VALUE-ADDED COOPERATIVE MODEL IN RENEWABLE ENERGY INVESTMENT: AN ANALYTICAL NOTE

Gratian CroneryRwekaza[1,*] and Frank Kinabo[2]
[1, *]Kizumbi Institute of Cooperative and Business Education, Moshi Co-operative University-Tanzania, email address: gratiancronery@gmail.com
[2]Kizumbi Institute of Cooperative and Business Education, Moshi Co-operative University-Tanzania, email address: frankkinabo@gmail.com

Abstract
The cooperative investment model in renewable energy presents a transformative opportunity for citizen-led participation in the global energy transition. This paper investigates the added value of cooperative business models in the renewable energy sector, focusing on how cooperatives can effectively structure and operate successful energy institutions. Guided by resource-based theory, which emphasises leveraging internal resources and community capacities, the study employs a systematic literature review of secondary literature was analyzed without primary data collection *and best practices from various cooperative contexts. The findings suggest that renewable energy cooperatives provide distinct advantages, including enhanced community engagement, local economic empowerment, and reduced dependence on centralized fossil-fuel-based energy systems. However, cooperatives also encounter substantial challenges, such as limited access to capital, regulatory barriers, and the necessity for sustained member participation. Key features identified in valuable cooperative investment models include collective financing mechanisms, local ownership and democratic governance. Further, these together promote inclusive, sustainable energy development. Also, it was found that, cooperatives can venture in renewable energy by challenging the traditional dominance of large-scale energy corporations; cooperatives act as alternative business models capable of delivering both environmental and social value. This paper contributes to the policy makers and academic discourse on sustainable energy transitions by offering insights into how cooperative frameworks can align with renewable energy investment strategies and community development goals.*

Keywords: Value-Added Cooperative; Renewable Energy Investment; Cooperative opportunity.

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INTRODUCTION

Cooperative investment models in renewable energy are community-driven initiatives where individuals or groups jointly invest in renewable energy projects to benefit themselves or meet local energy requirements. These models prioritise democratic governance, social accountability, and delivering quasi-public goods, rather than just maximising profits (Brouder, 2010;

Helms et al., 2016). Energy cooperatives, a prevalent example, strive to lower energy expenses for their members while also financing the establishment of sustainable energy infrastructure (Baden-Fuller and Morgan, 2010). In 2024, countries such as Norway, Brazil, New Zealand, Denmark, and Iceland have emerged as global leaders in renewable energy adoption. Norway, for example, generates a significant share of its electricity from hydropower (Behrangrad, 2015). Brazil similarly relies heavily on hydroelectric sources, while New Zealand incorporates hydropower and wind as key contributors to its energy mix (Bocken, 2014). Denmark continues to push toward wind and solar energy dominance (Bergmann 2020), and Iceland stands out for its efficient utilization of geothermal energy (Kubli, 2018). Other notable nations embracing renewables include Sweden, Canada, Colombia, Chile, and Germany (KollmussandAgyeman, 2002). These investments are lacking in developing nations as opportunities that can be invested by cooperatives models. In Europe, renewable energy initiatives foster citizen and community ownership through renewable energy cooperatives (RES coops). These 'citizen energy communities,' officially acknowledged by the EU, enable local populations to engage in energy and efficiency projects (IbanLizarralde, 2020). RES coops encourage democratic investment, shared advantages, and inclusive decision-making (Loock, 2012). Literature shows that, in the United States, cooperative electric utilities are adopting renewable sources such as wind, solar, hydro, and biomass. Many co-ops are located in rural areas and are expanding into distributed energy systems like rooftop solar, aiming to provide affordable and reliable clean energy (Mollick, 2014; Amit andZott, 2001, McInerneyand Bunn, 2019). On the other hand, Asia demonstrating increasing collaborative initiatives in renewable energy. A prominent example is the Thailand-Malaysia-Singapore Power Integration Project, which facilitates regional electricity trading and emphasises cross-border cooperation in renewable energy (Pandyaswargo, 2022). China, which leads the continent in renewable energy capacity, maintains its dominance in hydropower development (2001). In Sub-Saharan Africa, cooperatives are increasingly viewed as essential for addressing energy poverty. These community-driven organizations facilitate access to affordable clean energy, generate employment, and strengthen local governance structures (Vasileiadou, 2015). Solar and wind power continue to be the most promising resources. Global organizations such as the ILO and the World Bank are partnering with local cooperatives to enhance access to sustainable energy (Helms et al., 2016). In Kenya, cooperatives play a transformative role in rural electrification. They enable communities to own and manage renewable energy systems, improving energy access and sustainability. Financial institutions like the African Guarantee Fund and Cooperative Bank of Kenya increasingly support green financing to boost such initiatives (Bergmann 2020). However, cooperative movement had not hold higher stake in utilising such opportunity on investing in renewable energy business using these potential support institutions. In Rwanda, cooperatives play a significant role in promoting renewable energy, particularly in rural areas. They have been instrumental in increasing the adoption of improved cooking stoves and promoting alternative fuels like cooking gas and biogas. The Rwandan government recognizes the importance of

renewable energy and aims to achieve 60% of electricity generation from renewable sources by 2030. Cooperatives are seen as key partners in achieving Rwanda's green economy goals by facilitating the use of improved cooking stoves and alternative fuels in both urban and rural areas (Boons and Lüdeke-Freund, 2013, Bocken, 2014). Additionally, cooperatives are involved in Integrated Water Resources Management (IWRM) to optimize and scale up catchment-based coordination and planning (Apajalahti et al, 2015). The Rwanda Renewable Energy Fund (REF) project aims to accelerate off-grid access to electricity in rural areas, promoting private sector engagement in renewable energy development (Bonzanini, Giudici and Patrucco, 2016; Bergmann, Burton and Klaes, 2020). In Tanzania, cooperatives play a crucial role in expanding access to renewable energy, particularly in rural areas, by leveraging community-based initiatives and promoting sustainable practices. This collaboration supports both economic development and climate resilience. As noted by Bocken (2014), sustainable business models are essential for achieving long-term social and environmental benefits. Cooperatives facilitate community participation in renewable energy projects, empowering local populations and ensuring equitable access. The Urambo Electric Consumers Co-operative Society (UECCO), for example, demonstrates the viability of community-managed electrification projects by providing local control and sustainable solutions (Walker, 2008). These initiatives align with Dóci and Vasileiadou (2015), who emphasize the significance of grassroots organizations in decentralized energy transitions. Cooperatives investment on renewable energy business in Tanzania is potential since it attracts the global focus and promotes environmental friendly power generation. Cooperatives help communities leverage local resources, improve market access, and enhance their economic resilience, particularly in sectors like agriculture and tourism. According to Richter (2012), business models that integrate local ownership and collective investment are particularly well-suited to developing economies. Furthermore, cooperatives promote environmentally friendly practices, encouraging the use of renewable energy sources and contributing to climate change mitigation efforts. The Tanzania Renewable Energy Association (TAREA) is actively involved in promoting the productive use of renewable energy through partnerships with microfinance institutions, capacity-building initiatives, and joint pilot testing efforts that echo the socially embedded innovation frameworks explored by Bergmann 2020. Furthermore, efforts such done by microfinance institutions, such as those under the Tanzania Association of Microfinance Institutions (TAMFI), provide essential financial support for renewable energy projects, facilitating broader adoption of technologies like solar power in agriculture and other sectors. (Bonzanini 2016) and (Lam and Law 2016) emphasize the potential of crowd funding and microfinance as tools for financing renewable energy, particularly in underserved markets. The Tanzanian government also acknowledges the importance of renewable energy and is actively promoting its development through policies, incentives, and partnerships with the private sector and development agencies like the European Union (EU). As (De Broeck 2018) indicates, donor-supported programs can greatly enhance renewable energy access and economic empowerment in rural communities. Despite of these efforts in

place, developing nations Tanzania inclusive has not taped the available opportunities to venture largely in renewable energy investment potentials. That highlights the necessity to explore the available business opportunities within which cooperative movement can venture on. The paper was based on two main objectives which were; to explore the value addition and cooperative business models in the renewable energy; to analyse best practice that can be used by co-operatives models in renewable energy sector. The resource-based theory, which emphasises leveraging internal resources and community capacities, was adopted in this context. Cooperative renewable energy and resource-based theory theories focus on how communities can collaboratively develop and manage renewable energy projects, often through energy cooperatives (RECs). These theories emphasize local ownership, community participation, and the distribution of benefits from renewable energy sources. he cores founders of resource-based theory (RBT) are Birger Wernerfelt and Jay Barney. Wernerfelt's 1984 paper is considered the seminal work that introduced the concept of a firm's resources as a source of competitive advantage. Barney's 1991 article further developed and solidified the theory, emphasizing the role of firm resources in achieving sustained competitive advantage. Community empowerment theory was adopted as it emphasises cooperative on interconnected concepts focused on enabling communities to take control of their energy systems, fostering sustainability, and achieving social and economic benefits. Community empowerment, in the context of renewable energy, involves developing the knowledge, skills, and capacity for community members to collectively manage and benefit from renewable energy projects. Community empowerment theory provides a framework for community ownership and participation in renewable energy initiatives, leading to increased energy self-sufficiency and local control. Julian Rappaport is widely recognized as a key figure in the development of community empowerment theory, particularly within the field of community psychology. He emphasized the importance of empowerment as a focus for community psychology and advocated for helping individuals gain more control over their lives and situations. The study is in line with achieving the vital role of the Sustainable Development Goals (SDGs), particularly SDG 7: Affordable and Clean Energy. By transitioning to clean energy sources, the world can address climate change (SDG 13), improve health outcomes (SDG 3), and promote sustainable development across various sectors. Also, this aligns with African agenda 2063, the African Union's for the continent's development, prioritizes clean energy as a cornerstone for achieving sustainable and inclusive growth. The agenda envisions an Africa powered by renewable energy sources, supported by strong local manufacturing and robust infrastructure.

Literature Review: The role of cooperatives in rural electrification has gained increasing attention, as they offer viable solutions for bringing electricity to underserved rural communities. This is particularly relevant when considering decentralized renewable energy technologies, where cooperatives can facilitate local energy initiatives and empower communities to take control of their energy futures (Amit and Zott, 2001 Dóci andVasileiadou, 2015). Furthermore, cooperatives contribute to the growth of the green economy by creating jobs and fostering innovation in renewable energy sectors (Bocken et al., 2014; Blue et al., 2020). The

use of cooperatives in renewable energy has been significant on community empowerment in different forms. Cooperatives can operate through different types, each playing a significant role in fostering the use of clean energy. Consumption cooperatives allow members to purchase energy at reduced prices (Bergmann, 2020; Msaki et al 2014). Producer cooperatives engage members in the development and operation of renewable energy facilities, such as solar or wind farms (Behrangrad, 2015). Hybrid cooperatives combine both consumption and production, enabling members to both consume and contribute to energy generation (Boons and Lüdeke-Freund, 2013). These facilities contribute on socioeconomic development of citizens communities. A cooperative business model is one where members own and democratically control the business, unlike traditional businesses that prioritize profit for shareholders. Cooperatives focus on fulfilling members' needs and redistributing benefits based on their use of the cooperative. This model emphasizes shared ownership, democratic decision-making, and a commitment to community benefit (Osterwalder, 2011). The cooperative framework promotes mutual benefit through resource pooling, risk-sharing, and collective decision-making, with an emphasis on sustainability and community welfare (Rwekaza and Muhihi, 2016; Helms, 2016). Member's participation on renewable energy facilities increases their decision making and enhance their capacity in community projects. Renewable Energy cooperatives, a type of cooperative business model, enable communities to collectively own and manage renewable energy projects, providing an alternative to traditional, centralized energy systems. These cooperatives foster local control over energy generation, delivering environmental, economic, and social benefits to communities (Richter, 2013; McInerney and Bunn, 2019). The key features of cooperative models in renewable energy include citizen ownership and democracy, local focus, financial accessibility, reduced dependence on centralized systems, and environmental and social benefits (Giotitsas, 2015 and Richter, 2012). These models help diversify energy generation, reducing reliance on a few large companies and contributing to a more sustainable energy future (Setyawati, 2020, Rocha et al., 2019). Despite the potential benefits, cooperatives face several challenges in the renewable energy sector. Securing initial funding and managing long-term investments remain significant barriers (Brouder, 2010). Additionally, navigating complex regulatory frameworks and ensuring fair access to energy grids can hinder progress (Pires Klein. 2019). Balancing community and economic goals, especially as cooperatives are not-for-profit organizations, requires careful consideration (Kubli et al., 2018). Finally, transitioning beyond subsidies is a crucial challenge, as government support for renewable energy projects may change, and cooperatives must develop sustainable, long-term business models (Amit andZott, 2001 and Dóci andVasileiadou, 2015). Key sources of literature included works by Allegreni (2017), Amit and Zott (2001), and Bocken et al. (2014), among others. These studies provide insights into the application of cooperative models, innovation in business models for sustainability, and the integration of renewable energy into community-driven initiatives. The review also considers theoretical and empirical research on the role of business model innovation in energy markets (Behrangrad, 2015; Hamwi and Lizarralde, 2017), as well as the use of crowd funding as a financial tool for renewable

energy investments (Bergmann et al., 2020; Mollick, 2014).

METHODS

This study adopts a Systematic Literature Review (SLR) methodology to critically explore the value-added cooperative model within the context of renewable energy investment. The SLR approach is designed to generate a comprehensive, transparent, and reproducible synthesis of extant scholarly evidence. This method ensures methodological rigor in capturing the breadth and depth of current academic discourse, thereby facilitating the development of well-informed insights into the cooperative frameworks underpinning renewable energy transitions. The literature search was conducted across major academic databases including JSTOR, Scopus, Web of Science, Science Direct, and Google Scholar to identify peer-reviewed journal articles, books, policy reports, and conference proceedings published primarily between 2000 and 2024. The search strategy employed Boolean operators and keywords such as *"cooperative business models*," "renewable energy investment," "value-added cooperatives," "energy transition," "crowd funding for energy," "energy democracy," "community energy," and "business model innovation." Specifically, articles that explore the role of crowd funding, Demand-Side Management (DSM), and business model innovations within renewable energy were included. The review process follows the guidelines outlined by Rwekaza (2021) and Tranfield et al. (2003) for systematic literature reviews, ensuring that the search strategy is both comprehensive and transparent. The inclusion of only peer-reviewed sources ensures the reliability and credibility of the findings. Studies were analyzed for their methodological rigor, relevance to the research questions, and the contribution they make to the understanding of business models and cooperative models in the context of renewable energy investment. In synthesizing the literature, this study aims to identify gaps in existing research, conceptual frameworks, and practical applications of cooperative models in renewable energy investment. By examining the diverse approaches to value creation, business model innovation, and community-based energy initiatives, the review seeks to contribute to the academic discourse on sustainable energy and cooperative investment strategies. Additionally, grey literature and working papers from leading institutions such as the International Renewable Energy Agency (IRENA), International Co-operative Alliance (ICA), and the OECD were reviewed to capture emerging trends and policy relevant insights. The inclusion criteria for the review were as follows, Publications that explicitly examine the intersection of renewable energy investments and cooperative organizational structures. Studies addressing value creation mechanisms, democratic governance, and community ownership within energy systems. Research that explores innovative financing mechanisms, including crowd funding, block chain-enabled energy sharing, and cooperative equity models, contributions focused on business model innovation, particularly those consistent with sustainability principles, energy justice, and the circular economy. Key theoretical contributions were drawn from seminal works by Amit and Zott (2001) on business model design, Bocken et al. (2014) on sustainable value creation, and Osterwalder and Pigneur (2010) on business model generation. Empirical studies such as Hamwi and Lizarralde (2017) and Behrangrad (2015)

were reviewed for insights into decentralized energy models and demand-side management. Recent findings from Bergmann et al. (2020), Yildiz et al. (2015), and Tasch and Mangelsdorf (2022) were incorporated to examine contemporary trends in citizen led finance, community resilience, and cooperative adaptation in the face of energy crises. This study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol and the methodological guidelines outlined by Tranfield et al. (2003) for systematic reviews in social sciences. The review process consisted of three main stages Identification and Screening a total of 215 documents were initially retrieved, followed by the elimination of duplicates and irrelevant titles, Eligibility and Data Extraction 73 full-text articles were reviewed, with key variables such as cooperative typologies, value propositions, and financing structures Thematic Synthesis selected studies were categorized into core themes such as value-added innovation, financial democratization, governance models, and community empowerment in renewable energy systems. To ensure quality and credibility, only peer reviewed sources and high-quality institutional reports were included in the final synthesis. Each document was appraised for methodological soundness, conceptual contribution, and relevance to the research objective specifically, the role of cooperatives in delivering added value across economic, environmental, and social dimensions of renewable energy investment. In synthesizing the reviewed literature, this study aims to, Identify conceptual frameworks and practical models relevant to value-added cooperatives in the energy sector, highlight research gaps and areas requiring further empirical investigation, analyze the ways in which digital technologies and hybrid financing mechanisms are reshaping cooperative-led renewable energy investment, contribute to the broader discourse on sustainable business models, energy democracy, and community-based climate action.

DISCUSSION

Value Addition and Cooperative Business Models in the Renewable Energy: Cooperative business models in the renewable energy sector play a pivotal role in fostering community driven development, sustainable energy transitions, and inclusive economic participation. Unlike traditional investor-led models, energy cooperatives empower member's often local citizens to become both producers and beneficiaries of clean energy. This dual role not only democratizes energy access but also embeds social and environmental values into the core of energy development (Huybrechts and Mertens, 2014). By embracing a member centred governance structure, cooperatives ensure that economic benefits, decision-making power, and technological innovation are retained within the community, rather than being extracted by distant corporate actors. One of the most impactful forms of value addition comes through community-owned solar energy projects. These initiatives allow cooperative members to jointly invest in and manage solar installations, thereby securing affordable and clean electricity. Such systems have been successful in regions with abundant sunlight but limited grid access, including parts of Sub-Saharan Africa and Southeast Asia (De Broeck, 2018). The participatory nature of solar cooperatives promotes a sense of ownership and accountability, while the decentralized infrastructure reduces transmission losses and enhances energy resilience in remote or rural areas. Moreover,

profits generated from solar electricity sales can be reinvested into other community services such as schools, health clinics, or microfinance initiatives. Similarly, local wind energy cooperatives offer a robust model for both energy generation and rural revitalization. By leveraging local wind resources, communities can produce renewable electricity at scale while ensuring that landowners and cooperative members benefit directly through dividends, lease payments, or equity stakes. In countries such as Denmark and Germany, wind cooperatives have flourished under supportive policy frameworks, illustrating the scalability of this model when combined with effective regulation and feed-in tariffs (Rwekaza and Anania 2021; Yildiz et al., 2015). In addition to providing clean power, these cooperatives often create skilled jobs in installation, maintenance, and technical training thus fostering long-term economic growth. Another form of value addition emerges through small-scale hydropower projects facilitated by cooperatives, particularly in regions with abundant water resources such as mountainous terrains or irrigation canals. These micro-hydro systems, often community-financed and operated, can supply energy for agricultural processing, household use, or small businesses. Agricultural cooperatives in East Africa, for instance, have piloted micro-hydro plants using waterfall streams and irrigation runoff, contributing to both food security and energy independence. Beyond energy provision, such initiatives strengthen local institutional capacity in managing natural resources and infrastructure (Rwekaza, 2013; Bhattacharyya, 2013). Biomass and biogas cooperatives represent another frontier in renewable energy value addition. Agricultural and dairy cooperatives can tap into waste streams—such as animal dung, crop residues, and agro-processing by-products to generate biogas or biomass energy. This not only reduces methane emissions and land pollution but also creates a circular economy where waste becomes a resource. In India, for example, dairy cooperatives have successfully implemented biogas units for household cooking and lighting, leading to reductions in firewood use and respiratory illnesses (Surendra et al., 2014). Additionally, sugarcane cooperatives have developed cogeneration plants that supply surplus electricity to the grid, generating additional income for their members. The cooperative model also proven effective in contractual energy distribution, particularly in areas where direct energy production is not feasible. In this setup, cooperatives negotiate collective purchase agreements with suppliers of LPG (liquefied petroleum gas), solar kits, or other renewable technologies. Acting as intermediaries, cooperatives secure lower prices and better service terms for their members while reducing logistical barriers to energy access. This model has proven especially beneficial in urban informal settlements and peri-urban areas where market-based energy delivery often excludes low-income households (Bonzanini, Giudici and Patrucco, 2016). In this way, the cooperative adds value by leveraging economies of scale and strengthening community bargaining power. The diverse models discussed demonstrate how cooperative business structures can be positioned to drive both energy democratization and socio-economic transformation. By aligning the goals of renewable energy development with the principles of equity, participation, and local control, cooperatives provide a holistic framework for achieving inclusive and

sustainable energy futures. As energy systems globally shift towards decarbonization and decentralization, integrating cooperative models into policy frameworks and financial incentives could significantly accelerate progress towards universal energy access and climate resilience.

Best Practice Co-operatives Models in Renewable Energy sector: The formation of energy services cooperatives where cooperatives offer energy efficiency services, home energy audits, and retrofitting solutions to reduce energy consumption (Zott and Amit, 2010). These cooperatives can operate as both energy producers and energy advisors, helping members cut costs while promoting sustainability. By reinvesting savings into renewable energy projects, such cooperatives support long-term energy transition strategies. Also, Bourcet and Bovari (2020) and Rwekaza and Said (2022) contend that, the formation of energy communities' cooperatives can organize and manage energy production, distribution, and consumption within defined geographical areas. In this scenario, cooperatives act as localized governance structures that empower citizens to collectively invest in renewable energy infrastructure, such as solar panels, biogas systems, and wind turbines. These cooperatives not only enhance energy self-sufficiency but also strengthen community cohesion by enabling democratic decision-making over energy-related issues. By retaining control over energy resources within the community, they ensure that the economic and social benefits of energy production such as job creation, lower energy costs, and reinvestment of profits remain local. Furthermore, these cooperatives serve as critical tools for facilitating the transition to low carbon economies by fostering behavioural change, energy awareness, and active participation in sustainability initiatives at the grassroots level. Another viable model is the establishment of renewable energy production cooperatives, which focus on generating clean energy through solar, wind, biomass, or hydro technologies (Huybrechts and Mertens, 2014). These cooperatives are member owned and ensure inclusive participation, equitable benefit-sharing, and community-based energy governance. They support decentralized energy systems, particularly in off-grid or underserved regions, and contribute to both local socio-economic development and broader national energy transition goals. However, in circumstances where challenge occurred, especially in their early stages, access to capital need to solved at the earlier stage. In this regard, crowd funding cooperative financing platforms that present a complementary and innovative financing mechanism. De Broeck (2018) and Rwekaza and Nko (2012) highlights how crowd funding has emerged as a popular tool in the EU to support renewable energy investments, and identifies best practices such as transparency, regulatory alignment, and community engagement. Many of these projects are organized around cooperative or community ownership structures, illustrating a natural synergy between crowd funding and energy cooperatives. By combining the democratic governance and local anchoring of cooperatives with the financial reach and participatory ethos of crowd funding, this hybrid model can increase community buy-in and financial viability. Crowd funding allows community members and supporters even those with limited financial capacity to become co-investors, thereby reinforcing the cooperative principle of member economic participation. Additionally, crowd funding

serves as a signal of public support, which may enhance credibility and attract supplementary funding from development institutions or local governments. Also, the use of decentralized renewable energy model, Bonzanini, Giudici, and Patrucco (2016) argue that cooperatives can organize community ownership and empowerment programs, especially in renewable energy cooperatives. These cooperatives enable citizens to actively participate in energy projects, giving them the opportunity to gain ownership and have a meaningful voice in decision-making processes. This participatory governance model fosters a deeper sense of community ownership and engagement, which is crucial for driving the energy transition at the local level. By involving local communities directly in renewable energy production, cooperatives can overcome the disconnect often felt in top-down energy systems and strengthen local involvement in shaping energy futures. Crowd funding clean energy cooperative financing which allows cooperatives to tap into the financial support. Cooperatives, especially those focused on renewable energy, can explore various innovative financing models to overcome traditional funding barriers. One such model is crowd funding, which allows cooperatives to tap into the financial support of their members and external investors, democratizing access to capital and expanding project reach (Laurence 2022; Rwekaza and Said, 2022; Bonzanini et al., 2016). This model not only reduces the dependency on conventional financial institutions but also strengthens community engagement, ensuring that stakeholders have a vested interest in the project's success. Additionally, member investments allow cooperatives to pool resources and fund renewable energy installations, thereby directly involving the community in financing and decision-making processes. This aligns with the core cooperative principle of collective ownership and responsibility. Further, the use of Public-Private partnerships (PPPs) offers a valuable opportunity for renewable energy cooperatives to access resources, expertise, and funding from both public and private sectors. By working with local governments, cooperatives can benefit from public funding and incentives for green energy projects, while also gaining access to private sector technology and efficiency. This combination of funding models helps cooperatives overcome the limitations of traditional financial sources, making them more sustainable and resilient in the long term.

CONCLUSION, RECOMMENDATIONS AND CHALLENGES

Conclusion: The transition to renewable energy is indispensable for achieving long-term sustainability, mitigating climate change, and promoting inclusive economic growth. Renewable energy sources such as solar, wind, hydro, and biomass offer viable alternatives to fossil fuels by reducing greenhouse gas emissions, decreasing environmental degradation, and enhancing energy security. Their integration into national and local energy systems is critical for building resilient and low-carbon economies. Renewable energy cooperatives, in particular, present a compelling model for advancing this transition in a socially inclusive and economically sustainable manner. By emphasizing community ownership, democratic governance, and local participation, cooperative ventures contribute significantly to value addition in the renewable energy sector. These models enable communities to actively engage in the production, management, and distribution of

clean energy, ensuring that the associated benefits, such as job creation, capacity building, and improved energy access, remain within the local economy. Moreover, cooperative renewable energy initiatives align with broader development goals by addressing energy poverty, promoting environmental stewardship, and enhancing social cohesion. Through a variety of practical applications, including community-owned solar systems, local wind farms, small scale hydropower projects, and bioenergy from agricultural waste these cooperatives demonstrate the potential for localized and decentralized energy solutions that are both effective and equitable. In essence, renewable energy cooperatives not only contribute to diversifying the energy mix but also embody a model of participatory development and environmental responsibility. As countries seek to fulfil their commitments to sustainable development and climate goals, the promotion and support of cooperative models in the renewable energy sector will be instrumental in achieving an inclusive and just energy transition. In conclusion, cooperative business models in the renewable energy sector offer a viable and equitable framework for accelerating the energy transition. By cantering communities in the energy equation, these models not only address pressing energy challenges but also pave the way for a more inclusive, sustainable, and resilient future.

Practical recommendations: Cooperative business models present a promising and inclusive pathway for the advancement of the renewable energy sector, particularly by empowering communities and fostering widespread social acceptance. Through democratic governance structures and community-based ownership, cooperatives institutions should enable local citizens to participate actively in the planning, investment, and management of renewable energy projects. This inclusive approach not only addresses energy poverty but also ensures that the benefits of clean energy are shared equitably among stakeholders. One of the most significant strengths of renewable energy cooperatives lies in their ability to enhance community engagement through citizen-driven initiatives. These cooperatives, often referred to as renewable energy cooperatives should involve local members throughout the project lifecyclefrom planning and financing to implementation and operation. Such participation will foster a sense of ownership and accountability, which in turn enhances public trust and support. Empirical evidence suggests that projects with strong community involvement tend to enjoy higher levels of social acceptance, reducing opposition and facilitating smoother implementation. Moreover, cooperative renewable energy projects should play a vital role in local economic development. They contribute to job creation in areas such as construction, maintenance, and operations, thereby stimulating local economies and reducing rural-urban migration. The pooling of resources and sharing of costs also makes capital-intensive renewable energy technologies more accessible, particularly in underserved or remote communities. By offering clean and affordable energy, cooperatives help reduce dependence on expensive fossil fuels and alleviate the burden of high energy costs. Another key advantage of cooperatives in the renewable energy sector is their potential to retain economic value within local communities. The profits generated are typically reinvested locally is important in supporting other community ventures and fostering a more resilient and vibrant local economy. Additionally, the

cooperative model should be used to encourages financial inclusion by allowing individuals with limited resources to invest collectively in energy projects that would otherwise be inaccessible to them. Looking ahead, the sustainability and scalability of cooperative renewable energy models depend on their ability to adapt to evolving regulatory frameworks and dynamic market conditions. Strategic collaboration through Public-Private Partnerships (PPPs) can enhance cooperatives' access to funding, technical expertise, and institutional support, helping them overcome investment barriers and expand their reach. Furthermore, cooperatives can design community-specific business models that address localized energy needs, including energy efficiency programs, micro-grids, and hybrid energy systems. To remain viable in a post-subsidy environment, cooperatives must innovate and develop self-sustaining business models. These may include direct electricity marketing, energy-as-a-service models, or offering bundled energy and efficiency services. Importantly, such models can thrive even without government subsidies, provided that they are built on sound financial planning and community participation. In the broader context of sustainable development, cooperatives are uniquely positioned to align economic objectives with social and environmental goals. They often prioritize social responsibility, focusing on energy access, community empowerment, and environmental conservation. Their contribution to climate change mitigation is significant, as they promote the use of clean energy, reduce greenhouse gas emissions, and encourage sustainable resource use.

Practical Challenges: Cooperative business models in the renewable energy sector across East African countries face several significant challenges that hinder their potential for growth and long-term sustainability. One of the major barriers is regulatory in nature. Cooperatives often operate within complex and unclear policy frameworks that make it difficult to access the necessary permits, secure grid connections, and obtain financing. In many cases, existing energy regulations are not adequately designed to accommodate or promote community-based models, which results in high compliance costs and administrative hurdles. Financial limitations also present a serious obstacle. Most energy cooperatives have limited equity and low creditworthiness, making them heavily reliant on member contributions, government subsidies, or donor support. Traditional investors are typically reluctant to finance small-scale cooperative projects that lack secure revenue guarantees or long-term power purchase agreements. This limited access to finance makes it challenging to initiate or scale up projects and reduces the overall viability of cooperative-led renewable energy initiatives. Technological gaps further exacerbate the challenges. Cooperatives often lag behind large commercial energy firms in adopting modern technologies such as smart grids, energy storage systems, or hybrid models. They frequently lack the technical expertise, skilled personnel, and capital needed to install and maintain advanced energy systems. In remote areas, these issues are compounded by a shortage of trained technicians and logistical difficulties in sourcing equipment and spare parts. As a result, cooperative energy systems may suffer from inefficiencies and reduced reliability. Additionally, the viability of many energy cooperatives is dependent on continued government incentives such as feed-in tariffs, tax exemptions, or targeted grants. However, in many East African countries, these

incentives are either inadequate, inconsistently applied, or vulnerable to policy shifts. The lack of predictable and supportive government frameworks undermines investor confidence and discourages long-term planning. Compounding these issues is a general lack of awareness and institutional support for cooperative models. Policymakers, financial institutions, and energy planners often overlook cooperatives in Favor of large-scale private sector initiatives, leading to underrepresentation in national electrification strategies and funding programs. In summary, unless East African countries adopt more cooperative-friendly regulatory frameworks, provide targeted financial and technical support, and recognize the strategic role of community-based models in the energy transition, cooperatives in the renewable energy sector will continue to face steep and persistent challenges.

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