ENERGY ACCESS, GOVERNANCE, AND TRANSITION PATHWAYS: INSIGHTS FROM SHAPE COMMUNITY IN NIGERIA

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Abstract

Achieving univ*ersal access to affordable, reliable, and sustainable electricity remains a major challenge in many developing countries, where rural electrification is constrained by weak institutions, inadequate infrastructure, and limited investment. Although decentralised renewable energy technologies are increasingly promoted to address energy poverty, their long-term sustainability depends as much on governance as on technological performance. This study aims to examine how governance arrangements influence the implementation, sustainability, and scalability of community renewable energy systems using the Shape community renewable energy project in Nigeria as a case study. A qualitative case study design was adopted, drawing on semi-structured interviews, documentary analysis, and field observations, interpreted through the complementary analytical lenses of the Multi-Level Perspective, Transition Management, and Strategic Niche Management. The findings show that the project significantly improved electricity access and generated important socio-economic and environmental benefits. However, its transformative potential was constrained by fragmented governance, weak institutional coordination, limited community participation, financial sustainability challenges, and inadequate organisational learning. The study argues that governance is the principal mechanism linking technological innovation to wider socio-technical transformation in developing-country contexts. It extends sustainability transition theory by proposing a governance-oriented framework that identifies institutional capacity, governance coordination, community agency, financial sustainability, and knowledge diffusion as interdependent capabilities shaping transition pathways. The findings provide practical insights for policymakers, rural electrification agencies, development partners, renewable energy developers, and local communities seeking to strengthen the governance and long-term sustainability of community renewable energy programmes in developing countries.*

Keywords: Energy transition; Sustainability transition; Rural electrification; Community Renewable Energy; Energy governance; Nigeria; Transition theory

1. Introduction

The global transition towards sustainable energy systems has emerged as one of the defining development priorities of the twenty-first century. Central to this transition is the challenge of achieving universal access to affordable, reliable, sustainable, and modern energy while simultaneously addressing climate change,

reducing energy poverty, and promoting inclusive socio-economic development. Although significant progress has been made in expanding electricity access, approximately 685 million people worldwide still lack access to electricity, with nearly four-fifths of this population residing in Sub-Saharan Africa (IEA, 2024; World Bank, 2024). These persistent disparities highlight the urgent need for innovative, context-sensitive, and institutionally sustainable approaches to rural electrification.

Nigeria exemplifies this challenge. Despite being Africa's largest economy and most populous country, its electricity sector continues to experience inadequate generation capacity, weak transmission and distribution infrastructure, unreliable electricity supply, and persistent governance deficiencies. Consequently, millions of rural households continue to depend on traditional energy sources such as fuelwood, charcoal, kerosene, and petrol generators, with significant environmental, health, and socio-economic consequences (Babanyara & Saleh, 2010; Gujba et al., 2012; World Bank, 2024). These conditions perpetuate energy poverty, constrain local economic development, and reinforce wider patterns of social inequality.

Decentralised renewable energy technologies, particularly solar photovoltaic mini-grids and stand-alone systems, have increasingly been recognised as viable alternatives to conventional grid extension. Declining technology costs, advances in battery storage, and supportive policy reforms have substantially improved their technical and economic feasibility, particularly in geographically isolated communities where national grid expansion remains prohibitively expensive. Among these approaches, community renewable energy initiatives have attracted growing attention because they combine decentralised electricity provision with local participation, shared ownership, and community-centred governance (Walker & Devine-Wright, 2008). International evidence indicates that meaningful community participation enhances project legitimacy, strengthens accountability, improves social acceptance, and contributes to long-term operational sustainability (Bauwens et al., 2016; Hicks & Ison, 2018).

Despite growing scholarly interest in community renewable energy, important gaps remain in the existing literature. First, an empirical gap exists. Although numerous studies have examined the technical performance, financial viability, social acceptance, and socio-economic impacts of community renewable energy projects (Walker & Devine-Wright, 2008; Bauwens et al., 2016; Hicks & Ison, 2018), comparatively few have investigated how governance arrangements influence project implementation, long-term sustainability, and scalability, particularly in developing countries. Where governance has been considered, it has often been treated as a contextual or enabling factor rather than as the principal mechanism through which

renewable energy transitions are enabled or constrained.

Second, a theoretical gap persists. Sustainability transition frameworks such as the Multi-Level Perspective (MLP), Transition Management (TM), and Strategic Niche Management (SNM) have substantially advanced understanding of socio-technical change by explaining how innovations emerge, diffuse, and interact with incumbent socio-technical regimes (Geels, 2002, 2004, 2011; Loorbach, 2007, 2010; Schot & Geels, 2008; Köhler et al., 2019). However, these frameworks were largely developed from empirical experiences in Europe and other industrialised economies and have been criticised for paying insufficient attention to governance quality, institutional fragility, political economy, power relations, and state capacity in developing-country contexts (Lawhon & Murphy, 2012; Binz & Truffer, 2017; Wieczorek, 2018; Newell et al., 2021). Consequently, governance remains insufficiently integrated into sustainability transition theory as a central explanatory dimension rather than merely an enabling condition.

Third, a contextual gap remains evident. Existing evidence on community renewable energy is dominated by studies from Europe, North America, and other industrialised economies characterised by relatively mature institutions, stable regulatory environments, and well-developed financial systems (Walker & Devine-Wright, 2008; Bauwens et al., 2016; Kooij et al., 2018). Comparatively little is known about how community renewable energy initiatives operate within developing countries where fragmented governance, institutional weaknesses, financial constraints, limited administrative capacity, and complex socio-political relationships fundamentally shape transition processes (Ahlborg & Hammar, 2014; Ahlborg et al., 2015). This limits the transferability of existing theoretical insights to countries such as Nigeria, where governance challenges frequently determine project success more than technological capability.

Fourth, a methodological gap can also be identified. Much of the existing literature relies on quantitative modelling, techno-economic assessments, policy evaluations, or large-scale comparative analyses that provide valuable evidence regarding technical feasibility and economic performance (Bhattacharyya, 2012; IEA, 2024). However, these approaches offer only limited understanding of the dynamic interactions among government agencies, regulators, development partners, private developers, community organisations, and local stakeholders throughout the project lifecycle (Meadowcroft, 2009; Radtke, 2025). Consequently, there remains a shortage of in-depth qualitative case studies capable of explaining how governance processes influence project planning, implementation, stakeholder coordination, institutional learning, financial sustainability, and long-term project evolution within community renewable energy initiatives.

Collectively, these empirical, theoretical, contextual, and methodological gaps demonstrate the need for research that places governance at the centre of analysis. Accordingly, the aim of this study is to examine how governance arrangements influence the implementation, sustainability, and scalability of community renewable energy initiatives in rural Nigeria using the *Shape* community project as an empirical case study. Specifically, the study seeks to:

- Analyse the governance structures and institutional arrangements that shaped the implementation of the *Shape* community renewable energy project.
- Identify the institutional, socio-political, financial, and organisational factors affecting the long-term sustainability and scalability of community renewable energy initiatives.

The *Shape* community renewable energy project offers a valuable empirical setting for examining how governance arrangements impact project planning, stakeholder coordination, community participation, financial sustainability, institutional learning, and long-term system development. Rather than assessing technological performance alone, this study explores how interactions among public institutions, regulatory frameworks, financial mechanisms, development partners, and local communities collectively shape transition outcomes. In doing so, it argues that governance constitutes the critical mechanism through which technological innovations are translated into sustainable socio-technical transformations in developing-country contexts.

The study draws upon the complementary analytical perspectives of the Multi-Level Perspective (MLP), Transition Management (TM), and Strategic Niche Management (SNM). While these frameworks have significantly advanced understanding of socio-technical transitions (Geels, 2002; Loorbach, 2007; Schot & Geels, 2008), this study evaluates their explanatory capacity within Nigeria's decentralised renewable energy sector and identifies areas where they require theoretical refinement to better account for governance quality, institutional capacity, stakeholder coordination, and political realities in developing countries.

Accordingly, the study addresses the following research questions:

- How do governance arrangements shape the development and implementation of community renewable energy projects in rural Nigeria?
- What institutional, socio-political, financial, and governance barriers constrain the sustainability and scalability of community renewable energy initiatives?

This study contributes to the literature in three important ways. Theoretically, it extends sustainability transition scholarship by demonstrating that governance should be treated as a central explanatory dimension of

socio-technical transitions rather than merely a contextual factor, particularly within institutionally fragile developing-country settings. Empirically, it provides one of the first in-depth qualitative analyses of governance processes shaping community renewable energy implementation in rural Nigeria through the *Shape* case study. Practically, the findings provide evidence-based insights for policymakers, the Rural Electrification Agency, the Federal Ministry of Power, regulators, development partners, investors, and rural communities seeking to design more inclusive, financially sustainable, and scalable decentralised renewable energy programmes capable of accelerating progress towards universal electricity access and national energy transition objectives.

The findings are expected to benefit a broad range of stakeholders. Policymakers and energy regulators can use the evidence to strengthen governance and institutional coordination for decentralised electrification programmes. Development partners and investors may draw on the findings to design financing and implementation models that enhance project sustainability. Community organisations and local governments can apply the lessons to improve participation, accountability, and long-term management of renewable energy systems. Finally, researchers will benefit from the study's governance-oriented refinement of sustainability transition theory, which offers a framework for analysing renewable energy transitions in developing-country contexts.

The remainder of the paper is organised as follows. Section 2 reviews the literature on energy poverty, community renewable energy, governance, and sustainability transitions. Section 3 presents the theoretical framework. Section 4 describes the research methodology. Section 5 presents the empirical findings from the *Shape* case study. Section 6 discusses the findings in relation to sustainability transition theory and proposes a governance-oriented refinement to existing transition frameworks. The final section concludes by outlining the study's theoretical implications, policy recommendations, limitations, and directions for future research.

2. Literature Review

2.1 Energy Poverty, Rural Electrification and Sustainability

Despite considerable progress in global electrification over the past two decades, energy poverty remains one of the most persistent barriers to sustainable development, particularly in Sub-Saharan Africa. Contemporary scholarship increasingly recognises that energy poverty extends beyond the absence of electricity connections to encompass the affordability, reliability, accessibility, quality, safety, and sustainability of energy services (Sovacool, 2012; Bouzarovski & Petrova, 2015). This multidimensional conceptualisation represents an important shift from earlier binary measures of electricity access by recognising that households may be formally connected to electricity networks while continuing to experience severe

energy deprivation because of unreliable supply, frequent outages, poor service quality, or unaffordable tariffs. Nevertheless, scholars differ in the extent to which energy poverty should be viewed primarily as a technical infrastructure deficit or as a broader manifestation of socio-economic inequality, institutional weakness, and governance failure (Day et al., 2016). These contrasting perspectives imply that expanding electricity access alone may be insufficient to address the underlying causes of energy deprivation.

There is broad consensus that reliable access to modern energy is fundamental to sustainable development because it improves education, healthcare, agricultural productivity, enterprise development, and overall quality of life (Bhattacharyya, 2012; Blimpo & Cosgrove-Davies, 2019). However, much of this evidence is derived from cross-sectional household surveys and programme evaluations that primarily measure development outcomes rather than the institutional processes through which these outcomes are achieved. Consequently, while the developmental benefits of electrification are well established, comparatively less attention has been devoted to understanding why similar electrification interventions produce different outcomes across countries and communities. This limitation suggests that contextual factors, particularly governance quality and institutional capacity, may play a more decisive role than is often acknowledged.

The environmental, health, and gender dimensions of energy poverty further reinforce its complexity. Continued dependence on fuelwood, charcoal, and kerosene contributes to deforestation, greenhouse gas emissions, biodiversity loss, and indoor air pollution, while women and children disproportionately bear the burden of fuel collection and exposure to harmful pollutants (Clancy et al., 2003; IRENA, 2024). Although these relationships are widely recognised, existing studies differ in their emphasis. Environmental research tends to prioritise emission reductions and ecosystem protection, whereas development-oriented studies focus more strongly on poverty alleviation, health outcomes, and gender equity. This disciplinary divergence highlights the need for more integrated analyses capable of examining environmental, social, economic, and institutional dimensions simultaneously.

Historically, rural electrification policies in developing countries focused primarily on extending centralised electricity grids. While grid expansion has generated significant socio-economic benefits, numerous studies demonstrate that this approach is frequently constrained by high infrastructure costs, dispersed settlements, difficult terrain, and relatively low electricity demand in remote communities (Bhattacharyya, 2012; Barnes, 2019). These findings have encouraged growing interest in decentralised renewable energy systems as complementary or alternative approaches to rural electrification. Nevertheless, the literature remains divided over whether decentralised

systems should be regarded as transitional solutions pending future grid expansion or as long-term components of national electricity systems. This unresolved debate has important implications for investment priorities, regulatory frameworks, and governance arrangements.

Technological advances have significantly improved the viability of decentralised renewable energy. Declining costs of solar photovoltaic systems, battery storage technologies, smart metering, and digital energy management have made mini-grids and stand-alone systems increasingly competitive with conventional grid extension (ESMAP, 2022; IRENA, 2024). However, evidence regarding their long-term sustainability is less conclusive. Engineering and techno-economic studies generally emphasise cost reductions, system performance, and technical reliability. In contrast, socio-technical research argues that technology alone cannot ensure lasting project success because implementation is mediated by institutions, governance systems, financing mechanisms, and user practices (Geels, 2002; Markard et al., 2012). These contrasting interpretations illustrate an important conceptual divide between technology-centred and governance-centred explanations of rural electrification outcomes.

Growing empirical evidence supports the latter perspective. Many technically successful projects have experienced operational decline because of weak governance, limited institutional capacity, inadequate financial management, poor maintenance arrangements, and insufficient community participation (Kirubi et al., 2009; Ulsrud et al., 2018). Nevertheless, much of the available evidence is based on individual case studies, making it difficult to determine the relative importance of different governance factors across institutional contexts. Consequently, while governance is increasingly recognised as important, there remains limited understanding of how specific governance arrangements influence the long-term sustainability and scalability of decentralised renewable energy systems, particularly in developing countries.

This broader understanding has increasingly influenced sustainability transition research, which conceptualises rural electrification as a socio-technical transformation involving simultaneous technological, institutional, behavioural, financial, and governance change rather than infrastructure provision alone (Meadowcroft, 2011; Köhler et al., 2019). Despite this theoretical shift, relatively few empirical studies have examined how governance mechanisms operate within community renewable energy initiatives in developing-country contexts. This empirical and contextual gap provides the foundation for the present study, which investigates how governance arrangements shape the implementation, sustainability, and scalability of the *Shape* community renewable energy project in Nigeria.

2.2 Community Renewable Energy

Community renewable energy has become an increasingly important component of sustainability transitions, reflecting a shift from centralised, utility-dominated electricity systems towards decentralised, participatory, and locally governed energy systems. Unlike conventional rural electrification models, where communities primarily function as passive consumers, community renewable energy emphasises community involvement in planning, ownership, financing, operation, and governance. While there is broad agreement that community renewable energy represents both a technological and institutional innovation, scholars differ in the extent to which community participation should be considered essential to its definition. Consequently, community renewable energy remains a contested concept rather than a universally agreed model of decentralised energy development.

Existing definitions vary according to the degree of community ownership, participation, decision-making authority, and benefit sharing. Walker and Devine-Wright (2008) distinguish between the process dimension, which focuses on participation in planning and governance, and the outcome dimension, which concerns the distribution of economic, social, and environmental benefits. Bauwens et al. (2016) extend this perspective by conceptualising community renewable energy as a continuum ranging from fully community-owned cooperatives to hybrid arrangements involving governments, private developers, financial institutions, non-governmental organisations, and local communities. Although these frameworks recognise the diversity of organisational models, they also reveal a lack of conceptual consistency that complicates comparisons across studies and limits the development of a common analytical framework. This inconsistency has contributed to differing interpretations of what constitutes meaningful community involvement.

The rapid expansion of community renewable energy has been facilitated by declining costs of renewable energy technologies, particularly solar photovoltaic systems, battery storage, digital monitoring, and smart metering (Verbong & Geels, 2010; Geels, 2011). However, technological progress alone does not explain the increasing prominence of community renewable energy. While engineering and policy studies frequently attribute its growth to improved technical feasibility and cost competitiveness, governance scholars argue that its significance lies equally in its potential to democratise energy systems, strengthen local resilience, and redistribute decision-making authority (Burke & Stephens, 2018). These contrasting perspectives suggest that community renewable energy should be understood not merely as a technological innovation but as a socio-technical governance model whose effectiveness depends on institutional arrangements as much as technical performance.

This governance perspective has strengthened connections between community renewable energy and broader debates on energy democracy, energy justice, and participatory governance. Energy democracy emphasises greater citizen participation, transparency, and local ownership, whereas energy justice highlights procedural fairness, equitable benefit distribution, and recognition of historically marginalised communities (Jenkins et al., 2016; Sovacool et al., 2021; Sovacool et al. 2020). Although these normative frameworks provide valuable insights into inclusive energy transitions, empirical evidence regarding their practical implementation remains mixed. Much of the supporting literature originates from Europe, where favourable policy environments, mature financial systems, and relatively stable institutions facilitate community participation. Consequently, it remains uncertain whether similar governance arrangements can achieve comparable outcomes within developing-country contexts characterised by institutional fragility and resource constraints.

Empirical studies from Germany, Denmark, the Netherlands, and the United Kingdom consistently report that meaningful community participation enhances public acceptance, institutional legitimacy, stakeholder trust, and operational sustainability (Bauwens et al., 2016; Hicks & Ison, 2018; Wierling et al., 2021). However, these findings are based predominantly on longitudinal case studies and mature cooperative energy systems that differ substantially from institutional conditions in many developing countries. Directly transferring lessons from these settings therefore risks overlooking differences in governance capacity, regulatory quality, financial markets, and political contexts. This methodological limitation suggests that the external validity of many existing community renewable energy studies may be more restricted than is often assumed.

Evidence from developing countries further illustrates these challenges. Although many projects are described as community-based, strategic decisions concerning technology selection, financing, ownership, tariff setting, and long-term management frequently remain concentrated among governments, donors, or private developers. As Cooke and Kothari (2001) and Aitken (2010) argue, participation may therefore become largely symbolic rather than transformative, limiting local ownership and weakening accountability. These contrasting findings indicate that the effectiveness of community renewable energy depends not simply on community participation but on the quality of governance arrangements through which participation is organised and sustained.

Despite the rapid expansion of community energy research, significant knowledge gaps remain. Existing scholarship continues to be dominated by studies from Europe and North America, while comparatively limited empirical research examines how governance arrangements influence the

implementation, sustainability, and scalability of community renewable energy initiatives in Sub-Saharan Africa. Furthermore, much of the literature continues to prioritise technical performance, business models, and public acceptance over the institutional processes through which community energy initiatives become embedded within wider socio-technical systems. Addressing these theoretical, methodological, and contextual limitations, this study examines the *Shape* community renewable energy project through the complementary perspectives of the Multi-Level Perspective, Transition Management, and Strategic Niche Management. By integrating these frameworks, the study conceptualises community renewable energy as a socio-technical governance innovation whose long-term success depends on interactions among governance arrangements, institutions, financing mechanisms, stakeholder participation, and organisational learning.

2.3 Community Renewable Energy in Developing Countries

While early community renewable energy research focused predominantly on Europe and North America, an expanding body of scholarship has examined community-based renewable energy initiatives across Africa, Asia, and Latin America (Bhattacharyya, 2012; Sovacool, 2013; Ulsrud et al., 2018). Collectively, these studies demonstrate that community renewable energy can improve rural electrification, stimulate local economic development, reduce poverty, and promote environmental sustainability. However, the reported outcomes vary considerably across countries and projects, suggesting that technological deployment alone cannot explain project success. Instead, differences in governance quality, institutional capacity, financing arrangements, and socio-political contexts appear to shape implementation and long-term sustainability. This variation challenges the assumption that successful community renewable energy models can be readily transferred across different institutional environments.

Evidence from South Asia illustrates both the opportunities and limitations of decentralised renewable energy. Studies from India indicate that solar photovoltaic and biomass systems have expanded electricity access while supporting local enterprises, education, and social development (Palit & Chaurey, 2011; Bhattacharyya, 2012). Similarly, community-managed micro-hydropower schemes in Nepal have strengthened local governance and improved access to modern energy services (Yadoo & Cruickshank, 2012). Nevertheless, subsequent research identifies persistent challenges related to technical maintenance, tariff affordability, revenue collection, and institutional sustainability (Chaurey & Kandpal, 2010a, 2010b; Palit et al., 2014). These contrasting findings suggest that short-term improvements in electricity access do not necessarily translate into long-term organisational resilience. Moreover, much of

the available evidence is derived from project evaluations conducted during or shortly after implementation, limiting understanding of how governance arrangements evolve over time.

Comparable patterns emerge across Sub-Saharan Africa. Studies from Kenya, Tanzania, Uganda, and Rwanda consistently report that mini-grid systems have improved household welfare, supported productive economic activities, and enhanced access to education and healthcare services (Kirubi et al., 2009; Moner-Girona et al., 2019; Ulsrud et al., 2018). Community participation is frequently associated with stronger project acceptance and operational performance. However, these benefits are often constrained by weak institutional support, inadequate technical capacity, limited financial management, uncertain regulatory environments, and insufficient maintenance systems (Brew-Hammond, 2010; Eberhard et al., 2017). While most studies acknowledge these governance challenges, relatively few examine how they interact or identify which governance mechanisms are most influential in determining long-term project sustainability. Consequently, governance is commonly recognised as important but remains insufficiently theorised and empirically examined.

Evidence from Latin America reinforces these observations. Community renewable energy initiatives in Brazil, Peru, and Bolivia demonstrate the potential of decentralised energy systems to promote rural development, strengthen local institutions, and enhance social inclusion (Lema & Lema, 2013; IRENA, 2015). However, project sustainability has depended largely on continued government support, effective local governance, and reliable financing mechanisms. In several cases, projects experienced declining performance after external donor funding ended, indicating that initial implementation success does not necessarily guarantee long-term sustainability (Eberhard et al., 2017; Moner-Girona et al., 2019; Ulsrud et al., 2018). These findings question the widespread tendency to evaluate projects primarily on early implementation outcomes rather than their capacity for long-term institutional adaptation and financial self-sufficiency.

Across developing countries, three interrelated governance challenges emerge consistently from the literature. First, institutional capacity remains limited, with many projects constrained by weak administrative systems, shortages of technical expertise, and inadequate local management capabilities. Second, financial sustainability continues to present a major obstacle. Although donor funding and government subsidies frequently support project implementation, many initiatives lack viable revenue models capable of financing routine maintenance and future infrastructure replacement. Third, community participation often remains confined to consultation rather than meaningful involvement in ownership and strategic decision-making, reducing accountability and long-term commitment

(Cooke & Kothari, 2001; Aitken, 2010). Although these challenges are widely recognised, existing studies rarely examine how they interact within broader governance systems, leaving important questions regarding institutional coordination and organisational learning unresolved.

Another unresolved issue concerns the transferability of governance models across institutional settings. Governance arrangements that have proven effective in industrialised countries cannot be assumed to perform similarly in developing economies characterised by weaker regulatory institutions, limited financial markets, fragmented governance structures, and more complex political economies (Lawhon & Murphy, 2012; Wieczorek, 2018). This raises important questions regarding the contextual applicability of prevailing sustainability transition theories, which continue to be informed largely by evidence from advanced economies.

Nigeria reflects many of these broader governance challenges. Despite abundant renewable energy resources and growing policy support for decentralised electrification, reliable electricity access remains limited across many rural communities. Although recent reforms, including the Electricity Act 2023, recognise the importance of community renewable energy, existing Nigerian research has focused primarily on technology deployment, investment requirements, and policy design, with comparatively little attention devoted to governance processes, institutional coordination, stakeholder interactions, and organisational learning. This empirical, methodological, and contextual gap provides the rationale for the present study, which examines how governance arrangements influence the implementation, sustainability, and scalability of the *Shape* community renewable energy project in Nigeria.

2.4 Governance and Energy Transitions

Governance has become a central theme in sustainability transition research as scholars increasingly recognise that energy transitions are shaped not only by technological innovation but also by institutional arrangements, policy frameworks, stakeholder interactions, and power relations. Although early transition studies focused primarily on technological change and market dynamics, more recent research conceptualises energy transitions as socio-technical and socio-political processes requiring coordinated action among governments, regulators, private actors, communities, and civil society (Geels, 2002; Meadowcroft, 2011; Köhler et al., 2019). This institutional dimension is particularly important in developing-country contexts, where weaknesses in governance and state institutions can constrain the capacity to translate available resources and development opportunities into sustainable development outcomes (Bello & Sagagi, 2017). Despite this broad consensus, there remains considerable debate regarding the extent to which governance functions as an enabling condition for technological change or as the primary driver of sustainability

transitions. This distinction has important implications for understanding how renewable energy systems emerge, stabilise, and scale.

Governance generally refers to the formal and informal institutions, rules, networks, and decision-making processes through which collective action is organised and public objectives are pursued (Rhodes, 1997; Pierre & Peters, 2000). Within the energy sector, governance encompasses regulatory frameworks, policy instruments, institutional arrangements, stakeholder relationships, accountability mechanisms, and participation processes that influence how energy is produced, distributed, financed, and consumed (Meadowcroft, 2009; Lockwood et al., 2013). While this broad definition is widely accepted, studies differ in the aspects of governance they prioritise. Policy research often emphasises regulatory effectiveness and institutional design, whereas transition scholars focus more on actor networks, learning processes, and multi-level interactions. As a result, governance remains a multidimensional concept whose operationalisation varies considerably across empirical studies, making comparisons difficult and limiting cumulative theoretical development.

The growing emphasis on governance reflects increasing recognition that technological innovations rarely diffuse automatically. Their adoption depends on institutional environments that shape incentives, legitimacy, resource mobilisation, and actor behaviour (North, 1990; Smith et al., 2005; Geels, 2011). Governance structures influence which technologies receive policy support, how financial resources are allocated, whose interests are represented, and which transition pathways become politically feasible (Avelino & Rotmans, 2009). However, empirical studies differ regarding the relative importance of these governance dimensions. Some emphasise institutional stability and policy consistency as the principal determinants of successful transitions, while others argue that stakeholder participation, social learning, and collaborative decision-making are equally important. These differing interpretations suggest that governance should be understood as an integrated system of interacting institutions rather than a collection of isolated policy instruments.

Evidence from industrialised countries demonstrates that effective governance has played a significant role in accelerating renewable energy deployment. Stable policy environments, long-term strategic planning, institutional coordination, and inclusive stakeholder engagement have supported successful transitions such as Germany's Energiewende, Denmark's wind energy expansion, and community energy initiatives in the United Kingdom (Loorbach, 2007; Verbong & Geels, 2010; Meadowcroft, 2011; Geels et al., 2017). However, much of this evidence is derived from countries characterised by mature institutions, strong regulatory capacity, and relatively stable political environments. Consequently, the transferability of these governance models

to developing countries remains uncertain. Comparative studies seldom examine how differences in institutional quality, political economy, and administrative capacity affect the applicability of governance frameworks originally developed within advanced economies.

This limitation has generated increasing criticism within sustainability transition scholarship. Lawhon and Murphy (2012) and Wieczorek (2018) argue that prevailing transition theories remain heavily influenced by European experiences and therefore insufficiently account for the institutional fragility, fragmented governance, financial constraints, and informal institutions that characterise many developing countries. Although more recent studies acknowledge these contextual differences (for example: Newell et al., 2021), empirical evidence from Sub-Saharan Africa remains comparatively limited. Consequently, governance challenges in developing-country energy transitions are frequently identified but insufficiently theorised, leaving uncertainty regarding the institutional mechanisms through which governance shapes transition outcomes.

Institutional fragmentation represents one of the most persistent governance challenges identified in the literature. Responsibilities for policy formulation, regulation, financing, implementation, and project oversight are often dispersed across multiple organisations without effective coordination mechanisms (Lockwood et al., 2013; Bulkeley et al., 2014). Although institutional diversity may stimulate innovation, excessive fragmentation frequently results in overlapping mandates, inconsistent policy implementation, regulatory uncertainty, and weak accountability (Jordan et al., 2015). Evidence from Sub-Saharan Africa consistently identifies poor coordination among government agencies, regulators, donors, and implementing organisations as a major constraint on renewable energy development (Eberhard et al., 2017; Butu & Strachan, 2022). Nevertheless, existing studies rarely examine how institutional coordination interacts with financing, participation, and organisational learning to influence long-term project sustainability.

Stakeholder participation has likewise become a defining characteristic of effective transition governance because it enhances legitimacy, accountability, local knowledge integration, and public acceptance of renewable energy initiatives (Reed, 2008; Loorbach, 2010; Chilvers & Longhurst, 2016). Community renewable energy projects characterised by meaningful participation generally demonstrate stronger local ownership and greater operational sustainability than predominantly top-down interventions (Walker & Devine-Wright, 2008; Hicks & Ison, 2018). However, empirical evidence remains mixed. While many studies associate participation with improved outcomes, others argue that consultation is frequently mistaken for genuine participation, with communities excluded from strategic decisions relating to ownership, financing, tariff setting, and long-term governance (Aitken, 2010; Ulsrud

et al., 2018). This unresolved debate suggests that the quality of participation, rather than participation alone, determines whether governance arrangements become genuinely transformative.

Financial governance and organisational learning constitute equally important, yet comparatively underexplored, dimensions of sustainability transitions. Renewable energy projects require substantial upfront investment together with sustainable mechanisms for operation, maintenance, and infrastructure replacement (IEA, 2024; IRENA, 2024). Although grants and donor finance often support implementation, long-term viability depends upon transparent financial management, cost-reflective yet socially acceptable tariff systems, and effective lifecycle planning (Mazzucato & Semieniuk, 2018; Blimpo & Cosgrove-Davies, 2019). This financing dimension is particularly relevant in developing-country settings, where inadequate access to finance, infrastructural deficiencies, regulatory uncertainty, macroeconomic volatility, and institutional weaknesses can constrain organisational and development outcomes (Usman et al., 2026). Similarly, sustainability transitions depend upon institutions capable of monitoring outcomes, adapting policies, and disseminating lessons across projects (Voß et al., 2009; Grin et al., 2010). However, existing studies rarely integrate financial governance, organisational learning, institutional coordination, and stakeholder participation within a single analytical framework, limiting understanding of how these governance dimensions collectively influence transition outcomes.

Overall, the literature demonstrates that governance is not simply a supporting element of sustainability transitions but a central determinant of their implementation, sustainability, and scalability. Nevertheless, important theoretical, empirical, methodological, and contextual gaps remain. Existing transition scholarship continues to emphasise technological innovation while paying comparatively less attention to governance deficits, institutional fragility, and power asymmetries prevalent in developing countries. Furthermore, empirical evidence explaining how governance processes interact to shape community renewable energy transitions in Sub-Saharan Africa remains limited. The Nigerian context makes these institutional questions particularly significant because weaknesses in governance and state institutions have previously been identified as constraints on the country's ability to translate its substantial resources and development potential into sustainable outcomes (Bello & Sagagi, 2017). Addressing these limitations, the present study integrates the Multi-Level Perspective, Transition Management, and Strategic Niche Management to examine governance as the principal explanatory mechanism through which community renewable energy initiatives evolve, become institutionalised, and contribute to broader sustainability transitions in Nigeria.

3. Theoretical Framework

Understanding renewable energy transitions requires analytical approaches capable of capturing the complex interactions among technologies, institutions, governance arrangements, markets, and social actors. Traditional models of technological change have largely emphasised economic efficiency and technology diffusion, but they have been criticised for overlooking the institutional, political, and governance dimensions of systemic transformation (Rip & Kemp, 1998; Geels, 2002; Markard et al., 2012). In response, sustainability transition theory emerged as an interdisciplinary field concerned with explaining how socio-technical systems evolve towards more sustainable configurations (Geels, 2004; Köhler et al., 2019).

This study draws on three complementary frameworks within sustainability transition theory: the Multi-Level Perspective, Transition Management, and Strategic Niche Management. Together, these frameworks provide a comprehensive lens for analysing how CRE initiatives emerge, evolve, and interact with broader institutional environments.

The Multi-Level Perspective (MLP) conceptualises transitions as interactions among three analytical levels: niches, where radical innovations emerge; regimes, comprising the dominant technologies, institutions, regulations, and practices that stabilise existing systems; and the broader landscape, which includes external pressures such as climate change, demographic trends, and international policy commitments (Geels, 2002; Geels & Schot, 2007). Transition occurs when landscape pressures create opportunities for niche innovations to challenge and gradually transform established regimes. While MLP explains the dynamics of socio-technical change, critics argue that it pays insufficient attention to governance, political agency, and institutional fragility in developing countries (Avelino & Rotmans, 2009; Lawhon & Murphy, 2012).

Transition Management (TM) complements MLP by focusing on how transitions can be deliberately guided through participatory governance, long-term visioning, stakeholder collaboration, experimentation, and reflexive learning (Rotmans & Kemp, 2003; Loorbach, 2007). It emphasises strategic coordination among diverse actors to facilitate systemic change. However, its assumptions of collaborative governance may be difficult to realise in contexts characterised by weak institutions, limited administrative capacity, and fragmented governance structures.

Strategic Niche Management (SNM) focuses on how innovative technologies develop within protected experimental spaces before competing with established socio-technical regimes (Kemp et al., 1998; Schot & Geels, 2008). It identifies three critical processes for successful niche development: the articulation of shared expectations, the formation of strong stakeholder networks, and continuous learning. Although SNM has been widely applied to renewable energy transitions, its effectiveness depends on supportive

institutional environments that are often absent in many developing countries (Smith & Raven, 2012).

Building on these complementary perspectives, this study argues that governance constitutes the critical mechanism linking technological innovation with broader socio-technical transformation. It proposes that transition outcomes in developing-country contexts are shaped by five interrelated governance capabilities: institutional capacity, governance coordination, community participation and agency, financial sustainability, and learning and knowledge diffusion. These dimensions provide the analytical framework for examining the *Shape* CRE project and refining sustainability transition theory for contexts characterised by institutional fragility and evolving governance systems.

4. Methodology

This study adopts a qualitative case study design to examine the governance arrangements, implementation processes, and sustainability challenges associated with the *Shape* CRE project in Nigeria. A case study approach is appropriate for investigating complex socio-technical phenomena within their real-life contexts, particularly where the boundaries between the phenomenon and its institutional environment are closely intertwined (Yin, 2009). The *Shape* project was selected because it represents one of Nigeria's earliest decentralised renewable energy initiatives and provides a valuable opportunity to explore how governance influences the implementation and long-term sustainability of community renewable systems.

The research is grounded in an interpretivist paradigm, which assumes that social reality is constructed through the experiences and interactions of different actors (Creswell, 2013). This perspective is well suited to examining how government officials, regulators, private developers, and community members perceive governance processes, stakeholder participation, and project outcomes.

The study was conducted in *Shape*, a rural community located near Abuja, Nigeria's Federal Capital Territory. Before the project, residents depended primarily on kerosene lamps, fuelwood, and petrol generators because the community lacked access to the national electricity grid. The renewable energy project, implemented by the Federal Ministry of Power, was designed as a pilot initiative to demonstrate the potential of community renewable energy for rural electrification.

Data were collected from multiple sources to strengthen the credibility of the findings through triangulation. Primary data consisted of 24 semi-structured face-to-face interviews with representatives from the Rural Electrification Agency, the Nigerian Electricity Regulatory Commission (NERC), the Federal Ministry of Power, private developers, non-governmental organisations,

and community representatives. All interviews were audio-recorded and lasted between 60 and 90 minutes. Translation was not required because all interviews were conducted in English. The audio recordings were transcribed verbatim. To capture how governance arrangements evolved over time, 12 follow-up interviews were conducted approximately five years after the initial fieldwork. This longitudinal element provided insights into project sustainability, institutional learning, stakeholder relationships, and governance adaptation beyond the implementation phase.

Participants were selected using purposive sampling, targeting individuals with direct involvement in or substantial knowledge of the *Shape* project. The purposive sampling was implemented by first identifying the key stakeholder groups involved in the *Shape* community project through project documentation, institutional records, and recommendations from the Federal Ministry of Power and other relevant agencies. These stakeholder groups included officials from the Federal Ministry of Power, the Rural Electrification Agency (REA), regulatory bodies, project developers, donor representatives, community leaders, and end-users within the *Shape* community. Potential participants were then screened against predefined inclusion criteria that included: direct involvement in the planning, implementation, operation, regulation, or financing of the project, or substantial knowledge of the project's governance and implementation processes. Individuals who met these criteria were contacted via email, telephone, or in person and invited to participate in semi-structured interviews. Sampling continued iteratively until thematic saturation was reached, with no substantially new information emerging from additional interviews. Community participants included both male and female residents representing different age groups and community roles. In addition to interviews, the study analysed relevant policy documents, project reports, and field observations to provide contextual understanding and corroborate interview findings.

Data were analysed using thematic analysis following the procedures outlined by Braun and Clarke (2006). Interview transcripts, documentary evidence, and field notes were coded and organised with the support of NVivo software. The analysis focused on four interrelated themes: drivers of community renewable energy transition, planning and implementation processes, governance arrangements and stakeholder participation, and barriers to long-term sustainability. Comparing evidence across multiple data sources enhanced the credibility and trustworthiness of the findings while providing a comprehensive understanding of how governance influences renewable energy transitions in rural Nigeria.

5. Findings and Results

This section presents the empirical findings from the *Shape* community renewable energy project. The analysis is organised around five interrelated themes that emerged

from the thematic analysis: (i) drivers of the renewable energy transition; (ii) planning and implementation processes; (iii) governance arrangements and stakeholder participation; (iv) socio-economic and environmental outcomes; and (v) barriers to long-term sustainability. Together, these findings demonstrate that while the project substantially improved electricity access and local livelihoods, its long-term sustainability depended more on governance quality than technological performance.

5.1 Drivers of the *Shape* Community Renewable Energy Project

Participants consistently identified energy poverty as the principal motivation for implementing the project. Before electrification, households relied primarily on kerosene lamps, fuelwood, and small petrol generators, which were expensive, unreliable, and environmentally harmful. One community respondent explained:

> "*Before the project, most families depended on kerosene lamps and small generators. Many could not afford fuel regularly, so people often stayed in darkness at night."*
> (Community01)

Government officials similarly linked poor electricity access to broader development challenges affecting education, healthcare, and local businesses:

> "*Lack of electricity was affecting education, healthcare delivery and local businesses. The project was intended to demonstrate how renewable energy could address these challenges.*"
> (FMPower01)

Beyond addressing local energy needs, policymakers viewed the project as contributing to Nigeria's rural electrification strategy and international climate commitments. Several respondents noted that donor support and global sustainable development initiatives also influenced project implementation.

5.2 Planning and Implementation Processes

A dominant finding was the top-down nature of project planning. Decisions relating to technology selection, financing arrangements, and system design were largely made by government agencies and technical experts, with communities playing a limited role during the planning stage. As one community leader observed:

> "*The community was informed about the project, but we were not involved in deciding how the*

> *system would operate or how electricity charges would be managed*."
> (Community03)

Another respondent similarly noted:

> "*Consultations were conducted, but participation was mostly limited to information sharing rather than joint decision-making*."
> (Community02)

Government representatives acknowledged that while community participation was recognised as important, rapid project delivery was prioritised over collaborative planning:

> "*At that time, the focus was on delivering the project quickly. Community participation was considered important but not fully integrated into the planning process*."
> (FMPower02)

Despite these limitations, consultation activities improved public awareness and reduced resistance during implementation. A project developer explained:

> "*Community meetings helped people understand the benefits of renewable energy. Without those meetings there would have been resistance*."
> (Developer02)

Nevertheless, respondents generally agreed that consultation alone was insufficient to create long-term ownership or strengthen project sustainability.

5.3 Governance Arrangements and Stakeholder Participation

Governance emerged as the most influential factor shaping project outcomes. Although responsibilities were distributed among government agencies, regulators, developers, and community representatives, respondents frequently described unclear accountability and weak institutional coordination. A regulator commented:

> "*Different organisations were responsible for different aspects of the project, but coordination was not always clear*."
> (Regulator01)

Similarly, another participant observed:

> "*When problems occurred, it was*

> *sometimes difficult to determine who was responsible for addressing them*." (Developer03)

Institutional fragmentation was repeatedly identified as a major governance challenge. Respondents described overlapping mandates, weak communication, and duplicated responsibilities among implementing organisations. According to one regulator:

> "*There were multiple programmes running simultaneously across different agencies. Coordination mechanisms were often weak, leading to duplication and inefficiencies*." (Regulator02)

Limited community participation further constrained project sustainability. Although residents benefited from improved electricity access, many felt excluded from important decisions concerning project management and future development. One community representative explained:

> "*People appreciated the electricity, but many did not feel the project belonged to them because they were not involved in important decisions*." (Community01)

These findings indicate that consultation without meaningful participation limited community ownership and reduced the project's long-term institutional resilience.

5.4 Financing and Sustainability

Project financing relied heavily on government and donor support, with respondents estimating that approximately 90% of project costs were covered through grants, while community contributions consisted mainly of labour, security, and local support services. As one developer stated:

> "*Without government support the project would not have been implemented because the community could not mobilise that level of investment*." (Developer01)

Although this funding structure enabled implementation, respondents questioned its long-term sustainability. Tariff affordability emerged as a recurring concern because many households had limited financial capacity to pay cost-reflective electricity prices. One resident noted:

> "*People wanted electricity, but many families struggled to pay for basic household needs. High tariffs would be*

> *difficult for some households*."
> (Community02)

Government officials recognised the challenge of balancing affordability with financial sustainability:

> "*Balancing affordability and financial sustainability remains one of the biggest challenges facing rural mini-grid projects*."
> (FMPower01)

Participants also expressed concern about the absence of dedicated financial reserves for equipment replacement, particularly batteries and other major components. According to one developer:

> "*Everyone focuses on installation costs, but fewer discussions take place regarding replacement costs after five or seven years*."
> (Developer04)

The absence of long-term asset replacement funds was widely viewed as a significant threat to project continuity.

5.5 Socio-Economic Outcomes and Sustainability Challenges

Despite governance and financial constraints, respondents overwhelmingly agreed that the project generated important socio-economic and environmental benefits. Households reported improved lighting, refrigeration, communication, and educational opportunities, while reduced dependence on kerosene and fuelwood contributed to improved environmental conditions. One resident explained:

> "*Children can study at night and households no longer depend completely on kerosene lamps."*
> (Community01)

A policymaker similarly observed:

> "*The project demonstrated that rural electrification can simultaneously improve livelihoods and reduce environmental pressures*."
> (Policy01)

However, respondents identified several factors that threatened long-term sustainability. These included dependence on external technical expertise, weak community ownership, governance fragmentation, and limited institutional learning. As one developer remarked:

> "*Many communities still depend heavily on external technicians when*

> *technical problems arise*." (Developer02)

Similarly, a community leader emphasised the importance of participation:

> "*People support projects more strongly when they are involved from the beginning*." (Community03)

Overall, the findings demonstrate that the *Shape* community renewable energy project successfully expanded electricity access and delivered important developmental benefits. However, its long-term sustainability and scalability were constrained by fragmented governance, limited community participation, financial uncertainty, and weak institutional coordination. The evidence suggests that technological innovation alone is insufficient to sustain renewable energy transitions; effective governance, inclusive participation, and long-term financial planning are equally critical for achieving lasting socio-technical transformation.

6. Discussion

The findings demonstrate that the *Shape* community renewable energy project substantially improved electricity access and generated important socio-economic and environmental benefits. However, they also show that technological success alone was insufficient to produce broader socio-technical transformation. Instead, the project's long-term sustainability and scalability were shaped primarily by governance quality, institutional capacity, stakeholder participation, financial sustainability, and organisational learning. These findings reinforce the growing argument that renewable energy transitions in developing countries are fundamentally governance-dependent rather than purely technological processes.

6.1 Governance and Socio-Technical Transitions

The study supports the central proposition of the MLP that renewable energy transitions result from interactions among niche innovations, established socio-technical regimes, and broader landscape pressures (Geels, 2002; Geels & Schot, 2007). The *Shape* project functioned as a niche innovation by demonstrating the technical feasibility of decentralised renewable energy within Nigeria's predominantly centralised electricity system. Landscape pressures—including energy poverty, climate commitments, and international development agendas—created favourable conditions for experimentation. However, the dominant electricity regime remained largely unchanged because institutional and governance constraints limited the diffusion of the innovation beyond the pilot stage.

These findings extend previous studies suggesting that niche innovations in developing countries frequently struggle to influence established regimes despite demonstrating technical viability (Smith et al., 2010; Lawhon & Murphy, 2012). The evidence indicates that the principal

challenge is not technological adoption but the creation of governance systems capable of embedding successful innovations within broader institutional structures.

6.2 Governance Deficits and Transition Management

The findings also provide important insights into TM. Although the project reflected national ambitions for rural electrification and renewable energy development, governance processes were largely top-down. Community participation was confined mainly to consultation, with limited influence over technology selection, tariff design, ownership arrangements, or project management. This contrasts with the participatory governance and shared visioning advocated by Transition Management (Rotmans & Kemp, 2003; Loorbach, 2007).

Similarly, the study identified limited mechanisms for reflexive learning. Although the project generated valuable technical and governance experience, these lessons were not systematically documented or incorporated into subsequent renewable energy initiatives. Weak institutional learning reduced opportunities for policy adaptation and replication, highlighting an important governance limitation within rural electrification programmes.

6.3 Strategic Niche Management and Project Sustainability

The findings also reinforce key propositions of SNM. Successful niche development depends on the alignment of stakeholder expectations, strong actor networks, and continuous learning (Schot & Geels, 2008; Smith & Raven, 2012). While the *Shape* project brought together government agencies, regulators, developers, donors, and community representatives, stakeholder expectations were not fully aligned. Policymakers viewed the project as a demonstration model, developers prioritised technical performance, donors emphasised scalability, and community members focused primarily on affordable and reliable electricity. These differing priorities created tensions that weakened long-term sustainability.

Furthermore, stakeholder networks remained largely project-specific rather than institutionalised. Coordination depended heavily on individual organisations rather than formal governance mechanisms, while lessons generated during implementation were not effectively disseminated across the wider rural electrification sector. These findings suggest that governance structures capable of sustaining collaboration and institutional learning are essential for scaling CRE initiatives.

6.4 Governance as the Central Transition Mechanism

One of the study's most significant findings is that governance fragmentation represented a greater barrier to sustainability than technological limitations. Respondents consistently identified overlapping institutional mandates, weak coordination, unclear accountability, and fragmented decision-making as major obstacles to

effective project implementation. These findings support previous research highlighting governance fragmentation as a persistent constraint on renewable energy transitions in Sub-Saharan Africa (Eberhard et al., 2017; Newell et al., 2021).

Financial governance emerged as an equally important challenge. Although government grants and donor funding enabled project implementation, respondents questioned the long-term viability of financing arrangements that lacked sustainable revenue mechanisms and dedicated asset replacement funds. Balancing tariff affordability with financial sustainability remains a persistent challenge for decentralised renewable energy systems in low-income rural communities (Kirubi et al., 2009; Blimpo & Cosgrove-Davies, 2019). These findings demonstrate that financial governance is integral to long-term transition success rather than merely an operational concern.

7.1 Conclusion and Recommendations

This study examined how governance arrangements influence the development, implementation, and sustainability of community renewable energy initiatives through an in-depth qualitative case study of the *Shape* project in Nigeria. Drawing on the complementary perspectives of the MLP, TM and SNM, the study explored the institutional, financial, governance, and socio-political factors shaping renewable energy transitions in rural communities.

The findings demonstrate that the *Shape* community renewable energy project successfully expanded access to modern electricity and generated important socio-economic and environmental benefits. Improved household electrification, enhanced educational and economic opportunities, and reduced dependence on traditional energy sources highlight the developmental potential of decentralised renewable energy systems. However, the evidence also shows that technological success alone does not guarantee sustainable energy transitions. Long-term sustainability was constrained by fragmented governance, weak institutional coordination, limited community participation, inadequate financial planning, and insufficient mechanisms for organisational learning.

A central contribution of this study is its demonstration that governance constitutes the critical mechanism linking technological innovation with broader socio-technical transformation. While existing sustainability transition frameworks provide valuable insights into how innovations emerge and diffuse, the findings indicate that they pay insufficient attention to the governance realities of developing countries, where institutional fragility, fragmented administrative systems, and resource constraints strongly influence transition outcomes.

Building on these findings, the study proposes a governance-oriented refinement of sustainability transition theory in which institutional capacity, governance

coordination, community participation, financial sustainability, and learning and knowledge diffusion operate as interdependent governance capabilities shaping renewable energy transitions. Rather than treating governance as a contextual variable, the framework positions it as the principal mechanism through which successful niche innovations become institutionalised and scaled. This perspective extends existing transition scholarship while offering a more context-sensitive explanation of renewable energy transitions in developing-country settings.

The findings have several implications for policymakers, regulators, development partners, and practitioners involved in rural electrification. First, governments should strengthen institutional coordination by clarifying the roles and responsibilities of ministries, regulatory agencies, rural electrification institutions, and local governments. Improved coordination would reduce duplication, strengthen accountability, and enhance policy coherence throughout the project lifecycle. Second, community renewable energy programmes should move beyond consultation towards meaningful community participation in planning, decision-making, financial oversight, and long-term project management. Greater community agency is likely to strengthen local ownership, improve accountability, and enhance project sustainability. Third, greater attention should be given to financial sustainability. While public and donor funding remain essential for expanding rural electrification, projects require transparent tariff systems, effective revenue management, dedicated maintenance funds, and long-term asset replacement mechanisms to ensure continued operation beyond the initial implementation phase. Fourth, investment in institutional and technical capacity should accompany infrastructure development. Strengthening the capabilities of government agencies, local organisations, and community technicians would improve project management, reduce dependence on external expertise, and enhance the resilience of decentralised renewable energy systems. Finally, governments and development partners should establish institutional learning mechanisms that systematically capture, evaluate, and disseminate lessons from pilot projects. Such knowledge-sharing systems would support evidence-based policymaking, improve programme design, and facilitate the replication of successful community renewable energy initiatives across rural communities.

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