plan 2018-2022	
3	Enhance resilience of the blue economy and water sector by ensuring adequate access to the efficient use of water for agriculture, manufacturing, domestic, wildlife, and other uses
6	Promote energy and resource efficiency in the manufacturing sector
7a	Ensure an electricity supply mix based mainly on renewable energy that is resilient to climate change and promotes energy efficiency; encourage the transition to clean cooking that reduces the demand for biomass
7b	Establish efficient, sustainable world-class transport systems and logistic services that can withstand the expected impacts of climate change

Table 1. Strategic objectives of the Kenya National Climate Change Action Plan 2018-2022 with relevance to electrification and sustainable provision of electricity.

Policy mechanisms associated with each strategic objective		
Strategic Objective	Page	Passage
3	49	“Implement the greening of the Mombasa port plan that builds resilience and mitigated GHG emissions through the installation of solar panels”
6	59	“Increase energy efficiency by doubling the number of companies participating in energy efficiency initiatives to 1000”
7a	63	“Increase renewable energy for electricity generation that is climate resilient and accounts for need of rural areas…2,405 MW of new renewables developed, to include: Geothermal (prioritized) as baseload generation that is climate resilient, biomass/co-generation, hydro, solar, and wind.”
7a	63	“Increase captive renewable energy generation capacity…captive renewable energy generation plants developed, where electricity is used by the developers, such as direct use of geothermal resources to power various industrial applications.”
7a	63	“Improve energy efficiency and energy conservation…losses in transmission and distribution to be reduced from 18% to 14%. 3.3

		million compact fluorescent lights (CFLs) distributed to households through CFL initiative. Energy efficiency and conservation projects to be delivered that focus on efficient lighting, minimum energy performance standards, and distribution of clean lighting."
7a	63	"Climate proof energy infrastructure…Concrete poles replace wooden poles, conserve and rehabilitate 1000 ha of water catchment areas by protecting water catchment areas feeding the hydro-power dams."
7a	64	"Enabling actions (capacity development) …Training and public awareness programs on climate change adaptation and mitigation mechanisms. Train 100 students per year by Kenya Power International (Institute of Energy Studies and Research) on renewable energy technologies. Train 60 participants per year at the United Nations University – Geothermal Training Program."
7b	65	"Develop an affordable, safe and efficient public transport system…Develop use of electric hybrid vehicles (buses) and appropriate incentives for their use. Extend the Standard Gauge Railway system (electrified) from Nairobi to Naivasha."
7b	66	"Encourage low carbon technologies in the aviation and maritime sectors…Install and commission 0.5 MW solar plant at Moi International Airport by 2018."
7b	66	"Enabling technology… Encourage domestic technology development for electric modes of transportation. Undertake research on the use of renewable energy or powering different modes of transport."
7b	66	"Enabling capacity development…Build awareness on fuel economy and electric mobility options, explore infrastructural needs for electric mobility."
7b	66	"Enabling policy and regulation…develop and implement standards for electric cars and two-wheelers by 2019."

Table 2. Policy mechanisms of the National Climate Change Action Plan 2018-2022 associated with each relevant strategic objective.

5.3 To what extent do Kenyan policies address the barriers listed?

Financial accessibility

The Kenya Energy Act contains policy mechanisms which attempt to address financial accessibility as a barrier to electrification. However, the NCCAP does not contain policy mechanisms which directly respond to this barrier. In the Kenya Energy Act, there are two primary passages which provide financial support for community access to electricity. The first passage pertains only to those communities affected by geothermal resource extraction, detailing that they receive five percent of all royalties from energy produced in their area. While this mechanism may significantly benefit affected communities, it is unclear as to how many communities receive those benefits and how they are ensured to go towards electrification. The

second piece of financial support for electrification comes with the Rural Electrification Program Fund. The Rural Electrification Program Fund differs from the affected communities fund in the explicit objective of its existence, to accelerate the development of electricity infrastructure. Under the Rural Electrification Program Fund the Cabinet Secretary is authorized to impose a levy of up to five percent on all electricity consumed in Kenya. Despite the authorization of financial resources to develop electricity access through infrastructure, the Kenya Energy Act does not detail specific projects or strategies to bring this benefit to those who need it.

Cost recovery, energy usage, and affordability

Policy mechanisms to encourage positive habits of energy usage and electricity mobility are included in both the Kenya Energy Act and the NCCAP. The Kenya Energy Act first establishes the Energy and Petroleum Regulatory Authority with the mission of ensuring optimal utilization of infrastructure and coordinating a national energy efficiency and conservation action plan. The act then goes on to include that meters must be used to quantify the amount of electricity being utilized by the consumer. Both of these mechanisms seek to encourage positive habits of energy usage by planning for efficient use and operation of existing energy infrastructure. While the Kenya Energy Act seeks to help people manage their electricity usage, the NCCAP goes further in detailing specific projects to meet this goal. The NCCAP initially does this by establishing the need for expanded public transport systems at the municipal level. This goal is further developed with a call for the standard gauge railway between Nairobi and Mombasa to be extended to Naivasha and electrified. Additionally, the NCCAP describes the need for electric vehicle standards to be created, along with appropriate financial incentives.

Grid management and expansion

The Kenya Energy Act and the NCCAP both contain provisions to strengthen grid management and expansion but do so in much different ways. While both policies include means of managing and expanding the grid, the Kenya Energy Act does so more comprehensively than the NCCAP. Most importantly, the Kenya Energy Act establishes 11 energy sector entities along with their respective functions and focus areas. Notably amongst these 11 entities are the Kenya Power and Lighting Company, the Rural Electrification and Renewable Energy Corporation, and the Kenya Electricity Transmission Company. The delegation of responsibilities within the Kenya energy sector is absolutely vital for the grid to be effectively managed and expanded. With that said, the existence of these entities and formal clarification of their functions does not go far enough in ensuring that those entities are held fully accountable in meeting their goals. The Kenya Energy Act goes even further in addressing grid management by stipulating certain circumstances under which a provider may lawfully discontinue the provision of electricity to a consumer. This provision helps to clarify grid management practices and protect consumers who may have otherwise been harmed by unlawful electricity shutoffs.

The foremost way in which the NCCAP addresses grid management and expansion is by calling for the increased development of renewable energy resources. Specifically, the NCCAP calls for the 2,405 MW of renewables to be developed, prioritizing geothermal as a means for generating electricity. The NCCAP additionally calls for reductions in transmission and distribution losses in order to increase operating efficiency of the grid.

Policy uncertainty, political priorities, and development policies

Both the Kenya Energy Act and the NCCAP are substantial in how they address the barrier of policy uncertainty, political priorities, and development policies. In addition to establishing 11 vital energy sector entities, the Kenya Energy Act sets forth clear priorities for each of them. While these priorities may deviate from the act in practice, their presence in the act sets a precedent of care for sustainability in the Kenyan electricity sector. The development of renewable energy is also clearly established as a political priority within the Kenya Energy Act through such mechanisms as a feed-in tariff and the consolidated energy fund. Each of these mechanisms seek to further develop Kenya's renewable energy potential by incentivizing the proliferation of renewable energy technologies and infrastructure.

Political priorities are further strengthened through several key passages within the NCCAP. A number of firm goals are set through this policy, including to reduce greenhouse gas emissions by 9.2 $MtCO_2e$ through the development of renewables by 2022. The NCCAP also clearly sets the goal of cutting 1.8 $MtCO_2e$ by electrifying the Standard Gauge Railway and adding a bus transit system in the Nairobi metropolitan area. These goals and their associated strategies underscore strong commitment to sustainability within Kenya's development policies. The NCCAP also sets political priorities through it's provisions to train 100 students per year in renewable energy technologies through Kenya Power International, and 60 students per year at the UN University – Geothermal Training Program. In addition to the implementation of electric vehicle standards by 2019, these initiatives exemplify Kenya's ambition to more clearly define sustainability as a priority within their development policies. Despite the development of these priorities, it should be noted that community-based efforts to improve sustainability and equity in electricity provision go unmentioned in both policies.

Electricity reliability

While both policies include provisions to improve electricity reliability, neither policy provides a strong policy mechanism or project to meet this goal. In the Kenya energy Act, electricity providers are held liable to pay 'appropriate compensation' to a consumer for irregular or poor quality of electricity. This is the only provision which clearly addresses electricity reliability issues and seeks to mitigate their negative effects. However, the policy fails to further define appropriate compensation for consumers as well as a timeframe for delivery of compensation. The NCCAP alternatively sets a goal to reduce transmission and distribution losses from 18% to 14% by 2022 but sets no clear agenda on how to do so. Additionally, the NCCAP also prioritizes the delivery of energy efficiency projects aimed at energy efficiency in buildings, minimum energy performance standards, and clean lighting initiatives.

Illegal connections

Of the seven barriers described in Section 3.1, illegal connections is the least addressed barrier through each of the two policies. Illegal connections are directly addressed through numerous passages within the Kenya Energy Act but go unmentioned within the NCCAP. The Kenya Energy Act seeks to limit illegal connections by strictly defining the requirements and responsibilities of licensed electricity distributors and electricians. Additionally, the Kenya Energy Act goes on to specify exact fines and punishments for individuals found to have violated

these standards. While such measures are laudable attempts to address illegal connections in Kenya, these policies fail to include any program or funding to help integrate users onto the grid.

Development of renewable energy resources

Each of these policies more effectively addresses the development of renewable energy resources than any of the six other barriers studied within this thesis. The Kenya Energy Act's first major action to address the development of renewables is through the establishment of the Rural Electrification and Renewable Energy Corporation (REREC). Besides overseeing the implementation of the rural electrification program, the REREC is also responsible for the development of the renewable energy master plan. Within the renewable energy master plan, the REREC is directed to take special notice to county-specific needs as well as equity. Furthermore, the REREC functions to bolster domestic research and production of renewable energy technology, as well as local capacity for installation, maintenance, and operation. Following the creation of the REREC, the Kenya Energy Act goes on to establish the Nuclear Power and Energy Agency. Apart from leading the research, development, and dissemination of nuclear power, the Nuclear Power and Energy Agency is tasked with proposing policies and legislation for the development of nuclear energy in Kenya. Another key function of the Nuclear Power and Energy Agency as set forth in the Kenya Energy Act is to undertake extensive public awareness campaigns on Kenya's nuclear power program. In addition to the two previous entities, the Kenya Energy Act also creates the Renewable Energy Resource Advisory Committee to advise on criteria for the development of renewables, and licensing of renewable energy resource areas.

Beyond establishing the aforementioned entities of Kenya's renewable energy sector, the Kenya Energy Act also utilizes financial mechanisms to encourage the growth of renewables. One such way that this growth is encouraged is through the renewable energy feed-in tariff, meant to encourage the uptake of, and stimulate innovation in renewable energy. The Kenya Energy Act further seeks to support the development of renewables through the Consolidated Energy Fund. The Consolidated Energy Fund serves to financially support the development of renewable energy initiatives, as well as necessary infrastructure on an as-needed basis. A final way in which the Kenya Energy act incentivizes the development of renewable energy resources is through the authorization of net-metering to qualifying grid users. Net-metering allows grid users who utilize solar or other renewable energy technology to exchange their excess energy to the grid for credit. This function of net-metering is especially helpful for solar users, who's production of electricity varies with time of day and year. During times when solar panels are not producing electricity, the excess energy given to the grid helps to dramatically reduce the cost of user electricity bills.

Similar to the Kenya Energy Act, the NCCAP substantially supports the development of renewable energy resources in Kenya. However, the NCCAP largely does so by setting goals for renewable energy generation and enacting projects to meet these goals. The first substantial goal set by the NCCAP is for the reduction of 9.2 $MtCO_2e$ by 2022 through the development of geothermal and other renewable energy resources. This goal is paired with ambitions for an additional 2,405 MW of new renewables to be developed, prioritizing geothermal capacity. In order to meet these goals the NCCAP sets forth several projects which seek to reduce emissions and develop renewable energy infrastructure. The first of these seeks to implement the greening of Mombasa port through the installation of solar arrays. Exact emissions reductions and installation goals of this program are unspecified within the NCCAP. The second project to

reduce emissions and develop renewable energy infrastructure is based at Moi International Airport, where 0.5 MW of solar panels were installed by 2018. Goals and projects for the development of renewable energy resources in Kenya are complemented by a pilot program for the issuance of green bonds. The NCCAP specifies that funds generated from these bonds will be earmarked for projects to develop renewable energy resources and protect against climate change impacts.

5.4 What barriers could Kenyan policies better address?

Financial accessibility

The literature reviews have established increased financial accessibility as an immediate need for the improved equity and sustainability of electricity grids throughout developing economies. While financial accessibility is a limiting factor for many would-be grid users in Kenya, we now understand that the rural and inner-urban poor are particularly affected by this barrier. With many households currently lacking financial accessibility to the grid despite being within range of a low-cost connection, wider access to consumer financing options is now essential to improve electricity equality. However, neither the Kenya Energy Act nor the NCCAP are substantial in their strategies to mitigate this barrier, and both fail to identify Kenyans in greatest need of financial support to access the grid. The implications of these shortcomings are dire in Kenya's race to offer universal electricity access by 2030. This goal will remain out of reach as long as the needs of Kenya's poorest citizens in attaining grid connection continue to go unrecognized.

Cost recovery, energy usage, and affordability

The barrier of energy usage is deeply connected to the barrier of financial accessibility due to the positive correlation between increased electricity usage and decreased price per connection. No matter the numerous challenges of encouraging energy usage, a solution to this barrier will be essential if Kenya is to improve the equity of their grid. Such a solution would allow more users onto the grid, increasing financial accessibility by augmenting the price per connection. Policy mechanisms which attempt to encourage electricity mobility were found in both of the policies studied. The NCCAP attempts to address this barrier by detailing specific initiatives in the public transport sector to increase electricity consumption. However, both polices fail to describe means of increasing consumption at the household level. Efforts to electrify public transportation and set standards as well as incentives for electric vehicles are laudable. Yet these efforts will not manage to increase household consumption as will be required to fully address this barrier. In recognition of the connection between Kenya's barriers of financial accessibility and energy usage, solutions to encourage increased electricity consumption should be prioritized in future polices.

Grid management and expansion

The challenges associated with grid management and expansion have been particularly salient in Kenya, as exemplified by KPLC's staggering revenue decline in recent years. The

Kenya Energy Act takes important steps in working towards a solution to these challenges by outlining 11 key energy sector entities along with their operating goals. Despite this effort, the Kenya Energy Act fails to go far enough in holding these entities accountable for their specified objectives. While the existence of these entities symbolizes hope to come in improved grid management practices, strengthened mechanisms to hold them accountable will be needed in future policies to more effectively address this barrier. This concern characterizes somewhat of an inherent barrier to electricity grids in all stages of development throughout the globe. However, a robust response to this barrier will be necessary if Kenya hopes to improve the financial viability of its grid in coming years.

Policy uncertainty, political priorities, and development policies

The barrier of policy uncertainty and unclear political priorities as well as development policies has been characterized by poor coordination between the entities governing Kenya's electricity sector. A lack of transparency from those entities in setting market mechanisms and regulatory requirements has hindered the growth of mini-grids and the domestic production of home solar systems. Kenyan political uncertainty and the difficulties arising thereof are unsurprising given the history of political unrest following independence, and that which preceded the renewed constitution of 2010. Kenya has made incredible strides in delegating responsibilities within the electricity sector through recent years. Further steps to improve coordination between, and transparency from those agencies should be of critical concern for future policies. Issues of environmental justice have also been noted in several Maasai communities which have been forcefully relocated for new geothermal and other energy projects. Such issues are unfortunately unsurprising due to the historic marginalization of Maasai communities throughout Kenya, and elsewhere in East Africa. Environmental injustice in the continued development of Kenya's electricity grid should be met with measures to increase transparency and care from energy sector entities when conducting community negotiations.

Despite an overall lack of strong policy mechanisms to prioritize equity in Kenya's electricity grid, both of the policies are strong in their attention to sustainability. Each of the policies do so in different ways, the Kenya Energy Act by establishing entities to govern renewable energy development, and the NCCAP by setting goals for renewable development. The clear objectives set within the NCCAP to bolster renewable energy development, establish electrified public transportation, and provide training for energy professionals are impressive. The strength of these strategies in setting a clear commitment to sustainability comes as a surprise given the overall lack of specific projects and goals set within the Kenya Energy Act. Despite this strength, the lack of community-based strategies to guide electrification is a point of concern in both policies. While the absence of these strategies is unsurprising given their nuance and complexity, their inclusion in future policies will be necessary if Kenya hopes to better address equity within grid development.

Electricity reliability

Low consumer confidence in the reliability of Kenya's electricity grid has been a cause for widespread dissatisfaction amongst grid users. This dissatisfaction has tarnished KPLC's public image, discouraging both connection from potential users and cooperation from existing users. Furthermore, poor electricity reliability in Kenya has been an immense financial burden

for many households. There are two major ways that Kenyan households have been financially burdened by poor electricity reliability from the grid. The first being a loss of business, academic, or domestic productivity resulting from frequent and unplanned outages. Loss of productivity has driven many households to further financially burden themselves with stand-alone solar system or other means of generation in addition to their grid connection, this characterizes the second major financial burden resulting from poor grid reliability. The latter of these two financial burdens is particularly interesting, especially considering the high cost for grid connection alone. This begs the question of how KPLC might be able to reduce the financial burden on their user base in coming years, restoring consumer confidence of the grid. The answer to this question will need to include means of improving the reliability of Kenya's electricity grid, especially if equity is to be prioritized in electricity provision. Without such a solution the financial security of many Kenyan communities will continue to be impeded, as will the overall financial security of the grid.

Despite the inclusion of goals to improve electricity reliability within both policies, neither proposes strong policy mechanisms to meet said goals. A lack of strong policy mechanisms to address this barrier is unsurprising given the complexity of potential solutions. Complex as they may be, such solutions will be absolutely critical if Kenya hopes to offer universal access to electricity in coming years.

Illegal connections

While the literature has revealed that many countries struggle with illegal grid connections, this challenge appears to be strikingly complex in Kenya's inner urban areas. Particularly, the presence of large, sometimes violent energy cartels seems quite unique to these areas. Apart from the predatory manner in which these organizations collect fees, there are many safety concerns to do with the haphazard construction of illegally connected infrastructure. The very existence of these cartels comes as a surprise given their scarcity elsewhere. However, the safety concerns resulting from unsafe electrical installation have been widely noted outside of Kenya. The threat that this growing electricity oligarchy poses to vulnerable inner-urban residents as well as the legitimacy of KPLC is extremely serious

Despite the clear threat that illegal connections from energy cartels pose to universal electrification and equitable electricity provision, this barrier was minimally addressed within the policies. Unfortunately, this barrier is unaddressed through the NCCAP and only addressed through punitive action within the Kenya Energy Act. Given the nature of this act as a regulatory document, the absence of proactive or community-based strategies to mitigate this challenge is unsurprising. However, that is not to say that future iterations of the Kenya Energy Act should shy away from such strategies going forward. Efforts to manage illegal connections through punitive action will not succeed without proactive efforts to integrate illegally connected people onto the grid. It is for this reason exactly that future solutions to this barrier will require a strong community-based approach in order to divert illegal connections onto the grid. Above all, improved coordination amongst community-based efforts to educate the public and reduce illegal connections will be critical in order to achieve universal and equitable electricity provision.

Development of renewable energy resources

The development of renewable energy resources in Kenya has been a notable success, exemplified by their status as a leading renewable energy generator on the global scale. While

Kenya's geographic location has primed it's use of geothermal and solar technology, the proliferation of these technologies has been a direct result of national policy efforts. Kenya's use of a feed-in-tariff for wind, biomass, small hydro, geothermal, biogas, and solar has dramatically increased the country's production of renewable energy. This feed-in-tariff is the preeminent policy mechanism used to address the development of renewable energy resources within the Kenya Energy Act. Additionally, the implementation of a net-metering systems has significantly incentivized the use of renewable energy technology at the household and community levels. The establishment of key regulatory authorities within the Kenyan renewable energy sector has also bolstered the Kenya Energy Act's strength. Considering the general lack of strong policy mechanisms to address other barriers, the strength of the Kenya Energy Act in addressing renewable energy development comes as a surprise. The inclusion of specific renewable energy goals and projects within the NCCAP comes as less of a surprise given the document's objective in providing measures for low-carbon, climate resilient development. This is also unsurprising due to the general trend of the NCCAP seeming to offer more specific goals, strategies, and projects than the Kenya Energy Act.

With a wealth of naturally occurring geothermal energy resources in Kenya, the eventual implementation of these resources on the grid seems intuitive. However, the rate at which these and other renewable energy resources have been developed in Kenya through policy mechanisms is quite unprecedented. To have increased renewable energy generation by over eight-fold in the last thirty years is a feat which has solidified Kenya's position as a leader of renewable energy development on the continent.

6. DISCUSSION

6.1 The seven barriers

Each of the seven barriers targeted within this thesis have been noted for their relevance in efforts to develop a more equitable and sustainable electricity grid in Kenya. The country has made significant strides in addressing renewable energy resources where it has not with other barriers, although each will need to be addressed if Kenya is to achieve universal electrification. Figure 3 and the following discussion section below are segmented to address each of the seven barriers as explored through the previous sections.

STRENGTH OF POLICY RESPONSE TO IDENTIFIED BARRIERS AND ASSOCIATED POLICY MECHANISMS FOUND WITHIN THE KENYA ENERGY ACT AND THE NATIONAL CLIMATE CHANGE ACTION PLAN

BARRIER TO ELECTRIFICATION	STRENGTH OF POLICY RESPONSE TO BARRIER	CURRENT POLICY MECHANISMS USED TO ADDRESS BARRIER
Financial accessibility	Weak	- Rural Electrification Program Fund - Funding to assist communities affected by geothermal resource extraction
Cost recovery, energy usage, and affordability	Moderate	- Mandate meter usage - National energy efficiency and conservation action plan - Electrification and expansion of public transit system
Grid management and expansion	Moderate	- Establish and outline 11 energy sector regulatory agencies - Clarify reimbursment conditions for unlawful electricity shutoffs - Call for 2.406 MW of additional renewable generation capacity
Policy uncertainty, political priorities, and development policies	Moderate	- Establish and outline 11 energy sectory regulatory agencies - Prioritize sustainability: feed-in tariff, net-metering, the consolidated energy fund, GHG reduction goals, renewable energy generation goals, renewable energy development student training
Electricity reliability	Weak	- Reimbursment conditions for unlawful electricity shutoffs - Goal to reduce transmission and distribution losses - Energy efficiency projects
Illegal connections	Weak	- Strict definition of requirements for licensed electricity distributors and electricians - Punitive action for illegal electricity connection and distribution
Development of renewable energy resources	Strong	- Renewable energy master plan - Feed-in tariff - Net metering - Consolidated energy fund - Establish Rural Electrfication and Renewable Energy Corporation - Establish Nuclear Power and Energy Agency - Call for 2.406 MW of additional renewable generation capacity - Green bond pilot program

Figure 3. Barriers to equitable and sustainable electricity provision in Kenya matched with strength of policy response and associated policy mechanisms found within the Kenya Energy Act and the National Climate Change Action Plan.

Financial accessibility

Previous unsuccessful efforts to address this barrier in Kenya and beyond now emphasize the need for governments to identify those people in greatest need of financial support for grid connection. While this shortcoming in Kenya has been detrimental to the equity of electricity provision there, it is unclear whether the government would be able to support the connection of these individuals under current financial conditions. That is, adequate financial support may not even have been made available regardless of whether the government was successful in identifying Kenyans in greatest need of such support. This indicates a probable lack of

motivation on the part of the government to identify those individuals as a result of inadequate government resources to support their connection under current conditions.

Cost recovery, energy usage, and affordability

While the Kenya Energy Act and the NCCAP each attempt to encourage positive energy use habits through policy mechanism, both fail to implement meaningful change at the household level. However, the shortcomings of these policies to interact with energy usage at the household level is unsurprising given the current apprehension of grid users towards grid management. Past attempts by KPLC to encourage positive habits of energy usage at the household and community levels have been characterized by poor planning and miscommunication. These repeated failures by KPLC to influence meaningful change in energy usage habits at the household and community levels indicate the complexity of this barrier. Under the grid's current development and political conditions, it is unlikely that KPLC will be successful in their efforts to positively influence energy use habits in order to improve cost recovery and affordability of the grid. Trust between grid management and its users will be absolutely essential in order for such changes to take place. The poor reputation which plagues KPLC and their customers' lack of trust in the grid may explain why the government is currently hesitant to implement policy mechanisms to influence energy use habits at the household level. Improved trust in the integrity of KPLC and the grid may serve as a catalyst for future policies to successfully encourage positive energy use habits at the household and community levels.

Grid management and expansion

Having delegated management responsibilities within the Kenyan electricity sector, the Kenya Energy Act has laid significant groundwork for the further improvement of electricity provision in Kenya. However, neither the Kenya Energy Act nor the NCCAP have gone far enough in holding the entities of the Kenyan electricity sector accountable in meeting their goals. This represents an obvious challenge for a country like Kenya whose grid has dramatically expanded in recent years. With a long history of corruption through all levels of government, Kenya has met that same familiar foe in the creation of governing entities within its energy sector. This corruption largely explains why Kenya has had so much difficulty implementing policy mechanisms to hold these entities accountable within recent policies. While systemic corruption in the Kenyan electricity sector is a substantial challenge to overcome, future policies will need to hold energy sector entities accountable to encourage more equitable and sustainable electricity provision.

Policy uncertainty, political priorities, and development policies

Similar to the barrier of grid management and expansion, policy uncertainty and unclear political priorities in Kenya have largely resulted from government corruption. Given this glaring challenge, it remains unclear just how successful efforts to resolve uncertain political priorities will be through policy mechanisms alone. Despite the inclusion of policy mechanisms for more transparent political priorities, an overall lack of community-based efforts to improve grid equity and sustainability is a major setback in current policies. The challenges in establishing community-based efforts to mitigate this barrier go well beyond initial difficulties in better

understanding the needs of marginalized communities. With environmental justice issues having recently developed from the coerced relocation of Maasai communities, it is clear that the needs of such marginalized groups are yet to be fully understood and respected. Beyond the difficulties related to assessing and understanding the unique needs of such groups, there is the question of whether the government and grid management has the capacity to accommodate their needs. As noted with the barrier of financial accessibility, it is unlikely that the current financial state of the grid could provide for the financial needs of these groups in order to connect. That is not to say that such a solution is impossible, rather, it is to note the improved grid management strategies and extensive financial support which will be necessary to meet this challenge.

The wealth of renewable energy resources which are naturally available in Kenya have allowed strong policy mechanisms within both of these policies to improve grid sustainability. These resources' wide availability currently makes the prioritization of sustainability over equity a means for these policies to elicit immediate progress. With Kenya's rapid development of renewable energy resources through policy mechanisms in recent years, it is clear why the government and grid management may have first chosen to focus on this low hanging fruit. However, where these policy mechanisms have succeeded in bolstering renewable energy development it is clear that they have failed in providing for equity of electricity provision.

Electricity reliability

Although both of the policies studied include loose policy mechanisms to improve electricity reliability and reduce unnecessary losses, neither of the policies effectively address the barrier of electricity reliability. As an absolute necessity to improve customer confidence in the grid, future policies will need to overcome this barrier and provide clear means of reducing transmission and distribution losses. At the forefront of this barrier are the financial and logistical difficulties associated with accessing remote areas of Kenya which suffer the most from unplanned outages and unnecessary losses. While there exist some fairly straightforward solutions to this challenge, the issue at hand has been overcomplicated by disorganization and corruption in grid management. Disorganization and miscommunication amongst grid management in Kenya has been a common theme identified through this thesis. In the case of KPLC, this disorganization and miscommunication can be traced to corruption within the company. With a questionable integrity at best, KPLC has yet to provide substantial incentives for improved efficiency and organization within the company culture. While identifying goals to reduce unnecessary losses is an important step in solving this problem, future strategies will need to overcome the disorganization which has long troubled KPLC.

Illegal connections

The barrier of illegal connections onto the grid is by far the most complex and difficult to address of any barrier studied through this thesis. Furthermore, the deeply complex nature of this barrier makes potential actions to mitigate its negative effects extremely resource intensive. Community-based initiatives will almost certainly be required to fully address the needs of Kenyans illegally connected to the grid and help facilitate their legal connection. The challenge of working towards such a solution through policy mechanisms goes well beyond the initial difficulty of building trust and rapport within communities. Nuanced financial circumstances and relationships with energy cartels between differing neighborhoods will complicate the process of

individual neighborhood intervention. Beyond the sheer resources needed to develop an accurate understanding of neighborhood needs, the poor financial state of the grid would make intervention based off of that understanding extremely difficult. The resource intensive action required to understand and address this barrier is likely the reason that KPLC and the Kenyan government have been so hesitant to intervene with policy mechanisms. Despite this, the grid's potential to address this barrier and reduce illegal connections will be greatly enhanced as it works to improve its overall financial viability.

Development of renewable energy resources

As mentioned above, Kenya's wealth of resources for renewable energy development have allowed the country to successfully address this barrier through policy mechanisms. Seeing as solutions to address this barrier are highly feasible in the Kenyan context, the appeal of prioritizing renewable energy development through policy mechanisms is logical for the grid. Having become an international leader in the development of renewable energy through recent years, the prioritization of this barrier has been a clear success.

7. CONCLUSIONS

Kenyan policies in the energy sector have made substantial progress in addressing barriers to equitable and sustainable electrification through policy mechanisms. Despite this progress, there are still many questions to be answered, and much work to be done if Kenya hopes to achieve its goal of universal access to electricity by 2030. Most important to these questions are the barriers of financial accessibility, insufficient energy usage, electricity reliability, and illegal connections to the grid. All of these barriers share a common need for increased transparency from the energy sector and national government when setting political priorities and development policies. Additionally, each of these barriers may be successfully addressed through the implementation of community-based mitigation strategies. In order to provide increased options for consumer financing and improve financial accessibility, grid managers must first identify and better understand Kenyan citizens in greatest need of financial support. The already resource intensive development process for consumer financing mechanisms explains why additional efforts to understand the most vulnerable citizens have yet been seen. However, it is due to the high cost of development for these mechanisms that community-based initiatives to better understand Kenyans in greatest need are now imperative. By working within these communities to establish rapport with existing and potential consumers KPLC would improve their unfavorable reputation and open the door for more informed consumer financing options. This community-based tactic would be doubly useful as a means of encouraging positive energy use habits at the household and community levels. By holding public forums or workshops at the community level, grid management would build a stronger relationship with the community while also disseminating information on how to access and improve electricity usage.

The barrier of electricity reliability will require an alternative community-based mitigation strategy from those mentioned above. Municipal and regional electricity cooperatives as have been developed in Bangladesh offer a promising tactic to help mitigate some of the financial burdens associated with this barrier. However, this strategy would require intensive

action at the community level, the magnitude of which KPLC and other key entities in the Kenyan electricity sector have yet to display. Despite the lack of precedence for this action in Kenya, the grid's financial security will continue to suffer until action is taken to improve electricity reliability. While there are other means of improving electricity reliability, it is unlikely that the necessary care and attention will be directed towards exact community needs unless strategies are based at the community level. Additionally, localized electricity cooperatives offer a promising means of discouraging illegal connections to the grid by improving grid-user relations and garnering increased support for the utility. Other community-based strategies have been utilized by KPLC in past attempts to reduce the control held by energy cartels. These failed efforts have been noted for their overall lack of internal coordination, limiting their effectiveness.

Although current Kenyan policies fail to embrace community-based strategies to develop equitable and sustainable electrification, the use of these strategies in future Kenyan policies will be imperative. Policy mechanisms to implement these strategies could be developed within future iterations of both documents, or within entirely new policies. Regardless of how they are implemented, community-based initiates within the Kenyan electricity sector will be essential for an improved understanding of community needs and challenges in accessing electricity.

Outside of community-based policy efforts for grid equity and sustainability, future policies must include improved mechanisms to hold energy sector entities accountable and increase transparency from grid management. While holding these entities accountable will be extremely difficult, a swift solution will be needed to mitigate recent revenue declines, failing service, and the grid's disintegrating reputation. Future research should be directed towards current mechanisms for accountability amongst grid management and methods for their improvement going forward.

The development of renewable energy resources through policy mechanisms has been prioritized in Kenya through recent years, resulting in significant progress. However, Kenya still has far to go in fully achieving an equitable and sustainable system for electricity provision. With the intermittent nature of many renewable energy resources, poor energy storage systems will continue to hinder the viability of their wider use in Kenya. Breakthroughs in these systems will not only enable further integration of renewables onto the grid but may also allow increased financial benefits through energy exports. Future policies should continue incentivizing the development of renewable energy resources through the expansion of current policy mechanisms like net-metering. These policies will find even more success when coupled with community-based efforts to gauge community preferences and improve relationships between the grid and its customers. Despite shortcomings in policy efforts to improve the equity and overall sustainability of Kenya's electrical grid, other countries now have much to learn from their example. They may choose to focus on the proven success of feed-in tariffs and net metering in encouraging the generation of renewable energy, or the striking need for community-based approaches in better serving marginalized communities. Through each of Kenya's triumphs as well as failures in developing a more equitable and sustainable grid through policy mechanisms, countries throughout East Africa and beyond may now gain tremendous insight. In particular, Kenya's exhaustive efforts to proliferate renewable energy generation capacity will serve as a potent example for other countries with developing economies to follow in coming years.

8. APPENDICES

Key Passages		
Section	Page Number	Passage
National Energy Entities	25	There is established the Energy and Petroleum Regulatory Authority… whose function shall be to regulate the generation, importation, exportation, transmission, distribution, supply, and use of electrical energy with the exception of licensing nuclear facilities. The Authority shall also regulate the production, conversion, distribution, supply, marketing and use of renewable energy…set, review, and approve contracts, tariffs, and charges for common user upstream petroleum facilities.
National Energy Entities	46	There is established the Electrification and Renewable Energy Corporation… The corporation shall perform such functions and exercise such powers as may be necessary under this act to oversee the implementation of the Rural Electrification Program…develop and update the renewable energy master plan taking into account country specific needs and the principle of **equity** in the development of renewable energy resources…develop, promote and manage in collaboration with other agencies, the use of renewable energy and technologies.
National Energy Entities	52	There is established the Nuclear Power and Energy Agency…The agency shall be the nuclear energy program implementing organization and promote the development of nuclear electricity generation in Kenya …propose policies and legislation necessary for the successful implementation of a nuclear power program.
Geothermal Resources	69	Any royalties received by the National Government from geothermal energy produced under this section shall be paid into the Treasury of the National Government and apportioned between the National Government, County Government and the local community…the local community's share shall be equivalent to five percent of the royalties and shall be payable through a trust fund managed by a board of trustees established by the local community.
Renewable Energy Feed-in-Tariff System	73	There is established a renewable energy feed-in-tariff system with the objective of catalyzing the generation of electricity through renewable energy sources, encouraging local distributed generation thereby reducing demand on the network and technical losses associated with transmission and distribution of electricity over long distances, encouraging uptake of, and stimulate innovation in renewable energy technology, and reducing greenhouse gas emissions by lessening reliance on non-renewable energy resources.
Electrical Energy	88	A person who carries out any electricity undertaking without a license commits an offence and shall, on conviction, be liable to

		a fine of not less than one million shillings, or to a term of imprisonment not less than one year, or both.
Electrical Energy	91	A licensee shall not purchase or acquire any undertaking of any public authority, person, or body of persons supplying electrical energy under any license, except with the consent of the Authority, which consent shall not be unreasonably withheld.
Electrical Energy	92	A licensee shall not transfer or otherwise divest any rights, powers or obligations conferred or imposed upon them by the license without the consent of the authority.
Rural Electrification	106	There is established the Rural Electrification Program Fund with the objectives of accelerating electricity infrastructure in the country. The Rural Electrification Program Fund consists of an electricity sales levy, donations, grants, loans, interests from bank deposits…The Cabinet Secretary may impose a levy of up to five percent on all electricity consumed in the country, the proceeds of which shall go into the Rural Electrification Program Fund.
Retail Supply of Electricity	107	A person who wishes to carry out electrical installation work must be licensed as an electrical contractor by the authority…A person who carries out any electrical installation work while not duly authorized as an electrical worker or contractor commits an offence and shall on conviction, be liable to a fine not exceeding one hundred thousand shillings or to a term of imprisonment not exceeding six months, or both.
Metering of Electrical Energy	110	The amount of electrical energy supplied to the consumer or the number of hours during which the supply is given or the maximum demand taken by the consumer, or any other quantity of time connected with the supply shall be ascertained by meters of a type approved by the Kenya Bureau of Standards, or determined in a manner agreed upon by the retailer and consumer…the retailer shall supply and fix meters upon the premises of the consumer and connect the supply system therewith.
Metering of Electrical Energy	113	A licensee shall not, except for reasons beyond the licensee's control, reduce, discontinue or refuse the supply of electrical energy to any consumer unless…(a) the consumer has failed to pay charges for consumption of electrical energy or instalments relating to deferred connection costs, whether such charges are due to the licensee for the supply of electrical energy to premises in respect of which such supply is demanded or in respect of other premises…(b) the consumer fails or neglects to make good any defects in his installation, provided that those defects and the period within which such defects are to be rectified, have been communicated to the consumer in writing.
Net-Metering	115	A consumer who owns an electric power generator of a capacity not exceeding one megawatt may apply to enter into a net-

		metering system agreement to operate a net-metering system with a distribution licensee or retailer, if that consumer has a generation facility that is located in the area of supply of the distribution licensee or retailer.
Offences and Penalties	120	A person who…without lawful right abstracts, branches off or diverts or causes to be abstracted, branched off or diverted any electrical energy, or consumes or uses any such electrical energy which has been wrongfully or unlawfully abstracted, branched off or diverted, knowing it to have been wrongfully or unlawfully abstracted, branched off or diverted, or disconnects, or permits to be disconnected anu conductor or apparatus from any electric supply line belonging to a licensee without consent of the licensee…commits an offence and shall on conviction, be liable to a fine of not less than one million shillings, or to a term of prison not less than one year, or both.
Offences and Penalties	121	A person who willfully or with intent to interfere with the management or operation of the apparatus of a licensee vandalizes or damages any works of or under control of a licensee, steals or with the intent to steal breaks, throws down or damages any works of or under control of a licensee, steals, illegally trades or improperly uses any of the electrical energy supplied by a licensee commits an offence and shall on conviction, be liable to a fine of not less than five million shillings, or a term of imprisonment of not less than five years, or both.
Offenses and Penalties	122	One who destroys or damages energy infrastructure, maliciously misinforms the public on matters of energy with criminal intent or driven by gain leading to economic sabotage commits an offence which is deemed to be an economic crime and shall on conviction, be liable to a fine of not less than five million shillings or a term of imprisonment of ten years, or both.
Miscellaneous Provisions	147	The Cabinet Secretary shall establish the Consolidated Energy Fund to cater for energy sector disaster mitigation and response, hydro risk mitigation, promotion of renewable energy initiatives, construction of appropriate energy infrastructure, energy efficiency and conservation.

Table 3. Key passages of the Kenya Energy Act 2019 describing policy mechanisms

9. COVID-19 IMPACT STATEMENT

The completion of this honors thesis will be relatively unaffected by the COVID-19 pandemic as its research is based in existing literature and government documents. I will be meeting with my academic committee over zoom. The updated academic calendar will not

impact my planned activities, and a return to fully remote operations would not warrant contingency plans for this honors thesis.

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