Master Thesis

Title: Assessment of governance context and supportiveness for off-grid renewable energy development in Kenya

Master Environmental and Energy Management

University of Twente

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Table of Contents

Tables and figures

Acronyms

ECOGRES = Enabling Components for Off-Grid RE Solutions

EPRA = Energy and Petroleum Regulatory Authority

FiT = Feed-in Tariff

GAT = Governance Assessment Tool

GDC = Geothermal Development Company

GDP = Gross Domestic Product

IoT = Internet of Things

IPP = Independent Power Producer

KEBS = Kenya Bureau of Standards

KenGen = Kenya Electricity Generating Company

KETRACO = Kenya Electricity Transmission Company

KNES = Kenya National Electrification Strategy

KPLC = Kenya Power

KRA = Kenya Revenua Authority

NEMA = National Environmental Management Authority

NuPEA = Nuclear Power and Energy Agency

PAYG(o) = Pay As You Go

RBC = Reward-based Crowdfunding

RBF = Result-based Financing

RE = Renewable Energy

REREC = Rural Electrification and Renewable Energy Corporation

Abstract

When compared to grid-based electrification, off-grid renewable energy has the potential to accelerate access to basic energy needs. However, the decentralized and technological nature of off-grid renewable energy solutions creates unique governance challenges that impede their long-term development and operation. Based on a literature review and qualitative case study research, this thesis aims to advance the understanding of the impact of governance on off-grid RE development. The paper describes governance challenges in developing countries and evaluates the governance context and supportiveness in Kenya, the case study country. The International Renewable Energy Agency's framework for enabling off-grid renewable solutions was used for a literature review on the governance challenges faced by developing countries, as well as to assess Kenya's governance context. The GAT assessment tool was then used to assess Kenya's governance context's supportiveness for off-grid renewable energy development. The findings show that Kenya faces significant challenges in terms of governance supportiveness for off-grid renewable energy, but there are also some opportunities. Recommendations for additional research are made, and lessons learned on how to use the two analytic frameworks and selected methodologies to assess a country's governance context and support for off-grid renewable energy are shared.

1. Introduction

1.1 Background

Renewably energy (RE) has the potential to significantly increase access to clean cooking facilities, alleviate energy poverty and gender inequality, promote sustainable development, and shift the paradigm toward green economies through the creation of sustainable jobs and employment opportunities (REN21, 2013; UN, 2018; Johnston, 2016). Adopting RE successfully will require widespread deployment of RE in off-grid areas throughout developing countries (IRENA, 2019), where centralized generation and distribution systems are unsuitable due to long transmission distances and prohibitively high capital costs for large centralized generation plants (Deichmann, 2011).

However, the decentralized and technological nature of off-grid RE solutions creates unique governance challenges that hinder their development and operation in a sustainable manner (Ma and Urpelainen, 2018; IRENA, 2019; UNDP and ETH Zurich, 2018). Despite their potential, progress has been restrained by a variety of challenges related to policy, institutional frameworks, technology, finances, capacities, and levels of knowledge and awareness (Frame, 2011; IRENA, 2019). Additionally, due to high entry costs and risks, as well as the lack of domestic manufacturing and service sectors, the private sector is frequently unable to supply affordable RE products and services to these sectors (UN, 2018).

Even countries with a high proportion of households without access to electricity have struggled to expand their off-grid RE capacity due to low uptake and consumption, as well as high connection tariffs (Blimpo and Cosgrove-Davies, 2019). Additionally, the introduction of advanced RE technologies into difficult environments raises concerns about their usability, reliability, and affordability (Frame, 2011; Feron, 2016). Furthermore, off-grid RE is a typically fast-moving private-led sector facing unclarity around policies and regulations, burdensome or poorly formulated procedures, and government support that falls short of adequately addressing private sector risks related to investments, financing, and return on investments (UNDP and ETH Zurich, 2018). All of these factors contribute to the high failure rates of off-grid RE solutions (Dauenhauer et al., 2020; Terrapon-Pfaff et al., 2014; Ma and Urpelainen, 2018; Feron, 2016).

1.2 Research objective

This thesis' primary objective is to advance our understanding of the impact of governance context on off-grid RE advancement based on a literature review and qualitative case study research. The thesis will examine the governance challenges in developing countries, and the governance context and supportiveness in the case study country Kenya. Kenya was selected country because of its front-runner role in Africa in terms of off-grid RE, particularly solar home systems. Additionally, the thesis will

make recommendations to relevant stakeholders and discuss the lessons learned from using the selected theoretical framework and methodology in this research context.

The following research question has been formulated: *What lessons can be learned from assessing the context and supportiveness of Kenya's governance in relation to the development of off-grid renewable energy?*

The sub-questions are:

1. What governance challenges do developing countries face in off-grid renewable energy development?
2. What is the governance context in Kenya concerning off-grid renewable energy?
3. To what extent is Kenya's governance context supportive for enabling off-grid renewable energy solutions for electricity generation?

Chapter 2 of this research paper will introduce the theoretical framework and research methods. Chapter provides an overview of the governance challenges faced by developing countries. Chapter 3 presents the findings of the analysis of Kenya's governance context using the ECOGRES framework. Chapter 4 analyzes the governance context's supportiveness for off-grid-RE development. Finally, chapter 5 concludes the research with conclusions, recommendations, and a reflection on the findings and the theoretical framework and methods used.

2. Theoretical framework and research methods

This thesis builds further on the analytic framework approach used by Jain et al. (2020) to assess the governance of low energy green building innovation in the building sector of Singapore and Delhi (Jain et al., 2020). Jain et al. (2020) use a synthesis of two analytic frameworks: the Sectoral Systems Innovation Assessment framework (SSIAf), which is based on frameworks Strategic Niche Management and Sectoral Innovation Systems (Jain et al., 2014), and the Governance Assessment Tool (GAT) developed by Bressers et al. (2016). Jaine et al. (2020) reason that combining insights from the two frameworks expands the scope and improves understanding of sustainable transitions and he role and state of 'governance' in niche development processes in sectoral systems. A helpful generic definition of governance used in this research is "the interaction of public and private actors aimed at solving societal problems or creating societal opportunities in an institutional context with a normative foundation" (Bressers, 2016, p4).

This chapter begins by explaining the analytic frameworks used, followed by the research methods wherein the data collection and data analysis are explained, and an overview of the interview participants.

2.1 ECOGRES and GAT frameworks

While the SSIAf could also be used for assessing the governance context of off-grid RE, this thesis instead applies the *Enabling Components for Off-Grid RE Solutions* (ECOGRES) developed by the International Renewable Energy Agency (IRENA), which is already tailored to the advancement of off-grid RE (IRENA, 2018; IRENA, 2019). With reference to the used definition of governance, the governance context of off-grid RE solutions is determined by looking at the dynamics within and between the different components of the ECOGRES framework. I.e., this research considers the ECOGRES' components as the governance dimensions for analyzing the governance context. The GAT framework on the other hand is used to assess the context's supportiveness for off-grid RE development based on the same ECOGRES components.

2.1.1 Defining governance context: ECOGRES

Accelerating progress toward the SDG 7 goal of ensuring access to affordable, reliable, sustainable, and modern energy for all requires concerted action across multiple enabling environment or governance components (IRENA, 2018). According to IRENA (2018) and IRENA (2019), these include policies and regulations, delivery and financing models, institutional frameworks, capacity building, technology adaptation, and multi-stakeholder -and cross-sector interlinkages (figure 1).

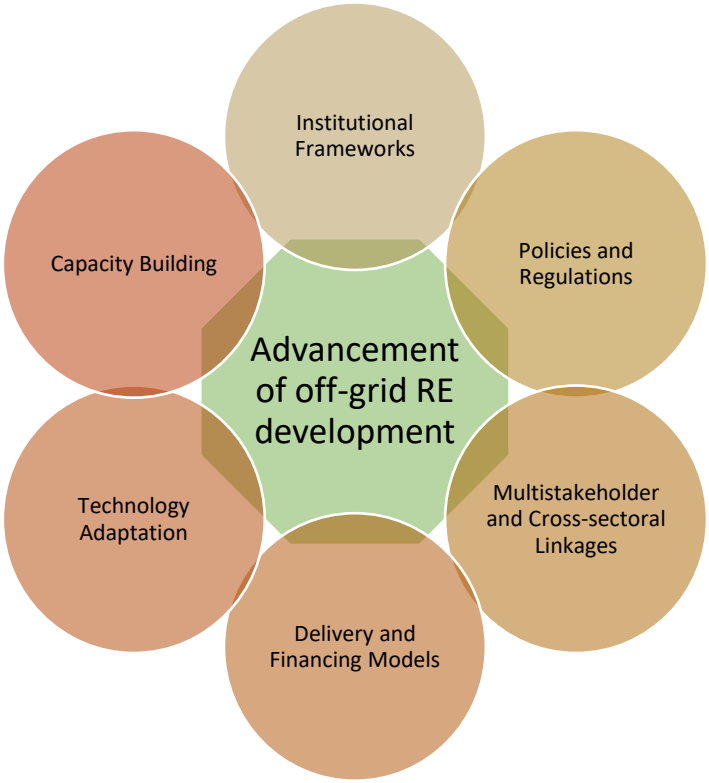

Figure 1: ECOGRES framework. Adapted from IRENA (2019), page 10.

The different components are elaborated in Annex II. Based on the component's explanation in IRENA (2018) and IRENA (2019), indicators were derived that will be used for describing the governance context. Table 1 gives an overview of the enabling components and the corresponding indicators.

Component	**Indicator**
Policies and regulations	Clear definition of off-grid areas
	Dedicated off-grid policies
	Clear goals and objectives
	Integrated electricity sector framework
	Adequate standards and quality control instruments
Institutional frameworks	Clear roles and responsibilities
	Simplified and streamlined administrative procedures
	Adequate capacities
Delivery and financing models	Tailoring to the local context
	Long-term and tailored financing
	Public financing for de-risking private investments
	Innovative financing models
Technology adaptation	Adaptation to local conditions
	Public-private partnerships (PPP) and loan grants
	Favorable market policies
Capacity building	Change readiness assessments
	Accessible entrepreneurial support programs
	Dedicated project facilitation tools
	Availability of adequate skills
Multi-stakeholder and cross-sector linkages	Multistakeholder approach to project development
	Cross-sector service approach
	Leverage of innovative solutions
	Provision to public services

Table 1: Enabling components and indicators for off-grid RE solutions. Adapted from IRENA (2018) and IRENA(2019)

The indicators are used to develop several descriptive questions per component (Annex III) that are used for the expert interviews.

2.1.2 Supportiveness of governance context: GAT

The GAT is based on Contextual Interaction Theory (CIT), which views policy implementation as a multi-actor interaction process that is ultimately driven by the actors involved (Bressers, 2007; Bressers, 2009; Bressers et al., 2016). CIT focuses on the organization and facilitation of the practical implementation of policy instruments used to influence various societal levels and sectors, arguing that multi-actor processes can be understood through an examination of the actors' motivations, cognitions, and resources. The GAT identifies five dimensions to governance and four criteria that influence the governance system's degree of supportiveness (Bressers et al., 2013). The five dimensions used are (1) levels and scales, (2) actors and networks, (3) problem perceptions and goal ambitions, (4) strategies and instruments, and (5) responsibilities and resources for implementation. However, instead, this research uses the six ECOGRES components described in Section 2.1.2 as governance dimensions

because they are specifically tailored for the advancement of off-grid RE. This means that, while the GAT framework can be used to describe both the governance context and the governance supportiveness of a particular resource, this research uses it exclusively to assess governance supportiveness.

The framework considers four supportiveness or governance quality criteria (Bressers et al., 2013):

1. *Extent:* are all relevant aspects of governance considered?
2. *Coherence:* are the components of the governance dimensions reinforcing rather than contradicting each other?
3. *Flexibility:* are multiple pathways to achieve the goals allowed or embraced, depending on opportunities and threats as they arise?
4. *Intensity:* how strongly do the regime elements push for changes in the status quo?

Figure 2 shows an example of a visualization of a national energy governance model's supportiveness to off-grid RE expansion. How the scores are determined is explained in section 2.2.3.

SUPPORTIVENESS		**GAT Governance Supportiveness Criteria**			
		Extent	Coherence	Flexibility	Intensity
ECOGRES Component	Institutional frameworks				
	Policies and regulations				
	Multi-stakeholder and cross-sector linkages				
	Delivery and financing models			↓	↓
	Technology adaptation				
	Capacity building	↑			
Colours Red: Restrictive; Orange: Neutral, Green: Supportive					
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend					

Figure 2: Example of visualization of the supportiveness of national energy governance concerning off-grid RE (Adapted from Bressers et al., (2013), page 8.

The ECOGRES and GAT integration also considers the time dimension by aiming to reveal significant past or future changes to the governance context and supportiveness. Similar to Bressers et al. (2013), this is done by including one time dimension question to each component questionnaire, which is "Have any of these conditions changed over time or are likely to change in the foreseeable future?".

2.2 Research methods

The research methods for this thesis paper includes a literature review of the governance challenges for off-grid RE development in developing countries and a case study of the governance context for off-

grid RE in Kenya. Both research methods use the ECOGRES framework for data analysis. An integration of the ECOGRES and GAT frameworks is used to determine the governance supportiveness for off-grid RE development in the case study country.

2.2.1 Data collection

Primary sources were used to collect data, which included nine semi-structured interviews. Secondary sources such as research articles, international reports, policy papers, and market status reports were used to review the governance challenges in developing countries related to off-grid RE, and to describe the case study country. The interviewees were selected through desk research that identified relevant stakeholders who are directly or indirectly involved in the governance of off-grid RE development in Kenya. The aim was to include at least one participant from the following actor types, who are directly or indirectly involved in off-grid RE development: 1) policymakers, 2) private sector, 3) development agencies, 4) international and local NGOs, 5) academics, and 6) industrial associations. Finally, only academics and local NGOs are absent due to a lack of responsiveness on their part.

2.2.2 Data analysis

The semi-structured questionnaires (Annex III) included questions about the ECOGRES framework's various components and indicators. The interview findings were then evaluated using the GAT framework's four supportiveness criteria. The initial aim of this research was to use an extensive list of evaluative questions for each supportiveness criteria, in line with the methodology explained in Bressers et al., (2013) and Bressers and Bressers (2016). However, due to the limited time available for research and interviews, as well as that all interviews had to be conducted virtually, it was not possible to delve deeply into all of the various components and indicators (further explained in the reflection section). Rather than that, this research attempted to evaluate the supportiveness by mapping relevant statements from participants' responses to the different criteria, focusing on the interviewees' terminologies, and the reading between the lines of their responses. For instance, *extent* can be related to “sufficient”, “gaps”, “missing”, “unavailable”, etc. *Cohorence* on the other hand can be related to “overlap”, “working together”, “conflicting”, etc. Same methodology is used for *flexibility* (e.g., “difficult to navigate”, “overbearing”, “impossible”, etc.) and *intensity* (e.g., “push”, “pressure”, “drive”, “control”, “championing”, etc.).

All interviews were conducted "in person," virtually via Microsoft Teams, and were audio-recorded and transcribed into text files. The interview transcripts have been anonymized at the request of some of the participants. Only a broad description of their position type, organization type, and relationship to the research topic. NVivo was used to conduct the qualitative analysis of the interview transcripts based on a deductive coding scheme. The ECOGRES framework's six components served as the primary coding

clusters, while the component's indicators served as subcodes. The qualitative data extracted from interview transcripts was then assigned subcodes. The weights assigned to the various subcodes are based on the frequency with which each interviewee makes unique statements or arguments at each level of supportiveness (i.e., supportive, neutral, restrictive). Finally, the weights of the subcodes were used to determine the overall weight of the coding cluster or component. Only indicators and components for which sufficient data from interview transcripts were available were weighted.

Nvivo was also used for the literature review, which involved assigning relevant data from research articles and reports to primary coding clusters (ECOGRES components). No subcodes (indicators) were used due to the diversity of governance, development, and sustainability definitions used throughout the research papers, making it difficult to assign subcodes appropriately. The literature review results are used to answer research sub question 1 and for validating and comparing the interview findings and for recommendation purposes.

The data analysis results are divided into three parts. First, the governance challenges in relation to off-grid RE in developing countries are presented based on the literature review (chapter 3). Second, the governance context in Kenya is analyzed using the data from the interview (chapter 4). Third, an analysis is given of the governance context's supportiveness for off-grid RE development using the same data.

2.2.3 Statements mapping and weighting method

For each component, relevant data statements are mapped to the GAT supportiveness criteria as either being *supportive* or *restrictive*. The level neutral has been omitted because very few statements can be mapped to it. Because of insufficient data, the criteria intensity has been determined only at the code cluster level, that is, at the component level (and not on the subcode, or indicator level). At the end of each section, a visualization matrix summarizes the supportiveness of each component. The component *technology adaptation* is left out from the analysis due to the limited amount of data gathered on this topic.

Similarly, possible trends are investigated in terms of how the overall component's conditions have changed in the past or are expected to change in the future. This is accomplished by categorizing statements according to three levels of observed or anticipated change: 1) positive change, 2) no change, and 3) negative change. The trends are represented visually in the visualization matrix by an arrow. The greater the size of the arrow, the stronger the upward or downward trend.

Only those indicators are considered for which at least two statements have been mapped to a specific GAT governance criterion. If the number of occurrences of a specific indicator and criterion within a

supportiveness level (supportive or restrictive) exceeds 60% of total occurrences, the supportiveness is determined to be supportive or restrictive.

To determine the overall level of supportiveness of each component for each governance criteria, first, the levels of supportiveness of the indicators are weighted using a simple calculation. Level restrictive is denoted by a 1, neutral is denoted by a 0, and supportive is denoted by a 1. If the mean of statements scores is greater than 0.25, the indicator's overall supportiveness level is considered supportive. A mean between 0.25 and -0.25 is regarded as neutral. Finally, a mean of lower -0.25 is regarded as constraining. The reason for including the means 0.25 and -0.25 in the neutral range is to allow for some variation in the results. The same weighting method is used for calculating the supportiveness on a component level using the indicators' means.

2.2.4 Interview participants

Nine experts were interviewed. Table 2 introduces the nine experts. The participants have been anonymized..

Position	Organization	Link to research topic	Abbreviation in text
Advisor Projects and Business Development	International Development Agency	Operating in RE sector in Kenya	IDA Expert
Business Consultant	International RE Advisory Company	Operating in RE sector in Kenya	IRECB Expert
CEO	Local Solar Company	Operating in RE sector in Kenya	LSC Expert
Commercial Development and Capital Raising Advisor	International RE Development Company	Operating in RE sector in Kenya	IRECA Expert
Advisor Inclusive Sustainable Energy Development	International NGO	Operating in RE sector in Kenya	INGO Expert
Senior Director	Energy and Petroleum Regulatory Authority	Energy regulator Kenya	EPRA Expert
CEO	Local Industrial Association	Operating in RE sector in Kenya	LIA Expert
Senior Project Manager	International Industrial Association	Operating in RE sector in Kenya	IIA Expert
Managing Director	International RE development company	Operating in RE sector in Kenya	IRECC Expert

Table 2: Interviewees and their positions, the type of organization they work for, their significance, and how they are mentioned in the text

3. Off-grid renewable energy challenges

This chapter discusses off-grid renewable energy solutions, and the governance challenges that developing countries face in expanding these solutions. The chapter's findings are also used to validate and compare the interview findings in the conclusions and recommendations.

3.1 Off-grid renewable energy solutions

Lack of electricity access in off-grid areas is considered one of the major obstacles to sustainable development (Khandker et al., 2009; Chaurey et al., 2004; IEA et al., 2021; Kanagawa and Nakata, 2008). Grid-based electrification is difficult to achieve in rural areas in developing countries because they are typically sparsely populated, geographically isolated, difficult to access, and have low electricity demand (Mainali and Silveira, 2013; Narayan, 2019). Investments in grid-based electrification of remote rural areas is therefore inherently risky due to the long payback period for a typical rural grid connection (Narayan, 2019).

Off-grid electrification is an alternative to grid-based electrification. Its primary advantage is that it can accelerate access to basic energy needs when compared to grid-based electrification (IRENA, 2019). Moreover, RE is easier to integrate into off-grid systems because these systems are built from the ground up and are relatively small (Narayan, 2019). This viability is primarily due to the significant decrease in solar photovoltaic (PV) price of more than 80 percent over the last decade (IRENA, 2019). The term "off-grid" refers to systems that do not rely on electricity supplied by main grids, which are primarily based on centralized power plants (Kempener et al., 2015).

	Stand-alone systems	Mini-Grid	Hybrid Mini-Grid Systems
Rural Energy Uses			
Household basic needs	Home-based SHS	Systems including a distribution grid	Systems including a distribution grid
Community services	Community-based SHS		
Productive uses	Productive-based SHS		
Consumer Number	Single	Multiple	
Energy Sources	Single		Multiple

Table 3: Off-grid Systems Matrix for rural electrification systems developing countries. Adapted from Mandelli et al., (2016), page 1625

Off-grid systems encompass mini-grids or micro-grids that serve multiple customers and standalone systems, or solar home systems, for individual appliances or users. Customers may be households, commercial users, and public facilities (Kempener et al., 2015). Table 3 and figure 1 provide an overview of the rural energy applications for the various types of off-grid RE systems and their typical configurations.

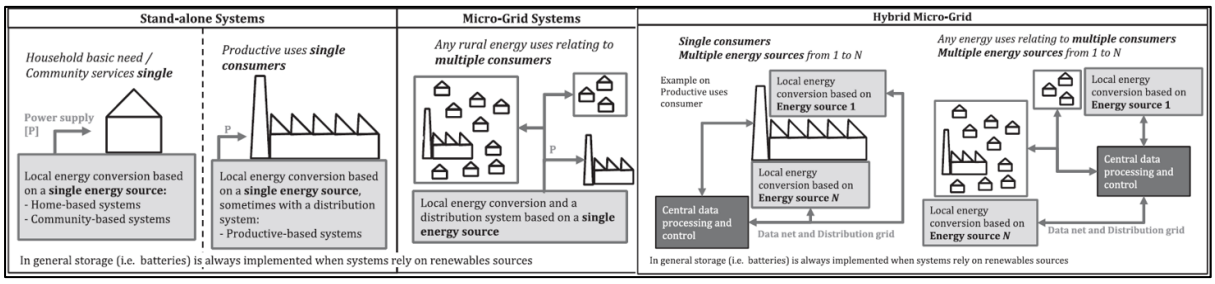

Figure 3: Decentralized off-grid systems. Adapted from Mandelli et al., (2016), page 1625 and 1626

Finally, based on the energy sources used, Mandelli et al. (2016) also classified the technologies used by off-grid systems in conventional, non-conventional, and hybrid (table 4). Conventional technologies rely entirely on fossil fuels (typically diesel), while non-conventional technologies rely entirely on RE (RE) sources. Hybrid microgrids rely on a combination of sources such as solar photovoltaic (PV) and diesel generators. Due to the unpredictable availability of RE sources, particularly solar and wind, storage is a necessary component of non-conventional systems. Batteries are the most prevalent storage device in rural areas of developing countries (Mandelli et al., 2016).

Off-grid technologies	Conventional	Non-conventional	Hybrid
	Diesel generator	Solar PV & storage system	Any combination of Solar PV, Wind turbines, Hydro power plant, Diesel generator, and Storage System
		Wind turbines & storage system	
		Hydro power plant (& storage)	

Table 4: Classification of generation technologies used by off-grid technologies. Adapted from Mandelli et al., (2016), page 1626

Note: *For the remainder of this research paper, the term "mini-grid" will be used for any off-grid system that includes a distribution grid. The terms "electricity" and "energy" will be used synonymously, even though energy encompasses a great deal more than electricity. The distinction between the two is of less relevance to the analysis and discussion contained in this paper.*

3.2 Governance challenges off-grid renewable energy

The findings of the literature review are broken down in one section for each ECOGRES governance component.

3.2.1 Institutional frameworks

Political instability and weak and unstable institutional frameworks, in which government levels and institutions lack the capability to carry out their functions and responsibilities and enforce regulations, limit the growth of off-grid RE in many developing nations (Bhattacharyya, 2013; Feron, 2016; Zebra et al., 2021). Furthermore, the absence of local communities and municipalities in the design and implementation of off-grid RE projects frequently result in significant adaptation and sustainability issues (Feron, 2016). Therefore, decentralization of responsibilities, or devolution, to local governments is often considered preferable for rural electrification (Feron, 2016).

However, many governance issues related to devolution occur because of the scarcity of resources and qualified specialists with the necessary skills and know-how in remote areas (Feron, 2016; Brisbois, 2020). According to Brisbois (2020), the reason technical skills and knowledge connected to energy systems are mostly found at national levels is that historically, national energy systems were centralized,

while locally, specific knowledge and skills in energy systems and project delivery were less necessary and hence underdeveloped.

Lack of clarity on the duties and responsibilities of government levels and institutions and bureaucratic licensing systems such as expensive, lengthy, or opaque permission procedures are some of the key reasons for off-grid project failures (Come Zebra et al., 2021, Hoeck et al., 2021, Ndirutu and Engola, 2021). Additionally, certain policy instruments, such as Feed-in Tariffs, rely heavily on technical competence and expertise that are not readily available in many developing countries (Ndirutu and Engola, 2021).

3.2.2 Policies and Regulations

Only recently have some governments in developing countries begun to consider off-grid renewable energy solutions for rural electrification, addressing a significant shortcoming of many national rural electrification strategies, which have historically overlooked households and small/micro businesses in sparsely populated areas (Muchunku et al., 2017). A lack of clear and transparent policies and regulations, as well as holistic, long-term electrification strategies for different counties and regions are important hurdles to the growth of off-grid renewable energy projects in many developing nations (Zebra et al., 2021; Hoeck et al., 2021).

Unsustainable low energy prices, together with insufficient policy incentives and electrification planning in off-grid areas, have a detrimental effect on private financial capital flows to RE development (Bhattacharyya, 2013; IRENA, 2019a; Come Zemra et al., 2021). Additionally, policy incentives frequently change or are terminated unexpectedly because of changing political priorities (Samoita et al., 2020).

Particularly the absence of integrated policy frameworks that incorporate a grid arrival strategy, is a known obstacle to investments in off-grid RE development (IRENA, 2019a; Come Zemra et al., 2021). Due to the absence of grid arrival policies that alter domestic priorities, mini-grids are frequently abandoned once a village is connected to the national grid (Tenenbaum et al. 2018; Come Zemra et al., 2021).

Another significant impediment to the development of off-grid RE is the availability of substandard and counterfeit products, as well as pricing that do not represent the product's quality (Wassie and Adaramola, 2021; Mugisha et al., 2021). The absence of or inadequate technical standards for off-grid RE systems results in cost increases, dissatisfaction with system performance and, ultimately, affects customer choice and trust in off-grid RE solutions (Feron, 2016; Mugisha et al., 2021).

3.2.3 Delivery and finance models

Most rural residents require only to power radios and mobile phones, which, combined with a low ability to pay for energy (Peters et al., 2019; Blimpo and Cosgrove-Davies, 2019) and high electricity generation costs, constrains off-grid RE development (Palit and Chaurey, 2011). As a result, policymakers pursuing ambitious electrification agendas face significant obstacles in achieving their goals and objectives (Mugisha et al., 2021).

With SHS products becoming more prevalent in electrification strategies (IRENA, 2019), the primary constraint to widespread adoption of SHS solutions in rural electrification is the high one-time cost (Adwek et al., 2020). Currency fluctuations further limit affordability of off-grid RE solutions as most equipment is imported (Urmee & Harries, 2011). In some cases, unaffordable electricity results in illegal usage by community residents, resulting in financial losses for the operator (Hoeck et al., 2021). Though pay-as-you-go (PAYG) systems have reduced the likelihood of illegal usage and improved power demand planning, they have been limited to providing the lowest level of energy access (Tier 0–1) for low-income communities and have not yet reached the true Bottom of Pyramid consumers (Hoeck et al., 2021; Muchunku et al., 2018).

A significant obstacle to the sustainability off-grid RE projects is that operation and maintenance expenses are frequently underestimated (Feron, 2016). Peters et al. (2019) identified several additional constraints to mini-grids to adopt quasi-commercial revenue-generating approaches. First, rural communities and local leaders may perceive mini-grids as inferior to the main grid or even a hindrance to a future grid connection. Second, social relations within communities may hinder rigorous enforcement of payments. Third, users believe that mini-grids operate on "free energy" and are not always convinced of the necessity of paying prices to cover maintenance and replacement costs. Fourth, in the typical design of community-owned mini-grids, communities are often aware the initial investments were made possible by external grants. Lastly, the ability to pay operational staff may appear to be unnecessary in rural subsistence communities where paid labor is the exception rather than the norm (Peters et al., 2019).

Tariff design is also a frequent source of contention in developing countries (Hoeck et al., 2021), with institutional and political barriers preventing high enough electricity consumption tariffs to cover capital and operating costs to make mini-grid investments attractive (Bhattacharyya, 2013). In contrast, grid-based electricity developers hardly aim to recover investment costs as they are largely or entirely funded by governments or international donors (Peters et al., 2019), are heavily cross-subsidized and benefit from economies of scale (Hoeck et al., 2021; Muchunku et al., 2018; Peters et al., 2019; Bhattacharyya, 2013). Additionally, traditional leaders on the ground, such as village chiefs or religious leaders, occasionally intervene when higher tariffs for commercial mini-grids are proposed (Peters et al., 2019).

As a result, private investors are unwilling and or incapable of financing projects at less-than-cost-reflective tariff levels (Mugisha et al., 2021; Come Zebra et al., 2021; Bhattacharyya, 2013).

Long-term financing challenges for off-grid RE projects in developing countries include high capital costs, insufficient funding mechanisms and low returns on investment, a lack of appropriate subsidies and credit line facilities, and market development barriers (Come Zebra et al., 2021; Bhattacharyya, 2013; Samoita et al., 2020). Even though prices have fallen significantly in recent years, renewables continue to be viewed as riskier investments by financial institutions, resulting in higher interest rates and poor returns of investments (UNDP and ETH Zurich, 2018; Samoita et al., 2020). Additionally, international donor agencies have generally provided limited support to small-scale projects (Bhattacharyya, 2013). As a result, many private investors find off-grid RE investment, particularly in smaller-scale projects, unappealing, given the time and effort required for due diligence and the lengthy payback periods (Hoeck et al., 2021; Come Zebra et al., 2021, Mugisha et al., 2021). Moreover, the inability of local banks to assess the risk of small-scale projects has also limited the number of local funds targeting smaller projects (Hoeck et al., 2021). Local banks are also cautious due to the high risk of loss associated with fluctuating exchange rates and high or uncertain inflation (Hoeck et al., 2021).

Mobilizing public financial resources for de-risking private investments, on the other hand, continues to be a significant challenge for governments in developing countries due to budget constraints, longstanding fossil fuel subsidizing, and unrealistic expectations regarding the commercial viability of private off-grid projects (Bhattacharyya, 2013; SEI Platform, 2018; Shahsavari and Akbari, 2018). Particularly when these businesses serve the most difficult-to-reach clients, operate in a distorted market environment, and compete with the heavily subsidized central grid and fossil fuel sectors (SEI Platform, 2018).

Grants, results-based financing (RBF), and reward-based crowdfunding (RBC) are three financial models that may address the high capital costs and financial risks associated with off-grid RE projects (Hoeck et al, 2021; ESMAP, 2000). Grant provide financial support to developers to cover a portion of their projects' total capital expenditure (capex) prior to construction. The disadvantage for developers is that this process is typically bureaucratic in nature (Hoeck et al, 2021). RBF in the context of electrification entails the payment of specified sums per completed connection against certain conditions (ESMAP, 2020). However, verification processes may be complex, costly and time consuming, and may lead to continuous subsidy dependence (Antony et al., 2017; ESMAP, 2020). Besides, the need to pre-finance projects may make it unsuitable for smaller companies or startups (ESMAP, 2020). In RBC, financing, typically startups raise funds through an online platform and offers funders a non-financial reward in exchange for a financial contribution (ESMAP, 2020). Some challenges with RBC are the significant human and financial resources required for the rewarding process, practicality issues related to a too large diversity of smaller funds acquired (ESMAP, 2020).

3.2.4 Multi-stakeholder and cross-sector linkages

As explain in section 3.4, electricity generated by off-grid RE solutions is generally too expensive for rural customers in developing countries. The lack of productive-use customers, who could generate revenue with the electricity generated during the day, puts economic pressure on the system's continuity and leads to many project failures (Hoeck et al., 2021; Come Zebra et al., 2021). This lack of revenue generation results in low demand and high default rates (Hoeck et al., 2021; Peters et al. 2019; Palit and Chaurey, 2011). Productive use potential is underutilized in rural electrification strategies in developing countries, which are eager to support entry-level off-grid systems that provide basic levels of electricity but do not explicitly describe how they would gradually enable higher levels of access for households and businesses (Muchunku, 2017).

The potential for productive uses of energy further hampered by poorly designed and implemented policy instruments due to poor coordination and lack of knowledge among the ministries and institution directly or indirectly involved with the energy sector, particularly when electricity access is not the major bottleneck (e.g., missing roads or market access) (Feron, 2016; Ndirutu and Engola, 2020; Peters et al., 2019). Additionally, inefficient collaboration between developers, their shareholders, and financiers, and civil society organization, result in costly and time-consuming arguments that obstruct project development (Ndirutu and Engola, 2020; Feron, 2016; Hoeck et al., 2021).

Another important factor that negatively impacts the sustainability of off-grid RE solutions is insufficient community participation and a disregard for cultural factors during design and implementation (Hoeck et al., 2021; Come Zebra et al., 2021; Feron, 2016). Inadequate community participation reduces communities' acceptance and awareness of off-grid RE options and their potential (Come Zebra et al., 2021; Feron, 2016). Appropriate community participation is even more critical in the off-grid RE context, as project designers and engineers are often from developed nations and are unfamiliar with their users and how their products are used (Feron, 2016). Even when communities participate, gender issues are often overlooked in project design, with men typically making the decision to acquire modern energy technologies and fuels, while women are frequently the primary energy users (Clancy, 1999). Moreover, in various developing nations, inadequate community participation has resulted in theft of off-grid RE components, and malfunctioning systems owing to vandalism (Feron, 2016). These problems are in part caused by lack of a sense of community ownership, with communities rather viewing off-grid RE systems as the property of project developers, who should bear complete responsibility for its operation and maintenance (Urmee and Harries, 2011).

3.2.5 Technology adaptation

Although off-grid renewable energy technologies have made significant strides in recent decades, there are still several technical barriers to widespread adoption (Samoita et al., 2020). Off-grid solutions rely mostly on solar energy which has a low energy conversion efficiency compared to other renewables and fossil fuels. Furthermore, dust deposition rates are extremely high in arid areas, further reducing the efficiency of solar systems that are not cleaned and maintained on a regular basis (Shahsavari and Akbari, 2018).

Additionally, unlike fossil fuel technologies, solar energy systems are affected by site-specific factors such as solar radiation, ambient temperature, relative humidity, and wind speed (Shahsavari and Akbari, 2018). Furthermore, the lack of solar radiation data in many areas in developing countries negatively impacts the establishment of successful solar energy projects (Shahsavari and Akbari, 2018). Because of this unpredictable nature of solar energy, storage devices are a necessary component, however, they further add to the cost of ownership (Shahsavari and Akbari, 2018). Bringing all these factors together adds to the complexity of system design, which, if not properly planned, dimensioned, and budgeted, results in low-quality power supply and poor application performance (Hoeck et al., 2021; Karakaya and Sriwannawit, 2015; Bhatia and Angelou 2015). Emerging technologies such as smart-grids and Internet of Things (IoT) can aid in managing the design complexities of off-grids, however, they add to the system's complexity in terms of operation and maintenance, and some serious data security and privacy concerns exist related to impersonation, data tampering, and cyber-attacks (Butt et al., 2021; Otuoze et al., 2018).

Failures of technology due to faulty technical standards and poorly designed systems in remote areas with limited technical capacities, and poor infrastructure and logistics, may result in significant downtimes (Fritzsche et al., 2019; Shahsavari and Akbari, 2018), that contribute to consumer dissatisfaction, erode user trust, and impede further adoption (Karakaya and Sriwannawit, 2015; Fritzsche et al., 2019).

While renewable energy sources, including off-grid RE systems, can help mitigate negative environmental impacts associated with energy generation, they can also cause environmental harm if not used properly (Panwar et al., 2011; Gasparatos et al., 2017). Solar energy's effects on ecosystems and biodiversity may be seen in the loss and alteration of habitats and local microclimates, as well as pollution from dust suppressants and herbicides (Gasparatos et al., 2017). Renewable may also become environmentally unsustainable because of improper battery disposal (Feron, 2016).

3.2.6 Capacity building

Technical issues, shortage of skilled technicians and qualified engineers are other barriers to off-grid RE development (Shahsavari and Akbari, 2018; Feron, 2016; Samoita et al., 2020). The lack of technicians relates to the novelty and complexity of off-grid RE technologies in remote areas, and has led to inadequate technology design and implementations, demand estimations, and the use of substandard products (Feron, 2016; Bertheau et al., 2020). Incentivizing workers and technicians to regularly travel to remote areas to provide services entails higher cost for constructing, operating, and maintaining systems (Bertheau et al., 2020; Come Zebra et al., 2021). Limited local expertise is also a key factor contributing to the regular use of foreign experts, who are often not familiar with the local conditions and unavailable for post-implementation support (Akinyele et al., 2018).

Another challenge in terms of capacity building is that technical support and maintenance is often done by unqualified personnel and limited to reactive measures only (Wassie and Adaramola, 2021). Some factors that contribute to this challenge are cost-saving considerations and the perception that installations of off-grid systems are plug-and-play exercises (Akinyele et al., 2018; Wassie and Adaramola, 2021).

Additionally, these seasonal capacity issues of off-grid RE systems are worsened by rural households' lack of education about energy efficiency and continued use of inefficient appliances (Akinyele et al., 2018). There is also a lack of understanding regarding the potential environmental impacts of off-grid renewable energy systems explained in the previous section (Akinyele et al., 2018).

Moreover, local project management and technology design skills are insufficient to properly manage the inherent complexities of off-grid RE design and delivery and are therefore frequently left to contractors (Akinyele et al., 2018). Nevertheless, education and training in different energy related technical and management disciplines are scarce in many developing countries' universities and technical training centers (Shahsavari and Akbari, 2018). Additionally, local research centers and R&D activities at the innovation stage are limited which limit developing countries’ capacities to adopt, adapt, absorb, and scale up off-grid RE technologies (Suzuki, 2015; Shahsavari and Akbari, 2018).

3.3 Conclusion

In many developing countries, the institutional framework barriers to off-grid RE are largely related to political instability and inadequate capacities of government levels and institutions to carry out their functions and responsibilities, implement policy instruments, and enforce regulations. Local government entities, in particular, are generally limited in terms of resources and capacities. Other factors include unclear roles and responsibilities of government levels and institutions, as well as bureaucratic licensing systems.

Ambiguous policies and regulations, subsidized fossil fuel energy prices, uncertainty about the duration of policy measures, and missing grid arrival policies all act as significant barriers to attracting private investors. Additionally, customer trust in off-grid RE solutions are harmed by the absence of or inadequacy of technical standards, which results in rising costs and substandard system performance.

Poor coordination and collaboration among energy stakeholders limits productive uses of energy and contributes to the failure of a large number of off-grid RE projects. Besides, community participation in the design and implementation of projects is often narrow-focused, incoherent, and inefficient, and often does not achieve a sense of community ownership over off-grid systems.

While PAYG models have achieved significant improvements, they primarily provide basic levels of energy access and have not yet reached the bottom of the pyramid. Financial sustainability is further constraint due to the frequent underestimation of operations and maintenance expenses. Furthermore, unrealistic, poorly designed tariffs, and the lack of appropriate subsidies all contribute to private financers' and developers' reluctance to invest in particularly small-scale projects. Allocation of public financial resources to de-risk private investments remains a significant challenge for governments in, owing to budget constraints and political priorities. While some financial models, such as RBC and RBF have potential to address some of the financial challenges, they both have limitations in terms of feasibility and applicability.

There are still several technical barriers to widespread adoption of off-grid RE in developing countries, the majority of which are related to site-specific weather conditions, sufficient solar radiation data, and solar energy's relatively low conversation rates. While emerging technologies such as smart grids and the Internet of Things can assist in managing the design complexity of off-grid systems, they also introduce additional complexities and security concerns. Without adequate support and infrastructure nearby, technology failures result in significant downtime, contributing to communities' and local policymakers' perceptions that off-grid renewable energy solutions are overly complex. Other technological challenges include improper disposal of system components such as batteries, as well as unforeseen habitat and local microclimate modifications.

In rural areas, a lack of locally qualified technicians and project managers have resulted in insufficient project design and implementation, unreliable electricity supply, and inefficient technical support and maintenance. Due to the scarcity of education and training facilities, this situation may not improve quickly enough to further accelerate off-grid RE development, whereas relying on foreign expertise has introduced additional challenges in terms of technology tailoring. Additionally, inefficient energy practices and a lack of awareness on RE's avoidable environmental impacts limit the climate mitigation potential and environmental sustainability of off-grid RE.

4. Results governance context Kenya

Due to the small number of interviewees per actor type, broad generalizations are impossible. That is, one cannot consider the perspective of, say, one participant working for an NGO to be representative of the entire NGO sector. However, by presenting the interview results as a discussion among individuals, this chapter aims to establish a basic understanding of governance context in Kenya that could serve as a starting point for further discussion and research. The chapter starts with an introduction to the case study country, followed by the governance context results presented in different sections per governance component and the corresponding indicators.

4.1 Introduction to case study country

The following sections outline Kenya's socioeconomic situation and development priorities, and describes Kenya's electricity access and off-grid electrification status, as well as its institutional and regulatory framework.

4.1.1 Socio-economic conditions and Vision 2030

Kenya is located in East Africa and is home to nearly 47.6 million people divided among approximately 21.1 million households (KNBS, 2021), and is East Africa's largest economy, with a Gross Domestic Product (GDP) of 106.04 billion USD (IMF, 2021), and is regarded as the region's transportation, economic, and financial hub (USAID, 2019).

However, Kenya's key development challenges remain poverty, inequality, climate change, persistently low private sector investment, and the economy's vulnerability to internal and external shocks (World Bank, 2021b). Recently, these challenges have become more difficult to overcome as economic and social disruptions resulting from the Covid-19 pandemic have eroded Kenya's progress toward poverty reduction (World Bank, 2020), which can be considered a setback in achieving its Vision 2030 long-term development agenda (GoK, 2007). According to the UNDP (2021) and (IEA et al., 2021), responding to the pandemic and accelerating poverty eradication in Kenya demands a green and inclusive, sustainable recovery because of its significant job creation and poverty alleviation potential. This view is in line with Hepburn et al.'s much-cited research (2020) that highlights the potential of green investments in providing high-quality jobs and reducing a country's vulnerability to climate change.

In its Vision 2030, the government of Kenya aspires to become a newly industrialized middle-income country by 2030 (GoK, 2007). This vision is implemented through a series of five-year medium-term plans, with the current plan for 2018-2022 focusing on the following "Big Four" agenda development

priorities: 1) food security, 2) affordable housing, 3) manufacturing and 4) affordable healthcare for all (GoK, 2018). In the 2018-2022 medium-term plan, energy is considered a critical enabler of Vision 2030 and the "Big Four" development plans and identified as the country's driver towards becoming an industrialized middle-income economy (GoK, 2021, homepage). Therefore, the government has set a target to achieve universal access to electricity for all Kenyans by 2022 in its Kenya National Electrification Strategy (KNES), assigning a critical role to off-grid RE systems in expanding access (GoK, 2018).

4.1.2 Electricity access and off-grid electrification

According to World Bank, Kenya's electrification level stood at around 85% in 2019 (World Bank, 2021c; (IEA et al., 2021), with an annual increase in electricity access in 2010-2019 averaging 5.6 percent, the fasted electrification rate in Africa (USAID, 2019). A noticeable urban-rural divide exists, with the urban access rate being 91 percent compared to a 62 percent access rate in rural areas (World Bank, 2021c).

The KNES considers three main types of rural electrification options: grid extension, projects for grid densification, and off-grid projects. By 2022, the strategy aims to add over three new million household connections through grid expansion and densification, and two million new household connections through off-grid RE, 1.96 million through SHS solutions, and 35.000 through 121 new mini-grids (GoK, 2018).

4.1.3 Institutional and regulatory framework

The institutional and regulatory framework for off-grid RE is summarized in Figure 5. The overview provides a high-level overview of the major energy actors, Kenya's energy strategies, regulations, and policy instruments, and should serve as context for the information gathered from the interviews.

Primary Energy Actors	Mandate		Development and energy strategies	
National government	National policy formulation, energy regulation, licensing, development, and operation of energy infrastructure (KLRC, 2021a).		Vision 2030	Kenya's long-term development strategy, aims to transform Kenya into a newly industrializing middle-income country with a high standard of living for all citizens, thereby recognizing energy and electricity access as critical enablers (GoK 2007; GoK, 2018).
County governments	County energy regulating and developing county renewable energy policies and programs, including resource mapping (CoG, 2021a).		Kenya National Electrification Strategy	Implemented in 2018, laying out a strategy for ensuring that all Kenyans have access to electricity by 2022, prioritizing off-grid connectivity (GoK, 2018).
Ministry of Energy	Overseeing of the energy sector through the development of energy policies (GoK, 2021a)		Rural Electrification Strategic Plan 2017-2021	Lays out a strategy for electrifying public facilities and nearby residences in rural areas, anticipating the establishment of 450 mini-grids (REREC, 2021a).
Energy and Petroleum Regulatory Authority (EPRA)	Sole sector regulatory agency responsible for the economic and technical regulation of the electric power, renewable energy, and downstream petroleum subsectors (GoK, 2021b)		Sustainable Energy for All 2015-2030	Country's strategy for achieving the SE4All goals of universal access to modern energy services, increasing energy efficiency, and increasing renewable energy to 80 percent of the energy mix by 2030 (MoE and SE4ALL) 2016).
Geothermal Development Company (GDC)	Geothermal field exploration, exploration and production drilling, steam field development, and contracting (GDC, 2021)			
Rural Electrification and Renewable Energy Corporation (REREC)	Spearheading Kenya's green energy drive, in addition to implementing rural electrification projects (REREC, 2021).		**Energy Regulations**	
Kenya Power (KPLC)	Kenya's main electricity utility and oversees power transmission and distribution, as well as consumer supplies (KPLC, 2021)		Energy Act 2019	Establishes national and county governments' responsibilities for the provision of affordable energy services, and guidelines for, among other things, promoting renewable energy, geothermal energy exploration, recovery, and commercialization (GovK, 2019)
Kenya Electricity Generating Company (KenGen)	Kenya's largest electricity producer, with hydro, geothermal, gas, and diesel-fueled power plants (KenGen, 2021)		Energy (Solar Photovoltaic Systems) Regulations 2019	Provides a framework for enforcing standards in the importation, design, and installation of solar photovoltaic systems (GOGLA, 2021)
Kenya Electricity Transmission Company (KETRACO)	To compete with Kenya Power, and plans, designs, constructs, operates, and maintains all-new high volrage transmission lines (KETRACO, 2021)		Finance Act 2020	Introduced 14 percent VAT, increasing to 16 percent in 2021, on off-grid solar and wind energy equipment after tax-exempted by the previous regulations (GOGLA, 2021)
Indep. power producers (IPPs)	Electricity generation and to a lesser extent distribution and retail (Kazimierczuk, 2019)		Standard Act 2020	Defines quality standard for renewable energy systems (GOGLA, 2021)
Nuclear Power and Energy Agency (NuPEA)	To promote and implement Kenya's Nuclear Power Programme (NuPEA, 2021)		Kenya Data Protection Bill 2018	regulates the processing, transfer and protection of privacy in personal data (GOGLA, 2021).
			Extended Producer Responsibility 2021	Holds manufacturers accountable for the entire product chain, emphasizing recycling and final disposal. Under review, not yet enacted. (GOGLA, 2021).
Secondary Energy Actors	Mandate		E-waste Regulations	Requires manufacturers of electric and electronic equipment to take responsibility for the equipment's end-of-life management and safe disposal. Under review (GOGLA, 2021).
National Treasury	Formulating financial and economic policies, including policies on taxation (GoK, 2021c)			
Kenya Bureau of Standards (KEBS)	Standardization, measurement, and conformance to internationally recognized standards and measurements (GoK, 2021d)		**Policy instruments**	
Kenya Revenue Authority (KRA)	Revenue collection and approving VAT and import tax exemptions (GoK, 2021e)		Feed-in Tariff (FiT)	Introduced in 2008 and revised in 2010 and 2012, and includes solar, wind, biomass, small hydro (Kazimierczuk, 2019).
Ministry of Environment and Forestry	protection, conservation, and management of Kenya's environmental and natural resources (GoK, 2021f)		Subsidies	Only provided to the Rural Electrification Authority to construct mini-grids, national electricity grid connections, and operating costs (George et al., 2019).
National Environmental Management Authority (NEMA)	Implementer of environmental policies (GoK, 2021g		Energy tax exemptions	Until recently, Kenya's government offered various tax incentives to encourage investment (George et al., 2019), but, in 2020, the Treasury Minister re-introduced VAT on off-grid solar and wind energy equipment, increasing from 14 to 16 percent between 2020 and 2021 (GOGLA, 2021).
			Net-Metering	The Energy Act 2019 permits grid-connected end-users who own an electric power generator with a capacity of no more than one megawatt to sell excess power to a distribution licensee or retailer. However, the regulations necessary to administer and implement the net metering system have not been finalized (Kazimierczuk, 2019; GOGLA, 2021;).

Figure 5: Kenya's Institutional and Regulatory Framework concerning off-grid RE

4.2 Institutional Framework

4.2.1 Clear roles and procedures

On paper, the roles and responsibilities of relevant institutions are clear, as almost all experts agree; however, implementation is less straightforward. The EPRA Expert explains how the Ministry of Energy, EPRA, and county governments have distinct roles and responsibilities. The division of roles and responsibilities between the national and county levels is elaborated further by IDA Expert, who discusses how the national government establishes regulations governing energy distribution, with an emphasis on electricity and mini-grids. Simultaneously, county governments have been mandated by the Energy Act 2019 to enforce national regulations and to amend or create their own.

However, both the IDA and LSC Experts discussed the disconnect between what is written on paper and what occurs in practice, as roles and responsibilities are frequently not well implemented. The LSC Expert argues that the private sector and financing frameworks have been critical actors in advancing off-grid RE. Energy institutions have played a lesser role, with Kenya only recognizing the value of off-grid RE only after major international organizations such as the World Bank, the United Nations, and GIZ recognized the value of off-grid RE and began structurally funding projects such as Lighting Africa.

According to the INGO Expert, there is some overlap between EPRA and the Ministry of Energy. The IRECA Expert acknowledges this overlap, stating that it appears as though EPRA is pressuring the Ministry of Energy to develop or implement policies, rather than the other way around. Additionally, both expert observes that the role division between counties and governments results in ambiguous administrative procedures; requesters may be required to bounce between different levels and institutions.

4.2.2 Simplified and streamlined administrative procedures

According to the EPRA Expert, after several years of experience with off-grid RE, administrative procedures have been streamlined and made crystal clear. The IDA Expert, on the other hand, argues that while they appear straightforward, implementation is a different story. The procedures are well defined in terms of requirements, but there is no transparency regarding feedback or the time required to process a request after submission. According to the expert, political motivations such as defending the primary utility corporation (KPLC) occasionally come into play. This lack of transparency results in a lack of trust in administrative procedures among private sector actors.

This mistrust is also confirmed by the IRECA and LSC Experts, who both explain that EPRA frequently misses deadlines with license application times are tenfold what they should be. Additionally, the LSC

Expert explains that no one at EPRA is willing to provide status information following the submission of a request, resulting in very capable and experienced local businesses operating without a license. Additionally, the IRECA Expert notes that a largely paper-based procedure further delays licensing and permit processes. While EPRA is attempting to automate this process, it is far from complete.

Most off-grid RE companies seem to encounter difficulties at the county level, which involves the approval process for construction and land use permits, as well as land rights. According to the INGO Expert, the approval process is quite complicated and time-consuming, requiring numerous licensing requirements and approvals, which is exacerbated in part by a lack of process linearity. The IRECA expert explains that the approval process is challenging for implementers regarding when to go where, frequently resulting in situations in which businesses are sent from pillar to post. The LIA Expert acknowledges the challenges, and notes that even though onsiderable effort is being made to develop guidelines for the new policy framework, implementation and clarification will be a gradual and painstaking process.

4.2.3 Adequate capacities and resources

There is a significant disparity in the resources and capacities available to various government institutions when it comes to off-grid RE. All experts agree that, in terms of knowledge and skills related to off-grid RE, government bodies at the national level, particularly EPRA, are generally well-equipped and knowledgeable. At the county level, skills and knowledge are largely lacking.

However, all experts agree that the primary issue at all levels is a lack of manpower and budget constraints. National government agencies, including EPRA, are typically overburdened and overwhelmed by requests, with only six to ten people juggling a diverse range of responsibilities and competing priorities. County funding is even worse, and when combined with a lack of off-grid RE skills and knowledge, counties are unable to capitalize on off-grid technologies in their own countries. Additionally, finding qualified, certified energy professionals willing to work for a county government is difficult, leaving them incapable of developing bankable projects or implementing strategic solutions.

4.3 Policies and Regulations

4.3.1 Clear definition of off-grid areas

There is no consensus among the various experts on whether existing policies and regulations include clear definitions of off-grid areas. However, according to the EPRA and IDA experts, the Energy Act 2019 and subsequent work clearly define off-grid areas. The KOSAP project, for example, focuses on off-grid areas in 14 counties in northeastern and northern Kenya.

4.3.2 Dedicated Off-grid policies

According to all experts, Kenya's government has yet to implement dedicated off-grid policies. However, as explained by the IDA and IRECA experts, the government is currently attempting to establish clear off-grid policies that define what constitutes ultimately off-grid areas and where mini-grids are permitted to operate. A component of that effort is the draft Mini-Grid regulations.

4.3.3 Clear goals and objectives

The experts generally agree that the goals and objectives for off-grid RE development are relatively clear. According to both the LIA and IDA experts, it is only after the Vision 2030's 2018-2022 medium-term plan, in which the government recognized that universal access to electricity requires off-grid RE electrification, that a noticeable shift toward more precise goals and targets occurs. This shift includes both SHS and mini-grid targets. According to the LIA expert, this trend is being driven primarily by county governments, particularly those located in off-grid areas, which are demanding their fair share of energy resources. The IDA Expert adds that the Ministry of Energy's commitment to off-grid RE electrification is also evident in its outreach to development agencies for assistance and in organizing training activities for regulators and the private sector on how to operate mini-grids with their assistance.

4.3.4 Integrated Electricity Sector Framework

The majority of experts were unaware of the existence of such a framework, except for the LIA Expert who calls it one of the significant regulatory issues in terms of RE and mini-grids, and that no concrete proposals have been done on integrating mini-grids into the national grid properly.

4.4 Delivery and Financing Models

4.4.1 Tailoring to local context

The experts interviewed generally agreed that affordability of off-grid RE solutions continues to be a challenge, particularly for those at the bottom of the pyramid. Though, according to the LSC Expert, PAYGo companies such as M-Kopa and Fenix Power have successfully expanded into off-grid areas and gained a sufficient understanding of the products and consumers to explain why a sizable portion of the rural population uses some form of solar energy. Nonetheless, the IRECA Expert asserts that off-grid RE products are generally too expensive for local markets, and donor subsidies are frequently insufficient. Donor grants cover the majority (up to 50%) of Capex costs, which is insufficient for off-grid RE companies to reduce their costs to compete with utility tariffs. This issue fuels conflict between businesses, local communities, and the government. The INGO Expert agrees that mini-grid tariffs in

Kenya are frequently significantly higher than those in on-grid areas, in a context that is, by definition more impoverished, with residents already struggling to make ends meet. Both the IRECA and INGO Experts emphasize that the government, as well as multilateral development agencies and development banks, should address this issue by balancing or subsidizing tariffs to ensure that poor and marginalized communities do not pay more for electricity access than those who live in urban areas or on grids. Ghana is cited as an example, where all mini-grid developers agreed to charge customers the same as grid-connected customers, with the government picking up the difference.

According to the INGO Expert, many mini-grid developers initially set their prices low in order to attract customers, only to be forced to raise them when it becomes clear that such a low tariff is unsustainable. Customers then stop paying, jeopardizing the mini-grid's viability. The INGO Expert adds that energy access must be affordable first and foremost, and charging these typically poorer communities more than grid-connected communities is unsustainable, even when other benefits of off-grid RE are considered, such as increased access to information. As a result, the government's efforts to assist development agencies and banks in making electricity more affordable for these communities must be increased. Additionally, the INGO Expert explains that the primary reason for the affordability issue is that poor communities are underrepresented in off-grid RE development stages such as feasibility studies and tariff setting. Subsequently, mini-grid projects frequently devolve into solutions that are not "owned" by their target community, but rather something that anyone with financial means can connect to.

The LIA Expert emphasizes that with integrated planning and innovative business models, off-grid electricity can be delivered at the same price as grid electricity without requiring subsidies in the same way that fossil fuels are subsidized. According to the LIA Experts, the simplest solution to the affordability problem is to provide people with opportunities to earn money through energy, as one cannot afford energy without income. Only then can the system achieve self-sufficiency. The LIA Expert adds that in order to properly implement this approach, rather than simply connecting people to electricity, it is necessary to consider how energy can be used productively and the critical productive tools that electricity can augment.

Another difficulty mentioned by the IIA Expert is obtaining additional local currency-based financing facilities for businesses. The majority of businesses obtain debt or equity in dollars, which has a significant impact on their portfolio as a result of currency fluctuations, which are primarily caused by (international) political events. Though a few projects are attempting to address this issue through various DFIs (development finance institutions), this will undoubtedly remain a significant challenge, increasing the investment risks associated with off-grid RE projects in Kenya and elsewhere. Finally, IRECC Expert argues that standardization of technology, project development, and project finance, are necessary component of making off-grid RE solutions more affordable.

4.4.2 Long-term and tailored financing

According to the IIA Expert, the majority of companies developing mini-grids rely heavily on grants to get started and then on investor equity to sustain operations. Even for large-scale projects, the majority of the time, a combination of equity and debt will be used to fund the project. According to the IRECC Expert, however, standardization in financing is difficult because different funders use distinct impact measurement systems.

Numerous financial challenges confronting mini-grids, according to the IRECB Expert, are related to the required rate of return on investments, which varies between five and fifteen years, depending on their capacity. In comparison, the return on investment for grid-connected projects is over fourty years. This situation puts pressure on mini-grid investors to include among other things, stimulating demand for productive uses of energy, which is not exactly what they are designed to do.

Additionally, the IRECA Expert emphasizes the unsustainable nature of mini-grid tariffs. When a private company initially secures a high tariff, there is a good chance that the government will request tariff reductions at some point. Consequently, most majority of investors would charge a premium for their returns to compensate for such risks. The EPRA Expert also notes that investors often consider mini-grids as temporary solution, however, it is becoming clear that extending grids to such remote areas is not always necessary when off-grid RE solutions are used appropriately. As a result, the government has begun considering mini-grids as long-term solutions, also within the KOSAP project.

The INGO Expert emphasizes that particularly local businesses face a significant shortage of financial resources because commercial banks are generally unfamiliar with off-grid RE projects, which may require a different funding model than agriculture projects, for example. To address the issue of insufficient financial resources, the LIA Expert explains that a regional perspective is critical. At the moment, scaling is difficult due to the emphasis on small-scale projects. Scale can be achieved when the East African Community establishes a truly integrated market that enables the frictionless transfer of technologies, products, and energy across borders.

4.4.3 Public financing for de-risking investments

According to all experts, there is no available government financing to de-risk investments in off-grid RE projects. According to the LIA Expert, the government has structured its finances in such a way that the majority of public funds go toward geothermal resource development or transmission and distribution projects. The LIA and IIA Experts explain available financial support is primarily intended for soft activities such as engagement or training workshops, rather than project development or implementation. The EPRA Expert confirms this nothing and clarifying that funding is currently being provided primarily by international donors such as the World Bank, the European Union and individual

European countries, and the African Development Bank. The government will only invest directly in RE projects via REREC, primarily through multi- or bilateral partnerships.

4.4.4 Innovative Finance Models

The IRECB expert explains that soms innovative financing models have emerged such as microlending platforms that enable individuals to lend money to low-income entrepreneurs. Microlending and crowdfunding, on the other hand, are generally only suitable for smaller project developers. The IRECB Expert adds that results-based finance, which compensate developers for each connection or person reached, is currently popular. Aas a result, international donors such as the International Finance Corporation increased their use of these schemes. However, it has the disadvantage of requiring fairly robust impact measurement and monitoring systems, which are expensive, and businesses frequently lack the necessary skills. Another finance model mentioned by IRECB Expert is carbon finance, which was a success a few years ago and is now reviving due to rising prices in voluntary carbon markets. This financing model is only applicable to companies specializing in cook stoves, not necessarily solar companies.

Other novel financing structures are mostly associated with integrated planning. By describing Marsabit county's county-wide integrated development plan, the LIA Expert demonstrated how this approach could be innovative. Due to the county's pastoral history, the plan focuses on irrigation of ranches via off-grid RE solutions. Additionally, the plan calls for the establishment of beef production and export meat processing, packaging, and cold storage facilities, all of which will be powered by innovative off-grid RE technologies and applications.

4.5 Multi-stakeholder and Cross-sector linkages

4.5.1 Cross-sector service approach

The majority of experts interviewed agree on the importance of a cross-sector service approach to off-grid RE. According to the IRECB Expert, the off-grid RE sector has been moving toward cross-sectoral service approaches that take into account a variety of services across sectors, with a particular emphasis on the agriculture-food-energy nexus. There is considerable funding and research devoted to off-grid RE solutions that offer a comprehensive service model to consumers. The INGO Expert explains that various workshops are organized between governments and stakeholders, particularly when initiating projects that focus on integrating productive uses of energy to ensure widespread adoption, not only for developers, but also for communities in terms of revenue generation. Kenya Power's research unit, according to the INGO Expert, is also actively incorporating cross-sectoral service approaches into its activities. Additionally, the flagship KOSAP project's strategy places a strong emphasis on productive

uses of energy in addition to energy access. The EPRA Expert explains that when RE sources such as solar or hydropower are considered, productive uses such as chicken farms, water pumps, maize flour mills, and carpentry are considered.

However, the LSC Expert asserts that while the government may adopt a cross-sectoral service approach in theory, actual financial support for private companies integrating productive uses of energy into their projects is generally lacking. Additionally, the LIA Expert argues that the current emphasis is primarily on the number of people connected to electricity, rather than on what happens to those connected. In general, the population in off-grid areas lacks the equipment required to absorb that energy. The LIA Expert adds that cross-sectoral service approaches are currently typically done ad hoc overlooking the economic opportunities available in particular areas and potential markets, most notably the entire value chain of food processing, storage, and delivery. The energy-water-food nexus is critical for Kenya, the LIA Expert concludes, because food demand is expected to double in the next two decades. Critical for understanding the various linkages is that both the national and county governments have a firm grasp on all cross-sectoral connections.

The IRECA Expert explains how they attempt to connect everyone in the relevant communities, depending on the target area, by charging different connection fees for business and residential housing. On the other hand, the IRECC Expert explains that their company intentionally avoids a cross-sectoral service approach in their business model, focusing exclusively on energy generation efficiency, assuming that this is the only way to achieve cost-effective and community-beneficial energy access in off-grid areas.

When it comes to stakeholder engagement, county officials and local leaders such as village elders frequently are underrepresented, according to the IRECA Expert, while they are tasked with communicating and explaining the policy to residents in the area. Additionally, the INGO Expert asserts that communities are frequently excluded from policymaking and that policies are frequently presented as facts. Underrepresentation also affects local civil society and grassroots organizations. "While international NGOs have a greater voice, local NGOs are frequently overlooked in policymaking," the INGO Expert continues. The LIA Expert explains that numerous off-grid RE systems have failed due to inadequate consideration of the end user. Besides, the LIA Expert argues, the absence of local financiers during the early stages of project development results in a complete disconnect between potential financiers familiar with the local context and those who are not.

4.5.2 Provision to public services

According to the IDA Expert, the REREC is responsible for developing RE and off-grid solutions, as well as connecting all rural elementary and secondary schools to the grid. If it becomes impossible to connect these schools to the grid, off-grid solutions are developed for these institutions. Mini-grids are

also used to power refrigerators at community health centers where medications are stored during the Covid19 crisis, the EPRA Expert adds. However, the IERCA Experts add that some companies choose to provide electricity to public facilities such as clinics and schools only on a voluntary basis, as a gesture of goodwill to communities, because the primary obstacle to providing electricity to public services is their ability to pay their bills.

4.5.3 Leveraging of innovative solutions

Government institutions generally assume that electricity provided by mini-grids is more expensive than electricity provided by the main grid, according to the LIA Expert. However, as a result of technological advancements and innovation, there are now innovative business models that enable off-grid electricity to be delivered at the same price as mains electricity without requiring subsidies in the same way that fuel is subsidized. Several models include industrial parks purchasing electricity generation byproducts such as steam and hot water, which can help projects become more viable. The LIA Expert adds that there are only few examples of these models being used properly.

4.6 Technology Adaptation

4.6.1 Adaptation to local conditions

The IRECB Expert describes that the off-grid RE sector has improved in terms of technology and business model adaptation. Prior to that, it was entirely about technology, owing to many developers' engineering backgrounds, with a primary focus on developing the most efficient products possible before considering the needs of farmers and households. Nowadays, a greater emphasis is placed on the integration of social, economic, and cultural factors, as well as on the development of more efficient business models. Additionally, the expert notes that the sector has shifted its focus to other technologies such as solar water pumps, agro-processing equipment, and cold storage as a result of increased interest in off-grid RE's productive applications. However, the IRECB Expert adds that to enable productive uses of energy, electrification reliability is critical, which is why international donors have remained open to hybrid mini-grids that incorporate a diesel generator as a backup energy source.

Private companies, according to the LSC Expert, have managed to tailor off-grid RE solutions to the off-grid context in Kenya. A case in point is the adaptation of mini-grid and SHS technologies to the reality that the majority of countries have a mobile network and that 80 to 90% of the population has access to a mobile phone or agent. Both the LSC and IRECB Exprerts agree that this reality has enabled the emergency of pay-as-you-go (PAYGo) models that have revolutionized the solar sector over the last five years.

However, the EPRA Expert asserts that highly remote areas present the greatest logistical and security challenges. These areas present challenges for operating and maintaining off-grid RE solutions, a situation worsened by a scarcity of local technicians. Solar technologies, on the other hand, are becoming easier to operate and maintain as technology advances. Nonetheless, adequate investments in community education and training are critical for effectively addressing this challenge. According to the LIA Expert, emerging technologies such as the Internet of Things (IoT) will soon help collapse energy into data, and off-grid RE solutions will become more autonomous and efficient in their operation as a result of digitalization and automation.

4.6.2 Favorable Market Policies

Concerning favorable market policies, the interviewed experts generally agree that the country's mostly "laissez faire" market policies have facilitated the advancement of off-grid RE solutions. Kenya, according to the IRECB Expert, is one of the most business-friendly markets in Kenya, with relatively simple procedures for starting a business, even for foreigners. However, the LSC Expert emphasizes that, aside from allowing the private sector to operate and establishing tax regimes, the government has played a relatively minor role in developing the off-grid RE industry. The LSC Expert argues that if the off-grid RE market is considered a success, it owes much of its success to private sector capabilities, Kenyan entrepreneurship, and consumers' ability to purchase the equipment. The IRECC Expert confirms this to a degree by stating that market policies are favorable only in the sense that they have not encountered any obstacles to their operation.

The LIA Expert adds another dimension to the discussion by focusing on the East African Community's regional market potential, which may provide opportunities for scaling up projects and free trade in off-grid RE technologies, products, and energy. However, numerous challenges remain in the way of realizing this potential.

4.7 Capacity Building

4.7.1 Adequate Capacities

Among the experts interviewed, there are some mixed views on the capacities of the various actors. Capacities in the private sector are regarded as adequate by most experts, particularly in terms technical knowledge, innovation, and entrepreneurship, as well as planning for off-grid RE projects. The biggest challenge however, according to the IRECB Expert, is that government institution generally lack adequate technological skills and knowledge. The INGO Expert describes that there is a general shortage of skills at all levels and among all actors, particularly at the community level, with limited on-the-job and continuous training in the operation and maintenance of off-grid RE solutions. The

IRECC Expert points out that while INGOs are capable of managing support programs and agriculture projects, they have limited knowledge of RE technologies and energy efficiency. Other actors lacking skills, according to the LSC Expert, are local commercial banks, which lack the necessary knowledge and skills to conduct adequate technical evaluations of off-grid RE systems for which a loan is requested.

The IDA Expert partially rebuts the notion that capacities are lacking at all levels of government, stating that while government capabilities in terms of off-grid energy solutions were lacking in the past, they are catching up today, particularly at the national level. This improvement is the result of proactive engagement with the private sector and development partners on training and knowledge exchange. Additionally, the IRECA Expert states that in general, all levels have some of the required skills, except at the county and local levels, where limited training is available to train county officials and community members to perform day-to-day tasks. The EPRA Expert asserts that continuous training on financial modelling and technical regulation are now a part of EPRA's culture, with the support of the AFD (Agence Française de Développement). The LIA Expert also recognizes EPRA's high level of knowledge and skills by recruiting members of the private sector and international organizations. However, their challenges are more related to their low number of staff, with only a few people looking after the energy needs of the whole country.

The LIA Expert goes on to explain that the situation becomes much worse when one descends to the county level, a perception shared by the majority of interviewees. The reason for this, according to the LIA Expert, is that recruiting qualified personnel to work in county governments is extremely difficult, even more so given counties' limited financial resources. As a result, they are frequently understaffed and thus are unable to develop bankable projects or strategically implement solutions.

4.7.2 Change Readiness Assessments

The IRECB Expert explains that all international donor-funded projects require feasibility studies well in advance, however, they are frequently conducted by foreign consultants who have the best of intentions but are frequently incapable of taking into account local realities and issues. According to the IRECC Expert, change readiness assessments for smaller projects are less common, because they are time consuming and costly and investors, are often unwilling to fund or facilitate this phase of the project. According to the INGO expert, some off-grid RE developers only conduct readiness assessment only after projects are completed, to seek out a variety of strategies for effectively engaging communities to ensure bills are paid and revenue is increased through productive uses.

4.7.3 Entrepreneurial Support Programs

There is broad agreement on the availability of entrepreneurial support programs, with the majority of experts stating that the number of incubator and accelerator programs for entrepreneurs is relatively large. These programs cover a range of subjects, from business, financial, and project management to the development, operation, and maintenance of technology. Other programs address issues ranging from policy development to registration assistance. The majority of programs are funded by international donors, with the government providing limited financial support.

4.8 Conclusion

While the roles and responsibilities of relevant institutions are clear on paper, and almost unanimously agreed upon by experts, implementation is less straightforward. Administrative procedures appear to be straightforward but are poorly implemented. Although the procedures are well defined in terms of requirements, they lack transparency and have unworkable timelines. Most challenges are encountered at the county level, which is involved in the approval process for construction and land use permits, as well as land rights. In terms of knowledge and skills related to off-grid RE, government bodies at the national level, are relatively skilled and knowledgeable. However, at the county level however skills and knowledge are largely lacking. The primary issue faced by all government levels is a lack of manpower and budget constraints.

The experts agree that the goals and objectives for off-grid RE development are relatively clear, however, there does not appear to be an integrated electricity framework that facilitates the integration of mini-grids. This situation may change by the new mini-grid regulations that are currently being drafted.

Most experts interviewed agree that the sector has been moving toward the incorporation of cross-sectoral service approaches. However, the integration of cross-sectoral service approaches is mostly ad hoc and lacks integrated planning on different levels and scales.

Though stakeholder engagement is common, communities and end-users, county officials, and local financiers are the actors who are most underrepresented in policy and project development. Energy provision to public services is considered by private off-grid RE companies, but they face difficulties collecting revenues from public facilities.

The experts interviewed generally agree that the affordability of off-grid RE solutions remains a challenge in Kenya. Mini-grid tariff rates are often higher than those for on-grid areas, while off-grid areas are naturally poorer. Besides, donor funds are generally insufficient to both implement and operate off-grid solutions, and companies engaging in RBF schemes, lack robust and costly monitoring systems. Smaller companies are limited in attracting finances from local financiers and international donors, though there are some small-scale financing models available such as micro-lending and crowdfunding. The only model considered by most to be adequate for addressing the affordability and viability challenges associated with off-grid RE at its root is the increase of productive uses of energy through comprehensive, integrated planning.

There is a general “laissez faire” attitude toward market policies, which have facilitated the advancement of off-grid RE solutions in terms of technology and business model. However, PAYG systems have been the primary factor in accelerating the adoption of off-grid RE systems in Kenya.

Leveraging technologies such as smart-grids and IoT may have the potential to further expand the off-grid RE sector.

Skills and knowledge are most lacking at the county and community levels. What is lacking at all government levels is manpower and financial resources. The most critical skills gaps at the national level are in integrated planning of productive uses of energy. The private sector, on the other hand, is generally skilled, partially due to the numerous internationally funded entrepreneurial support programs that exist.

5. Results governance supportiveness in Kenya

The chapter analyzes the results derived from using the GAT assessment tool to assess the supportiveness of the different governance components. Chapter and section 2.2.2 and 2.2.3 explain how the analysis is conducted. The results are presented in different sections per governance component and make multiple references to Annex I. The only governance component missing is technology adaption due to insufficient data.

5.1 Institutional frameworks

Regarding the institutional framework in place, the extent to which clear administrative procedures and adequate capacities to carry out assigned responsibilities are available, as well as their coherence, are deemed restrictive (figure 4). Statements mentioned include unclear procedures, overbearing license requirements, lack of basic templates for administrative procedures, processes being mostly paper-based, and missing licensing for larger project portfolios. Furthermore, processes and procedures are not always presented in a linear fashion because of poor implementation, and decision-making on licensing and permits may sometimes be politically motivated.

SUPPORTIVENESS INSTITUTIONAL FRAMEWORK		**GAT Governance Supportiveness Criteria**				**General trend**
		Extent	Coherence	Flexibility	Intensity	
ECOGRES Component indicators	Roles and Responsibilities					
	Simplified procedures					
	Adequate capacities and resources					
Colours Red = Restrictive; Orange = Neutral, Green = Supportive; Grey = Insufficient data						
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend. The longer the arrow, the more significant the trend						

Figure 4: Governance supportiveness Institution Framework

In terms of capacities, statements mostly emphasize how overstretched the quite knowledgeable ministry of energy and national energy institutions are in terms of manpower. The situation is

significantly worse at county level, with manpower and knowledge being nearly absent. With the enaction of the Energy Act 2019 the roles and responsibilities of the different institutions and governments have become reasonably supportive. However, their coherence is lacking because of mismatches between what is stated on paper and reality, inadequate national representation of energy institutions at local level, disharmony between institutions aims and activities, overlapping roles, and power struggles among national government actors on the one hand, and between national and county policymakers on the other hand. Although both supportive and restrictive pressure from government actors to change the status quo is perceived by the experts, they anticipate that it is a matter of time and before the situation improves, with one caveat, which may be the general elections planned for 2022.

5.2 Policies and regulations

The extent to which clear definitions of off-grid areas are in place is deemed supportive, with off-grid areas having been defined to some extent (figure 5), particularly as part of the KOSAP project. However, the absence of dedicated off-grid policies and an integrated electricity sector framework are restrictive governance factors, but there is a new mini-grid policy in development.

SUPPORTIVENESS POLICIES AND REGULATIONS		**GAT Governance Supportiveness Criteria**				**General trend**
		Extent	Coherence	Flexibility	Intensity	
ECOGRES Component indicators	Clear definition of off-grid areas					
	Dedicated off-grid policies					
	Clear goals and objectives					
	Integrated electricity sector framework					
	Adequate standards and quality control instruments					
Colours Red = Restrictive; Orange = Neutral, Green = Supportive; Grey = Insufficient data						
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend. The longer the arrow, the more significant the trend						

Figure 5: Governance supportiveness Policies and Regulations

There is disagreement over the level of supportiveness of the defined goals and objectives. Some statements argue that they are well formulated, inclusive, and clear, but other statements assert uncertainty around policy duration, lack of specifics, and the lack of energy planning at the county and community levels. Coherence of existing goals and objectives is regarded as restrictive, which makes sense given the absence of dedicated off-grid policies and an integrated electricity sector framework. Statements include the lack of enforcement according to the spirit of the policies and regulation, lack of policy awareness among public, conflicting interests in the energy sector, and non-harmonized objectives among different strategies and policies, and inadequate implementation of policy instruments. There is, however, some pressure to improve the status quo, which contributes to the

experts' expectation of significant positive change in the future, because of the mini-grid policy that is in development, the realization of inefficiencies within the national utility, and the efforts being put in developing policy guidelines.

5.3 Delivery and finance models

Because of the critical role of PAYG models and nearly universal access to mobile telephony, the extent to which delivery models are tailored to the local context is considered supportive (Figure 6). However, constraining factors mentioned include the fact that off-grid RE solutions are generally too expensive for the local context and that the poorer rural communities pay higher energy tariffs than urban communities. The coherence of current delivery models is constrained by non-harmonized tariff setting and an overemphasis on connecting households rather than on what happens after they are connected.

SUPPORTIVENESS DELIVERY AND FINANCE MODELS		**GAT Governance Supportiveness Criteria**				**General trend**
		Extent	Coherence	Flexibility	Intensity	
ECOGRES Component indicators	Tailored to the local context					↑
	Long-term and tailored financing					
	Public financing for de-risking private investments					
	Innovative financing models					
Colours Red = Restrictive; Orange = Neutral, Green = Supportive; Grey = Insufficient data						
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend. The longer the arrow, the more significant the trend						

Figure 6: Governance supportiveness Delivery and Finance Models

The conditions for long-term and tailored financing are considered particularly restrictive. Factors mentioned are that projects can only be financially viable through scale, which is difficult to achieve given the low demand for energy. Other factors mentioned include a lack of domestic financing due to commercial banks' limited understanding of the off-grid RE sector, inadequate integrated planning for productive use of energy, complex result-based financing in terms of operation, an overemphasis on mini-grids, and governments' complete reliance on international donors for off-grid RE development. Coherence of finance models is also viewed as restrictive due to different impact measurement systems used by international donors, and with funding available only to startups and large businesses, but not to those in between. Another constraint is the complete absence of public financing for de-risking private investments. Although there is limited pressure coming primarily from DFIs and NGOs to change the status quo, some positive change is anticipated in the future, largely as a result of technological advancements.

5.4 Multi-stakeholder and cross-sectoral linkages

The extent and coherence of cross-sectoral service approaches used in off-grid RE projects are deemed neither supportive nor restrictive in terms cross-sector service approaches (figure 7). Among the supportive factors mentioned are the growing emphasis on productive uses of energy by actors and stakeholders, the extensive stakeholder involvement required by Kenyan law, and the critical role of industrial and private sector associations such as KAM and international NGOs with strong ties to the Ministry of Energy. Restrictive factors mentioned include insufficient engagement of end users, village elders, county officials, and grassroots organizations in the development and implementation of policies and projects, a lack of cross-sector coordination at the macro level, and governments' ad hoc approaches and limited capacity for integrated planning for productive uses of energy. Another supportive factor is that projects somewhat consider energy provision to public services, but there are some challenges associated with collecting payments from public facilities.

SUPPORTIVENESS MULTI-STAKEHOLDER AND CROSS-SECTOR LINKAGES		**GAT Governance Supportiveness Criteria**				**General trend**
		Extent	Coherence	Flexibility	Intensity	
ECOGRES Component indicators	Cross-sector service approach					↑
	Leverage of innovative solutions					
	Provision to public services					
Colours Red = Restrictive; Orange = Neutral, Green = Supportive; Grey = Insufficient data						
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend. The longer the arrow, the more significant the trend						

Figure 7: Governance supportiveness Multi-stakeholder and Cross-sector Linkages

Supportive factors for governance intensity include the pressure to improve conditions exerted by international development agencies, consumers, and private sector associations. Restriction is imposed by supply-driven expansion of RE financed by international donor funds, and the government's tendency to follow rather than lead in terms of best practices. A significant positive change is anticipated by the experts, based on recent progress made, and their observations of how the government institutions have begun to emphasize the cross-sector service approaches and productive uses of energy.

5.5 Capacity building

The supportive factors mentioned in terms of the availability of adequate skills indicate that the private sector, along with the Ministry of Energy and EPRA, are skilled and knowledgeable. The restrictive mentioned, on the other hand, argue that the primary bottlenecks in terms of capacity building are a lack of skills and knowledge at the county and community levels, as well as a shortage of local technicians for operation and maintenance. According to some statements, there is also a lack of integrated planning

skills at all levels of government, as well as a lack of financial management and business model definition skills among PAYG companies.

SUPPORTIVENESS CAPACITY BUILDING		GAT Governance Supportiveness Criteria				Genera trend
		Extent	Coherence	Flexibility	Intensity	
ECOGRES Component indicators	Change readiness assessments					
	Accessible entrepreneurial support programs					
	Dedicated project facilitation tools					
	Availability of adequate skills					
Colours Red = Restrictive; Orange = Neutral, Green = Supportive; Grey = Insufficient data						
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend. The longer the arrow, the more significant the trend						

Figure 8: Governance supportiveness Capacity Building

Additionally, the extent to which change readiness assessments are incorporated into off-grid RE projects is deemed restrictive, with some claiming that assessments are frequently conducted only after implementation to stimulate demand and bill payments. The governance extent of accessible entrepreneurial programs is considered supportive, with statements explaining that this is primarily due to the numerous training programs funded by NGOs and international development agencies. In terms of governance intensity, there is some pressure from the private sector and EU donors to improve conditions.

5.6 Conclusion

Kenya's institutional framework's extent and coherence are deemed restrictive (figure 9). While the roles and responsibilities are clear, they are not cohesive. Despite low commitment from relevant actors to change the status quo, the interviewed experts expect significant institutional improvements in the near future.

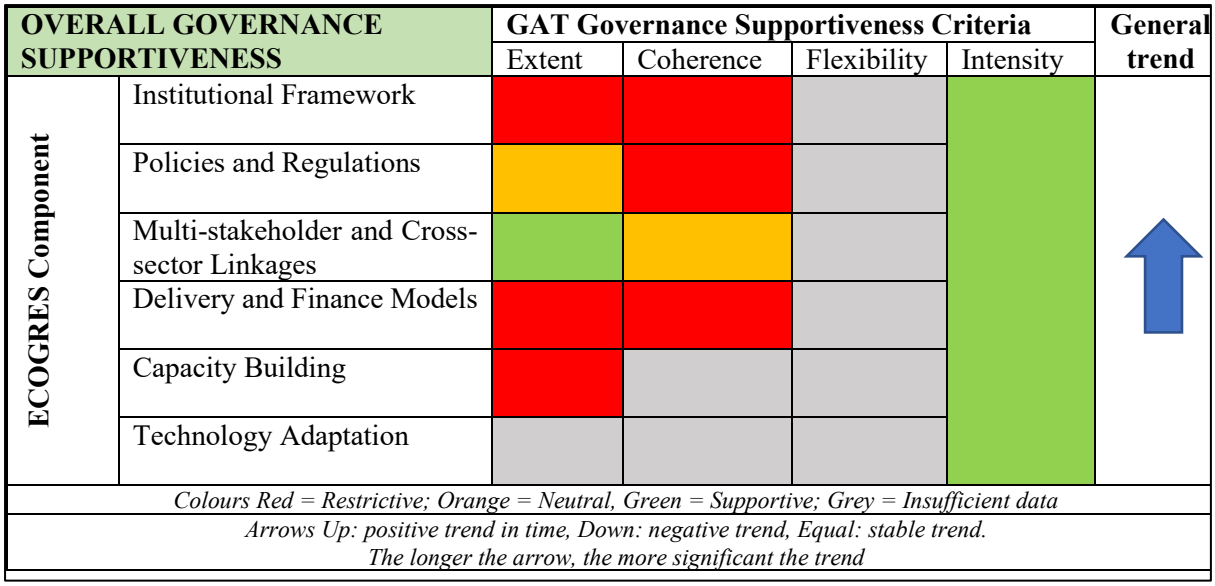

Figure 9: Overall governance supportiveness for off-grid RE in Kenya

The governance extent of the policies and regulations in place are considered neither supportive nor restrictive, while their coherence is considered restrictive. Off-grid areas are clearly defined; however, there is a lack of dedicated off-grid policies and an integrated electricity sector framework. Goals and objectives are not entirely clear to all interview participants. The lack of dedicated off-grid policies and an integrated electricity sector framework makes the coherence of existing policies and regulations also seem restrictive. However, different levels of government are pressuring for change, which appears to be contributing to the anticipated positive change in the near future.

The different multi-stakeholders and cross-sector linkages are fairly considered in off-grid RE development, yet, the applied approaches and their execution lack in terms of coherence. The extent and coherence of cross-sectoral service approaches used in off-grid RE projects are deemed neither supportive nor restrictive. Off-grid RE developers do consider energy provision to public services; however, these efforts often lack coherence. Due to the emergence of the concept of integrated planning and productive uses of energy, and the gradual implementation of the Energy Act 2019 are implement in the near future, there is a general expectation that the current conditions are will significantly advance in the foreseeable future.

Off-grid RE delivery and financing models are considered to be generally restrictive in terms of extent and coherence. The extent to which the models deployed are tailored to the local context is considered supportive; however, their coherence is mostly the restricting factor. Other restrictive factors are the extent and coherence of long-term and tailored financing and public financing to de-risk private investments. From the findings, it is not clear whether the current situation is expected to improve in the future.

Capacity building is also considered a restrictive governance component, with most experts agreeing that the extent of adequate skills and manpower is restrictive at all levels, particularly at the county and community levels. Although the findings do not indicate whether the current situation will improve in the future, private sector actors and international donors seem to push towards adequately addressing this challenge.

6. Conclusions, Recommendations, Research reflection

This thesis defined the research question in such a way that it could contribute to knowledge on both the chosen research topic and the chosen analytic frameworks and methodologies for this type of research. In that spirit, this chapter first aims to provide an answer to the research question. Then, the report makes recommendations for governance stakeholders as well as for further research, followed by a research reflection.

6.1 Conclusions

An interesting question would be to discover which governance component was instrumental in accelerating off-grid RE development in Kenya. Could it be that this is primarily due to favorable conditions for multi-stakeholder and cross-sectoral collaboration, as well as a high overall upward governance intensity? Or is it primarily due to the extent to which delivery and financing models are tailored to the local context, as well as the government's clear definition of off-grid areas? Unfortunately, the data collected from the interviews is insufficient to draw these types of conclusions about which governance components are most instrumental in Kenya's advancement of off-grid RE development. They do, however, provide an insightful preview of the governance extent, coherence, and intensity of the various components, which can serve as a starting point for further research.

The significance of the interview findings is enhanced when compared to the findings of the literature review, which produce some noticeable insights. Then, it becomes clear that Kenya is far from unique in terms of governance challenges compared to many other developing countries; in fact, the parallels are striking. Both point to the limiting factors such as political instability, which is particularly relevant in Kenya given the 2022 election year and the Covid19 crisis, and the insufficient capacity and manpower at all levels and institutions of government to carry out their responsibilities, implement policy instruments, and enforce regulations. Inadequate capacities thus mean that what may appear to be crystal clear on paper in terms of the institutional and regulatory framework, may result in a highly ambiguous situation in practice, as is also the case in Kenya according to the interview findings. Additionally, the absence of integrated electricity sector frameworks that facilitate mini-grid development in developing countries demonstrates that Kenya is not unique in this regard, which may be one of the reasons for the majority of off-grid RE solutions being SHS solutions.

Another striking parallel between the interview findings and the literature review is the emphasis on productive uses of energy to help rural households generate revenue and pay for electricity while simultaneously increasing electricity demand and, subsequently the financial viability of off-grid RE. The financial challenges are worsened by unrealistic tariffs for businesses or unaffordable tariffs for rural communities. Besides, there is chronic lack of financial resources and government subsidies, affecting particularly SMEs, in many developing countries, including Kenya. Both the literature review and interview findings indicate that there is little optimism about financial challenges being addressed adequately in the foreseeable future, except for the hope that technological innovations will improve the financial viability of off-grid RE solutions.

Additionally, while Kenya performs well in terms of multi-stakeholder engagement, similar to many other developing countries, end-user or community participation is relatively weak or poorly implemented, resulting in unfit solutions, lack of community ownership, and inefficient operation and maintenance. Foreign expertise is also characterized as a risk both in literature and by interview findings.

However, two of the most significant barriers to off-grid RE development, as emphasized across the board, is a lack of capacity and resources at the local or county government level to carry out their roles and responsibilities adequately, as well as a scarcity of qualified technicians and project managers at the community and county levels.

On a more positive note, what differentiates Kenya from other developing countries in terms of opportunities is that its national energy institutions are relatively well-equipped in terms of knowledge and skills. Furthermore, Kenya's institutional and regulatory framework is already relatively clear on paper; it only requires that final, but complex, push to properly implement the framework. Additionally, Kenya already has a solid foundation for stakeholder engagement that can be fine-tuned further to ensure proper community participation. Moreover, the interview findings indicate that there is considerable pressure to improve governance conditions and that there is significant optimism that this will come about, despite numerous obstacles.

Finally, the paper began by stating that Kenya is a leader in off-grid renewable energy development, which is remarkable given the restrictive nature of many governance components and indicators as found by the research findings. Apart from the general 'laissez-faire' market policies that have contributed to Kenya's progress, this progress could also be related to an assertion made by one interviewee, who claimed that Kenya's progress has been made possible by Kenyan entrepreneurship and private sector agility, despite poor governance. If this much progress has been made despite restrictive governance, one has to wonder what could be accomplished with slightly more supportive governance conditions.

This research demonstrates that utilizing the ECOGRES framework combined with the GAT to analyze the Kenyan governance context for off-grid RE solutions and the context's supportiveness for their advancement can yield valuable insights even when time and resources for data collection are limited. The ECOGRES framework provided a concise overview of the governance context, whereas the GAT criteria shed light on the extent, coherence, intensity, and trends of governance supportiveness. However, not enough data has been gathered to conclude with high levels of certainty. Therefore, the findings should not be seen as definite descriptions.

Using the ECOGRES components and indicators and the GAT criteria as a deductive coding scheme for primary cluster coding and sub coding, the data proved to be a relatively simple process that saved considerable time compared to inductive coding and provided some insightful information. These insights are useful for "testing the waters" as part of multiphased approach that first gathers background information that can be used to conduct a systematic brainstorming session by, for instance, a group of experts or practitioners from diverse backgrounds. Frequently, during workshops in which opinions and perceptions are shared, it is difficult to begin from scratch, i.e., to get the juices flowing. Presenting a picture of sometimes very opposite perceptions from different actors derived from a research design presented in this paper could be a first phase governance analysis that serves as a springboard for lively discussions and brainstorming sessions afterward.

6.2 Recommendations

As shown in the response to the research question, Kenya faces significant challenges in terms of governance supportiveness for off-grid RE, but there are also some clear opportunities. The findings also show that Kenya is not alone in its challenges, and that many of the challenges may be properly addressed if all governance components and indicators are carefully considered. According to the research findings, this can only be accomplished through holistic integrated planning approaches that adequately consider not only the national, but also the county and community levels. An opportunity appears to be growing awareness and aspirations for integrated planning among various governance levels and actors, as well as optimism that conditions will improve. To realize this potential, effective collaboration among the various actors is required. Collaboration may begin with focusing the most restrictive governance conditions, such as the financial unviability of many off-grid RE projects, the lack of capacity and resources at county government levels, and a scarcity of qualified technicians and project managers at the community level.

Though the research findings presented in this thesis are not conclusive, they can be used as a starting point for further research or collaboration activities among the various governance actors. Collaboration could be organized in guided or non-guided workshop format as advised Bressers et al.'s (2016), in which participants share information and perceptions, and contribute knowledge and counteract one-

sided bias in perceptions, thereby establishing a degree of shared view and understanding of the situation and how to address the challenges (Bressers et al., 2016). While it would be ideal for the same interview participants to attend the workshop, this is not always possible due to factors such as the sensitivity of the collected data. It would be preferable to host a more extensive workshop with additional off-grid RE practitioners and experts and present the findings in this paper as a starting point based on the perceptions of a select portion of their network.

Some research limitations have already been discussed in the research design and methodology section and the conclusions. First, the limited time available for research necessitated interviewing a small number of experts. As a result, the amount of data collected was insufficient to draw more precise conclusions and insufficient to cover all governance criteria comprehensively. Additionally, non-responsiveness from potential participants or postponements of scheduled interviews by participants prolong the data collection process while time is limited. As a result, no academics and local NGO experts were interviewed, and only one government official were interviewed for this research.

Additionally, the varied interpretations of concepts due to the participants' diverse backgrounds affected the data quality in some occasions, making some data parts insufficient for inclusion in the analysis. Furthermore, due to the interview's online format, there was insufficient time to explain each question prior to allowing participants to respond, which precluded the inclusion of more sophisticated pre-defined questions about the governance supportiveness criteria of extent, coherence, flexibility, and coherence, as Bressers et al. instructed (2016). The alternative methodology of mapping statements to governance supportiveness criteria is inherently less precise and leaves much room for interpretation.

Addressing these research limitations in subsequent research is dependent on the primary objective of the study. Suppose the primary purpose is for practitioners to gain practical experience. In that case, the methodology employed is a useful and efficient means of gaining insights into the governance context of off-grid RE development in a particular country, which can be used for further investigation during, for example, a workshop. If the primary purpose is scientific research, however, in which interviews with subject matter experts are just part of the data gathering, the time constraint can only be overcome by increasing the amount of time available for conducting the research. If this is not possible, it is recommended to focus on a subset of ECOGRES components or GAT supportiveness criteria and possibly on one actor type.

Comparative analysis between countries can also be interesting for scientific research purposes, as it may help identify which ECOGRES components and indicators, as well as GAT supportiveness criteria, are instrumental in advancing off-grid RE development across the board. Could it be, for example, that regulations and policies have a limited impact on off-grid RE advancement and that multi-stakeholder and cross-sector service approaches have been the deciding factor in all countries? Such comparative analysis, however, requires extensive research over a more extended period.

6.3 Research reflection

Numerous lessons learned can be identified by reflecting on this research and its design. At the start of the research, the desire to create a comprehensive picture of what advances or has advanced off-grid RE development throughout the developing world resulted in the audacious goal of analyzing the governance context in nine different countries. However, this ambition was soon reduced on the supervisor's advice to a single case study focusing on a single country. Even that, in the end, proved to be time-consuming, particularly reaching out to potential interviewees and the scheduling process.

Additionally, the online format of the interview limited interviews to 45 minutes to an hour, including the introduction, which constrains in-depth discussion on topics. It did not help that interviewees came from diverse backgrounds and interpreted the components and indicators discussed in sometimes very different ways. This timing constraint could have been avoided by focusing exclusively on a subset of components, criteria, or actor types; however, the more comprehensive attempt has still yielded valuable insights and learnings, as explained in the conclusion and recommendations. Thus, the objective of greater comprehensiveness can be considered fruitful in light of what is discovered, and perhaps more importantly, what is not discovered.

Another eye-opening challenge was the time required to correctly transcribe interviews (even when automated transcription is used) and clean and code all the data. Performing these three processes for nine interviews was at times wearying, especially when using Microsoft Teams' automated transcription process, which is still overly focused on the standard western English pronunciation. The time required for each process demonstrated how unlikely the initial goal was of conducting a comprehensive analysis of various countries. Such comprehensive scientific research appears to be impossible to complete without the assistance of a team of researchers and research assistants.

The difficulties encountered during the research process slowly led to more realistic objectives. The first aim to use all available primary and secondary sources to assess the different components, indicators, and criteria was quickly abandoned for the more realistic approach of focusing solely on the interview data, which led to the scrapping of two research questions. A comprehensive GAT analysis of the governance supportiveness criteria's scope, coherence, flexibility, and intensity was also initially aimed for but proved to be overly ambitious as well. As a result, the approach quickly shifted to focusing exclusively on the ECOGRES indicators and interpreting interviewees' views on the supportiveness criteria solely based on their responses to the ECOGRES indicator-related questions, which is inconsistent with Bresser et al.'s (2016) evaluative questionnaire methodology. However, this research demonstrated that the GAT tooling could be useful even without the evaluative questionnaires described in the tooling's instruction papers.

Additionally, the ECOGRES components and indicators effectively provided a concise overview of the governance context surrounding a particular research topic. Overall, this research has provided useful insights into the governance context of off-grid RE development in Kenya, how the ECOGRES framework can be used to describe the governance context of off-grid RE development, and how the GAT framework can be used without the evaluative questionnaires. However, further research is necessary to determine the value of this paper's research design and methodologies.

Acknowledgements: I sincerely acknowledge all interview participants for their time and patience, and for providing valuable input for this research. My supervisors, Prof. Dr. Joy S. Clancy and Dr. Frans H.J.M. Coenen of the University of Twente, are also duly acknowledged for their advice and guidance in getting this thesis prepared.

Conflicts of Interest: The author declares no conflicts of interest.

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Annexes

I. Statements mapping data on governance supportiveness

i Institutional framework

STATEMENTS MAPPING ON GOVERNANCE SUPPORTIVENESS

CRITERIA	Supportive	Restrictive
EXTENT	**Roles and Responsibilities:** 1. The Energy Act 2019 has made the roles and responsibilities very clear (***IIA expert***) 2. There are currently no government levels missing in terms of roles and responsibilities. (***IIA expert***) 3. Constitutionally, the way the mandate within the energy landscape has been deregulated and now being administered, is very clear (***IDA expert***) 4. Though there is some overlap sometimes between the regulator EPRA and the Ministry, but in general I would say that the roles are clear (***INGO expert***). **Adequate capacities and resources:** 1. We've engaged with the people involved in the regulator body and the utility and these are well-trained people who understand what they're doing (***IDA expert***). 2. In terms of knowledge, the Ministry of Energy and EPRA do have capacities (***IRECA expert***) 3. The people at the national government level are knowledgeable on the topic (***INGO expert***) 4. The best skilled institution that I have seen has got a high number of very qualified people, that's EPRA. (***LIA expert***). 5. The ministry of Energy, through various directorates, has improved its capacity and its understanding of RE (***IIA expert***) 6. but the professionals who do work there are quite well trained and educated and very effective (***IRECC expert***).	**Simplified and streamlined procedures:** 1. There's no standard or there is no basic template for development, nor is there a basic template for permits, licenses or procedures at the county level (***IRECC expert***). 2. What's in place now is not that clear or streamlined. (***INGO expert***). 3. Definitely are some gaps and much still needs to be done in terms of implementation (***IIA expert***). 4. What is missing are licensing for larger project portfolios where you don't need to reapply for licenses for each individual project (***IRECA expert***). 5. The administrative procedures such as license request are difficult because everything is paper based (***IRECA expert***). 6. Because of the substantial donor support, EPRA has become overbearing in terms of license requirement, making it hard for lots of young technicians to get their licenses (***LSC expert***) **Adequate capacities and resources:** 1. County funding is as bad or worse than central government funding (***LSC expert***) 2. Most of the departments at most will have six or seven people. So they are basically overwhelmed in terms of the number of requests (***IRECA expert***). 3. On the country level, there is supposed to be someone who handles the off-grid energy sector. That specific person is usually missing within counties (***IRECA expert***). 4. Every government office is overstretched and have to balance between many priorities (***INGO expert***). 5. The focus is more on petroleum, and RE is really lagging (***INGO expert***). 6. The county level is supposed to be involved because of the Devolution Act 2012, but at that level there really isn't any capacity at all (***INGO expert***). 7. County governments lack financial resources, equipment and skills (***EPRA expert***) 8. At the Ministry of Energy and EPRA they have very qualified people, but they are very few (***LIA expert***). 9. Now when you go down to the county level it gets much worse (***LIA expert***) 10. But as you head down to the county government and also to some of the parastatals, the level of capacity decreases (***IIA expert)***. 11. when you look at the county departments and ministries you will find that they are understaffed (***IRECC expert***)
COHERENCE	**Roles and responsibilities:** 1. Yes, all government actors work well together (***EPRA expert***)	**Roles and Responsibilities:** 1. The thing is, there's a mismatch between needs and what EPRA actually does. (***IDA expert***) 2. National energy institutions such as EPRA and Kenya Power are hardly embedded at the county level (***LSC expert***) 3. There's no harmony sometimes among the government institutions (***IDA expert***).

		4. Some of PPAs signed with IPPs, which is guided by EPRA, were never thought through well and KPLC ended up paying for the largest portion of the electricity costs. This is caused by a lack of collaboration between the two institutions (***IDA expert***) 5. The different institutions that we have in the country sometimes overlap in terms of roles or you will be required to bounce back and forth between institutions (***IRECA expert***) 6. Sometimes it seems that EPRA is the one telling the ministry what policies are required and what the industries needs, while EPRA is supposed to be the policy implementer only (***IRECA expert***) 7. They will work well together, but the ministry does not trust the counties to make decisions on energy (***IRECA expert***). 8. Their interpretation is still very subjective depending on who you talk too (**LIA expert**). 9. There's always some level of acrimony between the county and the national government in terms of executing national projects and budget allocation (***LIA expert***). 10. County overnments lack the capacity and support to develop own energy plans (***IIA expert***) 11. The roles and responsibilities between national government and county government overlap (***IRECC expert***) 12. There is some overlap sometimes between the regulator EPRA and the Ministry (***INGO expert***). 13. The relationship between national and county governments is difficult to balance, because of the lack of time and resources to curator the relationship, and because county officials change often, particularly during election years (***INGO expert***) 14. The government institutions' aims are sometimes conflicting (***IRECA expert***). **Simplified and streamlined procedures:** 1. The process is not always presented in a linear fashion, so it can be a bit confusing for the implementers to know when to go where (***INGO expert***). 2. There's no standard or there is no basic template for development, nor is there a basic template for permits, licenses or procedures at the county level (***IRECC expert***). 3. It's well defined, but sometimes it's not well implemented according to the paper. (***IDA expert***). 4. After submission you are left at the mercy of bureaucrats who makes decisions sometimes that are politically motivated (***IDA expert***)
FLEXIBILITY	Insufficient data gathered	
INTENSITY	**All indicators:** 1. There is a I think that there is a lot of positive drive from the industry associations and alliances (***INGO expert***) 2. There is pressure from civil society who play a role in ensuring a just energy access to the people ***(INGO expert***). 3. There are also champions within the government as well (***INGO expert***). 4. There is currently an alliance between the former Prime Minister and presidential candidate and the current president, jointly pushing together reforms to improve the funding challenge of the county governments through better resource allocation (***LIA expert***). 5. The Ministry of Energy has been the biggest champion pushing for RE (***IIA expert***)	**All indicators:** 1. You need to be dependent to make independent decisions, but I think there's always enough overreaching arm from the difference powerful institutions that can influence these kinds of decisions (***IDA expert***) 2. It's the problem of large bureaucracies which often seek to increase control and to grow bigger. But at the end of the day companies just try to get on with it (***LSC expert***) 3. The biggest challenge are the political dependencies in where key decision makers are elected every four years, and also have to adhere to a specific political program (***IRECC expert***). 4.

DIRECTION OF GOVERNANCE CONDITIONS TREND

	Positive change occurred or expected	No change to governance occurred or expected	Negative change to governance conditions occurred or expected
IN THE PAST	1. Yes, as much as we complain like this, we've seen dramatic changes over the years. (***IDA expert***).	None mentioned	None mentioned
IN THE FUTURE	1. The government is trying to streamline the regulation, and to clearly mention who's responsible for what and what the timeframes are (***IRECA expert***). 2. Last week EPRA have published a new draft regulation for mini-grids for public comments. So hopefully things will be streamlined soon (***INGO expert***). 3. Because the new Energy Act was only passed in 2019, we have not yet done all the necessary legislation. This currently work in progress so all will be clear and streamlined soon (***EPRA expert***). 4. Politically there is a strong will for change (***LIA expert***). 5. The institutional framework will become more supportive and it will take the next three years (***IIA expert***).	1. Whether the situation will improve depends a lot on the elections next year (***LIA expert***)	None mentioned

ii Policies and regulations

STATEMENTS MAPPING ON GOVERNANCE SUPPORTIVENESS

CRITERIA	Supportive	Restrictive
EXTENT	**Clear goals and objectives:** 6. The various institutions have rules that are properly formulated (***LSC expert***). 7. The government is actively trying to address the gaps in the Energy Act 2019 and make the policy instruments somewhat simpler to the off-grid sector (***IRECA expert***). 8. The Ministry of Energy has introduced a new gender policy in 2019 which is a great development (***INGO expert***) 9. The goals and objectives are very clear (***EPRA expert***) 10. The Kenyan National Electrification Strategy (KNES) sets out clear targets for off-grid electrification (***IIA expert***). **Clear definition of off-grid areas:** 4. Off-grid areas have been clearly mapped out (***EPRA expert***). 5. Off-grid areas have been defined to some extent (***IIA expert***) 6. Once the county governments are supported in developing their energy plans, there will be a perfect way of planning the energy sector (***IIA expert***).	**Clear goals and objectives:** 5. There is no clarity for investors and the private sector on how long government policies will remain (***IDA expert***). 6. The Energy Act of 2019 provides for private utilities (power producers) and mini-grid companies, but they do not go into specifics on how they should operate (***IRECA expert***). 7. Counties don't really have their own policies and regulations on energy or renewable energy (***INGO expert***) 8. Energy planning happens mainly on the macro level, but should also happen on the micro and community level (***INGO expert***). **Clear definition of off-grid areas:** 2. In the current policy documents the off-grid areas are not clearly defined (***INGO expert***). **Dedicated off-grid policies:** 6. There are no dedicated policies for off-grids. (***IIA expert***). 7. Not necessarily a policy on paper, but there is strong push from the government (***IDA expert***) 8. Currently not, but they are in development (***IRECA Expert***) 9. No, so we do not have a dedicated policy for off-grids (***IIA Expert***) 10. Instruments are missing that create equal opportunities between the national utility and independent power producers in the off-grid sector (***IRECA expert***). **Integrated electricity sector framework:** 3. There still haven't been any concrete proposals on how to navigate that process (***LIA expert***). 4. I don't think it exists (***IDA expert***)
COHERENCE	**Clear goals and objectives:** 3. There is a Kenyan National Electrification Strategy (KNES) that outlines an integrated planning approach with targets for both the grid and off-grid electrification.	**Clear goals and objectives:** 8. EPRA has the right regulations in place, the people enforcing the regulations use them as blunt instruments for bribes (***LSC expert***) 9. Communities do not understand what these goals mean, because most of the people are not educated. (***EPRA expert***). 10. Renewable energy interests and interests of particularly coal and nuclear will soon clash (***LIA expert***) 11. The objectives have not yet been harmonized among the different strategies, policies and regulations (***LIA expert***) 12. The only overarching goal is universal access to energy. The how sometimes points in different directions depending on the institution (***IDA expert***) 13. The Energy Act includes net metering, but the supporting regulation that can support this kind of activities are lacking (***IDA expert***).
FLEXIBILITY	Insufficient data gathered	
INTENSITY	**All indicators:** 3. Certain developments show that the government is well aware and anticipates that there are trend shift coming u (***IDA expert***). 4. EPRA is actively trying to fix or provide clarity on policy measures that are unclear because of the donor community (***IRECA expert***)	**All indicators:**

DIRECTION OF GOVERNANCE CONDITIONS TREND

	Positive change occurred or expected	**No change to governance occurred or expected**	**Negative change to governance conditions occurred or expected**
IN THE PAST	None mentioned	None mentioned	None mentioned
IN THE FUTURE	1. Conditions will likely change because the government has realised the inefficiencies that are hurting the KPLC (***IDA expert***) 2. The government right now is trying to set clear off grid policies. (***IRECA expert***). 3. The Mini-Grid policy is coming into play soon but it would require some level of goodwill from the government, particularly KPLC, to actually implement the measures according to spirit of the law (***IRECA expert***). 4. Because the new Energy Act was only passed in 2019, we have not yet done all the necessary legislation (***EPRA expert***). 5. There's a lot of effort happening too developing guidelines for the new policy framework (***IIA expert***).	1. I don't know if it's going to get better (***LSC expert***)	None mentioned

iii Delivery and financing models

STATEMENTS MAPPING ON GOVERNANCE SUPPORTIVENESS

CRITERIA	Supportive	Restrictive
EXTENT	**Tailored to local context:** 1. PAYGo models have been very successful in making off-grid RE accessible to off-grid communities (***IRECB expert***) 2. PAYGo companies such as M-Kopa and Fenix Power have managed to successfully reach off-grid areas with a model that is very tailored to the local communities (***LSC expert***) 3. Due to the large adoption of mobile telephony in the country, we have access to one of the best off-grid RE payment platforms in place (PAYGo) (***EPRA expert***) 4. Operation and maintenance is becoming more cost-efficient through smart technologies (***EPRA expert***) **Long-term and tailored financing:** 1. Result-based financing in where companies are paid per connection realized are offering new models for long-term financing (***IRECB expert***)	**Tailored to local context:** 1. Off-grid RE solutions are generally too expensive for the local market. Donor subsidies consist of mainly Capex grants, covering up to 50% of installation costs, which is insufficient to lower the costs enough to match grid tariffs (***IRECA expert***) 2. Lack of off-setting of tariff through subsidies result in poor communities in off-grid areas having to pay more for electricity than in urban areas (***INGO expert***) **Long-term and tailored financing:** 1. Financial sustainability in sites consisting mainly of households is, in the absence of subsidies, only possible by achieving scale and stimulating demand which can be challenging (***IRECA expert***) 2. Local companies lack access to domestic financing because commercial banks don't really understand off-grid RE and how these projects require different funding models (***INGO expert***). 3. Integrating planning is key to make tariffs make sense, unfortunately this is not being implemented yet (***LIA expert***). 4. Local financiers are missing, international financiers often do not understand the local context (***LIA expert***) 5. Investments have been targeted at a few companies, but smaller developers have a hard time reaching finance (***IRECB expert***) 6. Results-based finance comes with the disadvantage of requiring quite robust and complex impact measurement and monitoring systems which are costly (***IRECB expert***) 7. The government is leaning too much on donor and investor money, expecting that all projects come fully financed which is not the case (***LIA expert***) 8. There is too much emphasis on mini-grids which is the fashionable thing at the moment, but because of that little attention is given to other innovative energy generation models (***IRECC expert***) **Public financing for de-risking investments** 1. No public financing exist for de-risking private investments (***IRECA expert***) 2. No public financing available at the moment, but the Energy Act 2019 established an energy fund but hasn't been implemented yet (***EPRA expert***) 3. There is no public financing available (***IRECC expert***) 4. Financing that is available is only meant for soft activities such as engagement and training workshops, but not project implementation or development (***LIA expert***) 5. Most public financing is going to awareness creation only (***IIA expert***) **Innovative finance models:** 1. Some innovative finance models such as micro-lending and crowd funding exist but they are generally not sufficient for companies trying to achieve scale (***IRECB expert***)
COHERENCE		**Tailored to local context:** 1. There is no harmony in tariff setting. It doesn't make sense that poor communities in off-grid areas have to pay higher electrify (***INGO expert***) 2. The current focus is on connectivity on the numbers on how many people are connected to the grid, but it doesn't take into account what will happen when people are connected (***LIA Expert***)

		Long-term and tailored financing: 1. Associations such as GOGLA do not consider well enough over-the-counter traders in off-grid systems who are very successful in delivering off-grid RE systems to middle class households in rural areas (***LSC expert***) 2. There is no coherence in the impact measurement systems of international donors (***IRECC expert***) 3. Financing models are currently mostly targeted either on startups or on large companies, not the ones in between. These companies are not able to reach scale due to lack of financing (***IRECB expert***) 4. Many financial challenges concerning mini-grids are related to the required returns of investments for mini-grid of five to fifteen years depending on their capacity (***IRECB expert***) 5. The simplest solution that we found is that if you give people an opportunity to create income using energy, then you solve the problem of affordability. But this planning approach is not implemented properly (***LIA Expert***)
FLEXIBILITY	Insufficient data gathered	
INTENSITY	**All indicators:** 1. The strongest pressure comes from the Development Finance Institutes (***IRECA expert***). 2. Civil society and NGOs because they are the ones that pushing for off-grid renewables in the sense that it brings economic stability, especially for women and the youth (***IIA expert***)	**All indicators:** 1. Donor requirements are becoming increasingly difficult to meet which makes it even more difficult to obtain grants (***IRECB expert***). 2. No one is pushing for this because everyone expects that private companies should not operate in areas where it's not viable to operate (***IRECB expert***).

DIRECTION OF GOVERNANCE CONDITIONS TREND

	Positive change occurred or expected	**No change to governance occurred or expected**	**Negative change to governance conditions occurred or expected**
IN THE PAST	None mentioned	None mentioned	None mentioned
IN THE FUTURE	1. Maybe technology advancements could bring change by making investments and services getting cheaper (***INGO expert***) 2. Smart technologies will allow for most cost-effective operations and maintenance of off-grid RE (***EPRA expert***) 3. I believe that there is likely to be positive change. Kenya is one of the countries that has highly developed RE resources (***LIA expert***)	1. Providing subsidies to off-grid RE is not considered sustainable by many government officials. So, I don't expect any changes (***IRECA expert***) 2. Things will not change; it has to do with government priorities (***IIA expert***)	None mentioned

iv Multi-stakeholder and cross-sector linkages

STATEMENTS MAPPING ON GOVERNANCE SUPPORTIVENESS

CRITERIA	Supportive	Restrictive
EXTENT	**Cross-sector service approaches:** 1. There is more interest in the productive uses of energy in relation to off-grid RE (***IRECB expert***). 2. As much as they struggle according to the information they collect, stakeholders are usually very well involved during the development stage (***IDA expert***) 3. In terms of cross-sector linkages between stakeholders and other sectors, I think they are well connected and well involved (***IDA expert***). 4. It is by law it is required to involve all stakeholders (***IRECA expert***). 5. The Ministry of Energy and its RE Secretariat is quite keen on getting an inputs from the private sector, from the civil society, from academia. (***INGO expert***) 6. KPLC and the KOSAP projects are actively working on stimulating productive uses of energy (***INGO expert***) 7. Particularly when it concerns renewables such as solar or hydropower interlinkages are considered in terms of productive usage (***EPRA expert***). 8. After the new constitution in 2010, it is a must for politicians to consult the people that are going to be affected by any investment or decision that will affect them. (***EPRA expert***). 9. At least as far as EPRA is concerned, they have been engaging stakeholders quite well. (***LIA expert***) **Provision to public services:** 1. Powering community health centres has also been powerful during Covid (***EPRA expert***). 2. We generally try to connect everyone in the relevant communities, including public facilities such as clinics ***(IRECA expert***).	**Cross-sector service approaches:** 1. Integrated planning is certainly something that the government does not do well (***IDA expert***). 2. When trying to convince farmers them of the potential of RE for their farming practises, you find that there is some reluctance with farmers doubting whether there is a market that justifies expanding their produce (***IRECA expert***). 3. But the people that are missing are the county level officials and village elders (***IRECA expert***) 4. Community involvement is generally limited in stakeholder engagement processed. Policies often trickle down as a matter of fact (***INGO expert***) 5. Other stakeholders that are underrepresented in the off-grid renewable RE process are the local civil society and grassroots organization which often now best the local context outside the communities (***INGO experts***) 6. Potential local financiers are not involvement in the very early stage of project development. There is a tendency that most of RE projects are financed by people from outside the country, who understand less the local context (***LIA expert***) 7. A key component that is missing in developing off grid power is the end user (***LIA expert***). 8. Cross-sector linkages are not well understood at particularly the county level (***IIA expert***). 9. End-users are also missing from most conversations, which we realized when designing certain projects together with the government. The government tends to bring in civil society organizations to represent marginalized communities, which is not necessarily an adequate representation (***IIA expert***) 10. Tariffs for productive uses are not tailored to different scales of productive uses which for some is too expensive (***IDA expert***) **Provision to public services:** 1. The challenge with public services is that often they don't pay their energy bills, and it's difficult force them to do so (***IRECA expert***)
COHERENCE	**Cross-sector service approaches:** 1. KAM is a strong association who regularly conducts workshops between the power distributor, the energy generators, including private sector ones, and productive users. (***IDA expert***) 2. Associations such as KAM, KPSA, and a new association of household and small-scale productive users, have started working together on policy reviews in where they merge their all their views into one comprehensive review (***IDA expert***) 3. There are quite strong linkages between international NGOs and the Ministry of Energy, because they have the capacity,	**Cross-sector service approaches:** 1. Stakeholders are aware of cross-sector service approaches, but there is a lack of coordination at macro-level (***LRECB expert***) 2. A lot of political interference in stakeholder engagement causing wrong priority setting (***IDA expert***) 3. The strongest relationships are between the actors that have the most power and the ones that have most money. The communities belong to neither (***INGO expert***) 4. Sometimes politicians at the local level try to take advantage of off-grid RE investments to gain politically. Their involvement can negatively impact off-grid RE projects (***EPRA expert***) 5. Approaches to integrated planning and stimulating productive uses are very ad-hoc. National and county governments lack the capacities and resources to strategically adopt a holistic approach to integrated planning (***LIA expert***)

	experience and funding to implement large scale projects (***INGO expert***) 4. So national governments often reach out to these NGOs for understanding the local context (***INGO expert***) 5. The involvement of energy actors is more and more request and appreciated by other ministries and institutions (***IIA expert***)	
FLEXIBILITY	Insufficient data gathered	
INTENSITY	**All indicators:** 1. Most pressure to improve conditions comes mostly from consumer and private sector associations (***IDA expert***). 2. Pressure comes mostly from international development agencies and donors such the World Bank and the private sector (***LSC expert***) 3. The strongest pressure comes from SDG17 which has resulted in the creation of many multi stakeholder platforms aiming to integrate interests and priorities (***LIA expert***)	**All indicators:** 1. The government is not a leader but a follower in terms of cross-sector service approaches because of the large projects that are internationally funded (***LSC expert***). 2. There is a lot of international pressure on expanding the use of RE, driven by supply but not the demand in productive sense (***LIA expert***). 3. It's mostly NGOs that push for cross-sector service approaches, but NGOs often lack knowledge on sustainable energy and energy efficiency (***IRECC expert***)

DIRECTION OF GOVERNANCE CONDITIONS TREND

	Positive change occurred or expected	**No change to governance occurred or expected**	**Negative change to governance conditions occurred or expected**
IN THE PAST	1. There has been a big change in the past years, where the Ministry of Energy, its RE Secretariat and EPRA, and to a lesser extent the state companies, have become much more open to engaging civil society and collecting their vies (***INGO expert***) 2. Both the private sector and civil society organizations have realized the benefit of their engagement towards common goals (***INGO expert***).	None mentioned	None mentioned
IN THE FUTURE	1. First, there was no interaction with agriculture, education, and the environment sectors, but now that is something the Ministry of Energy is working on it is now being pushed to the other levels of government as well (***IIA expert***). 2. Though the Covid19 crisis has somewhat slowed down the progress, too much progress has been made to backslide too much (***INGO expert***) 3. In the next three years after all regulations are implemented properly, we expect a substantial improvement in terms of stakeholder engagement in tariff setting (***EPRA expert***) 4. Progress is being made in terms of stimulating productive uses of energy and things are expected to improve significantly but it will take a few years (***IIA expert***) 5. Consumer have become more informed and more powerful using social media, which will ensure continued progress (***IIA expert***)	None mentioned	None mentioned

v Capacity building

STATEMENTS MAPPING ON GOVERNANCE SUPPORTIVENESS

CRITERIA	Supportive	Restrictive
EXTENT	**Availability of adequate skills:** 1. In terms of the private sector, there is no shortage of skills, only a shortage of money (***LSC expert***) 2. At the national level, the Ministry of Energy and EPRA are very skilled and knowledgeable (***LIA expert***) 3. Kenya is quite unique in comparison to the rest Africa regarding skills and knowledge in off-grid RE (***IRECA expert***) **Accessible entrepreneurial programs:** 1. Programs exists mostly funded by the EfD and DfiD (***IRECA expert***) 2. There are many incubator and accelerator programs funded by international donors (***IRECB expert***) 3. There are programs offered by KEREA that are funded by development partners (***IDA expert***) 4. NGOs and development partners have been quite active in supporting people with technical, financial and business trainings (***LSC expert***) 5. There are many incubator programs, mainly in Nairobi (***IRECC expert***)	**Availability of adequate skills:** 1. The most difficult issue in terms of capacity building is that government really do not have good capacity (***IRECB expert***) 2. Startups have the highest potentials in terms of skills, but they lack support in terms of capacity building (***IRECB expert***) 3. PAYGo companies lack capacities to define business models and financial management (***IRECB expert***) 4. Project planning particularly in terms of integrated planning are lacking the most among government officials at all levels (***IDA expert***) 5. Capacities lack at all levels, particularly at the county and local level (***INGO expert***) 6. People in local communities sometimes associate off-grid RE technologies with the western world whicha re not aligned with traditional ways of doing (***EPRA expert***) 7. There is a lack of capable local technicians for operation and maintenance (***EPRA expert***) 8. At national level they do have the skills, but skills are mostly lacking at the county level (***LIA expert***) 9. NGOs form the biggest bottleneck because they don't understand sustainable energy and energy efficiency well (***IRECC expert***) **Change readiness assessments:** 1. Change readiness assessments are not a common practice because they are time-consuming and costly due to the significant number of resources required in advance (***IRECC expert***) 2. Feasibility studies are frequently conducted by foreign consultants who have the best of intentions but are frequently incapable of adequately considering (***IRECB expert***) 3. Often assessments are only done after projects have been implemented (***IDA expert***) 4. Change readiness assessments occur often only after projects are implemented, to stimulate demand and bill payments (***INGO expert***).
COHERENCE		Insufficient data gathered
FLEXIBILITY		Insufficient data gathered
INTENSITY	**All indicators:** 1. Pressure is coming from the private sector. (***IDA expert***) 2. The countries in the EU have been very critical in terms of providing support in capacity building and resource mobilization (***EPRA expert***)	

DIRECTION OF GOVERNANCE CONDITIONS TREND

	Positive change occurred or expected	No change to governance occurred or expected	Negative change to governance conditions occurred or expected
IN THE PAST	None mentioned	None mentioned	None mentioned
IN THE FUTURE	1. It will definitely change, but the the drive will not be from the government but that at least there will be more sharing and learning from one another (***INGO expert***).	None mentioned	None mentioned

Figure 10: Governance supportiveness Capacity Building

II. Components of ECOGRES framework further explained

i Institutional frameworks

Countries also require an adequate institutional framework to implement a national energy access strategy and off-grid RE successfully. The following indicators of an adequate institutional framework can be derived:

- *Clear roles and responsibilities:* Relevant institutions' roles and responsibilities must be clearly defined to provide sector participants with certainty regarding administrative procedures and institutional contacts.
- *Simplified and streamlined administrative procedures*: This is necessary to reduce transaction costs, such as those associated with obtaining required licenses and permits.
- *Adequate capacities*: Mandated institutions should possess sufficient capacity ranging from technical knowledge and skills to financial resources, which also requires intensive collaboration between diverse national and international institutions and agencies.

ii Policies and regulations

To provide a sound foundation for market development and incentives for different stakeholders to develop tailored solutions for off-grid RE, mainstreaming off-grid solutions within national energy strategies is required (IRENA 2018; IRENA, 2019). The following indicators can be derived for assessing the level of *enablement* of this component (IRENA, 2018):

- *Clear definition of off-grid areas*: Electrification plans and strategies should clearly define the areas that can be reached through grid extension within a reasonable time frame and suitable for off-grid solutions, and they should make this information available to all relevant stakeholders.
- *Dedicated off-grid policies*: Policies and regulations that specifically address off-grid technologies such as mini-grids and standalone systems should accompany holistic and integrated energy access strategies that also address licensing and permitting requirements, frameworks for setting tariffs, the implications of main grid arrival, and financing considerations.
- *Clear goals and objectives*: Policy stability and clarity are critical for off-grid renewable energy solution development. Policies, including incentive structures, must be designed to attract investment and encourage small and medium-sized businesses to contribute to the market's long-term development.

- *Integrated electricity sector framework:* Traditional, centralized electricity sector frameworks must be adapted to facilitate the deployment of mini-grids.
- *Adequate standards and quality control instruments:* There is a focus on adopting standards that encourage sustainable development and lifecycle management without discouraging adaptation and delivery modem innovation.

iii Delivery and financing models

Innovative delivery and financing models are essential to off-grid RE deployment to make solutions more accessible and affordable to end users while also increasing the sustainability of off-grid infrastructure (IRENA, 2018; IRENA, 2019). Indicators of proper delivery and financing models are (IRENA, 2018):

- *Tailoring to local context*: Delivery models must be developed in accordance with local socio-economic conditions, technology adoption, and current and projected electricity demand. By actively involving communities in the design, construction, operation, and maintenance phases of projects, we can increase community buy-in, improve sustainability, and expand rural employment opportunities
- *Long-term and tailored financing*: Sustainable financing models can increase the accessibility of off-grid solutions, whether products (e.g., solar home systems) or services (e.g., mini-grid connection fee). Designing financing in a way that engages local financial institutions can also assist households in gaining access to a broader range of financial services beyond energy.
- *Available public financing for de-risking private investments:* Off-grid companies seek increased access to affordable, long-term financing, with financing requirements varying according to the stage of the business, its product/service portfolio, and the stage of project development. Public finance will play a critical role in closing the funding gap in the off-grid RE sector and advancing delivery model innovation through research and pilot projects.
- *Innovative financing models:* When traditional financing is unavailable or prohibitively expensive, the use of financial instruments such as crowdfunding can assist in rapidly raising capital at a low cost while also fostering community awareness and acceptance in some instances.

iv Multi-stakeholder and cross-sector linkages

Off-grid RE solutions can help provide essential services like health, water, and education and support livelihoods through productive end-uses (IRENA, 2018). To maximize the cross-sector benefits of off-grid solutions, measures such as facilitating dialogue with stakeholders across sectors are necessary

during all stages of developing off-grid RE projects and sector strategies. Indicators for cross sector-linkages are (IRENA, 2018):

- *Multi-stakeholder approach:* Coordination and institutional interactions between between a range of actors and not just states are essential to ensure performance and effectiveness in the uptake of off-grid RE, as they can reduce project-risks and allocate risks between the public and private sector (Sovacool, 2013; Sanderink & Nasiritousi, 2020).
- *Cross-sector service approach*: A comprehensive approach to off-grid renewable energy development considers the diversity of energy services required across sectors to increase the sustainability of projects and programs and maximize outcomes.
- *Leverage of innovative solutions:* Off-grid RE innovations in technology, delivery, and financing models can be leveraged to support the delivery of electricity services across sectors, including agriculture. Examples are Pay-as-you-go, which has been tailored into pay-as-you-grow to enable small-scale farmers to finance off-grid solar irrigation systems.
- Service provision to public services: Off-grid renewable energy solutions can be designed to provide a cost-effective and reliable source of electricity for various public services, including water, education, and health.

v Technology adaptation

Technological advancements in technology generation, the balancing of system components, and end-use applications, combined with improvements in delivery, operation, and maintenance, will drive down costs of off-grid RE (IRENA; 2018). Indicators for the level of technology enablement are (IRENA, 2018):

- *Adaptation to local conditions* A holistic approach is required that considers the generation technologies (e.g., solar PV, micro-hydro turbines), the balance-of-system components (e.g., inverters, electronic load controllers, and smart meters), and appliances to provide accessible and affordable electricity services in rural areas for households, public institutions (e.g., health care, education), and productive uses (e.g., agriculture, rural enterprises).
- *Public-private partnerships (PPP) and loan grants*: PPP can enhance the development and implementation of projects, whereas public venture funds and subsidies contribute to knowledge generation and exchange.
- *Favorable market policies:* Policymakers should establish market policies that promote the commercialization of off-grid RE equipment and thus the growth of the sector.

vi Capacity building

Capacity building is a critical component of creating an enabling environment for the development of off-grid RE (IRENA; 2018). Capacities are required within public and financial institutions to support the national energy access strategy's implementation. Raising awareness and educating stakeholders about off-grid renewable energy solutions' characteristics can help overcome some of the barriers that new technologies face. Indicators for this component are (IRENA, 2018):

- *Change readiness assessments:* A capacity needs assessment is necessary to identify gaps in the value chain of off-grid RE technologies, which includes the public sector, financing institutions, the private sector, and standardization agencies. Technical assistance programs and international development finance should then be designed to support local capacity development to ensure the sector's long-term viability.
- *Accessible entrepreneurial support programs:* Dedicated platforms for small and medium-sized renewable energy enterprises to access advisory services for the local private sector could help foster sustainable market growth for off-grid solutions.
- *Dedicated project facilitation tools*: Project tools can help project developers secure financing and manage projects more efficiently.
- *Availability of adequate skills:* The availability of adequate vital to the sustainability of off-grid RE varies according to the technology, the value chain segment, and the nature of the task. Certification programs for off-grid skill development, their integration into training curricula, and a focus on local skills development for operation and maintenance could create employment opportunities for rural communities and contribute to overall socio-economic development.

III. Interview questionnaire

Enabling component	**Main descriptive questions for assessing governance context**
Policies and regulations	Are there clear definitions of off-grid areas?
	Are there dedicated off-grid policies?
	Have clear goals and objectives been defined regarding off-grid RE?
	Is there an integrated electricity sector framework?
	Are there adequate standards and quality control instruments for off-grid RE?
	Have any of these conditions changed over time, or are they likely to change in the foreseeable future?
Institutional frameworks	Are the roles and responsibilities between relevant institutions clear?
	To what extent are the administrative procedures concerning off-grid RE simplified and streamlined.
	Do the relevant institutions have adequate capacities for performing their duties?
	Have any of these conditions changed over time or are likely to change in the foreseeable future?
Delivery and financing models	Are the delivery models for off-grid RE generally tailored to the local context?
	Do off-grid RE projects sufficiently consider long-term and tailored financing?
	Is there sufficient public financing available for de-risking private investments?

	What innovative financing models exists in case of financial gaps?
	Have any of these changed over time or are likely to change in the foreseeable future?
Technology adaptation	Are the off-grid RE technologies deployed adapted and tailored to local conditions?
	Do public-private partnerships (PPP) and loan grants exist for the development of off-grid RE technologies?
	Has the government created favorable market policies for off-grid RE technologies?
	Have any of these conditions changed over time or are likely to change in the foreseeable future?
Capacity building	Are change readiness assessments conducted before planning and implementing off-grid RE projects and programs?
	Are there accessible entrepreneurial support programs available for private sector businesses?
	Do dedicated project facilitation tools exist for off-grid RE project planning, financing and implementation?
	Do actors involved in planning, implementation, operation, maintenance and use of off-grid RE have adequate skills?
	Have any of these conditions changed over time or are likely to change in the foreseeable future?
Multi-stakeholder and cross-sector linkages	Are all relevant stakeholders in-volved? Are there any stakeholders and/or cross-sectoral linkages not included or even excluded?
	Is there a cross-sector service approach to off-grid RE that takes into account the diversity of energy services required across sectors?
	Are innovations in technology, delivery, and financing models of off-grid RE leveraged to support the delivery of electricity services across sectors, including agriculture?
	Do off-grid RE solutions also provide cost-effective and reliable electricity to public services?
	Have any of these conditions changed over time or are likely to change in the foreseeable future?