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IN CLEAN ENERGY WE TRUST: CAN ENERGY CO-OPERATIVES BRING A NEW PATHWAY TO ENERGY STREAM IN TANZANIA?

Bikolimana G. Muhihi

Department of Community Development and Gender, Moshi Co-operative University, P.O. Box 474, Sokoine Road, Moshi, Tanzania, Email: bikolimana2004@gmail.com

ABSTRACT: In Tanzania, the top development agenda is the pursuit of expanding energy supply and access in both rural and urban areas. The purpose is to realise a viable transition to sustainable and universal access to clean energy. While the efforts are visible, there is still a need to increase access through a diverse approach. One of the possible approaches is through a potential energy co-operative model. Thus, this study explores the feasibility of the energy co-operative model as a complementary strategy in expediting production, distribution, and access to clean energy in Tanzania. The study documents the global success stories of energy co-operatives, examines how energy co-operatives in a worldwide perspective can be adapted in Tanzania to enhance energy access for sustainable development. Using desk review, interview and thematic analysis, the study found that the global north has successfully established and democratised energy co-operative models to increase energy access. Countries like Denmark, Germany and the United States of America have strong energy co-operatives that supply clean and modern energy to mega and small consumers in urban and rural areas. The study found that the true success

factors for energy co-operatives in the global north include the enabling policy and legal frameworks, stakeholders' involvement, financial support, and technological advancement that allows diverse forms of clean energy production and distribution, such as biogas. Moreover, the study expounds that Tanzania has the potential to expand energy streams and access using the available resources, such as environmental richness, supportive regulatory authority, collaboration, and partnership between the private and public sectors. The national energy strategy and objectives in Tanzania offer a conducive environment for clean energy production by the private sectors, which in turn contribute to the expansion of electricity supply for sustainable development. Strategic policy adjustments and co-operative sector regulation can serve as a viable alternative energy supply effort.

Keywords: Energy co-operatives, Co-operatives, Energy access, Clean Energy

INTRODUCTION

Energy access is not merely a matter of convenience but a fundamental prerequisite for socioeconomic development across the sectors. We trust that clean energy access is an entry to a wider range of sustainable development. Tanzania's energy sector is characterized by a diverse energy mix, with hydropower, natural gas, and biomass being the primary sources of energy. According to the Ministry of Energy (2023), the country's installed electricity generation capacity stands at approximately 1,600 MW, with hydropower accounting for 35%, natural gas for 57%, and diesel for the remaining 8%. The energy sector is regulated by the Tanzania Electric Supply Company Limited (TANESCO) and the Rural Energy Agency (REA), with the latter focusing on expanding energy access in rural areas (Ministry of Energy, 2023). Despite recent efforts to increase energy access, a significant urban-rural divide persists. While urban electrification rates are around 75%, rural areas lag behind at just 39% (Ministry of Energy, 2023). This disparity is not only a consequence of geographical challenges but also reflects the high costs associated with grid extension in sparsely populated regions (World Bank, 2021). The reliance on biomass for cooking and kerosene for lighting in these areas underscores the urgent need for alternative energy solutions (International Renewable Energy Agency, 2019). In rural Tanzania, limited access to electricity hampers the growth of small businesses, restricts educational opportunities, and exacerbates health risks due to indoor air pollution from traditional biomass use (United Nations Development Programme, 2020). The situation is compounded by the high cost of extending the national grid to remote areas, which often renders grid-based electrification economically unfeasible (World Bank, 2021). The lack of reliable energy access has far-reaching socioeconomic consequences. For instance, without electricity, health facilities struggle to provide adequate services, particularly in maternity care and emergency response. Schools are unable to extend study hours or utilise modern teaching aids, limiting educational outcomes. Additionally, women and children, who are primarily responsible for collecting firewood, bear the brunt of energy poverty, spending valuable time that could otherwise be used for education or income-generating activities (International Renewable Energy Agency, 2019). Modern energy access is a fundamental driver of global socio-economic development, encompassing grid-supplied clean energy, liquid fuels like kerosene, and gaseous fuels. Clean grid energy is particularly crucial, elevating societies up the "energy ladder" (International Energy Agency, 2021). However, despite its potential as a panacea for various challenges, 1.2

billion people (17% of the world), predominantly in low economically developing countries (LEDCs), still lack access (United Nations, 2023). Even for those with access, low quality (flickering supply) and prohibitive costs are common issues, especially in rural Sub-Saharan Africa, Developing Asia, and Latin America (World Bank, 2021).

The Divide in Clean Energy Consumption: The disparity in clean energy consumption across the globe remains a profound marker of developmental inequality. This global divide is not merely a matter of kilowatt-hours; it represents a fundamental divergence in quality of life, economic opportunity, and resilience to climate change (United Nations Environment Programme, 2022). **Norway** boasts an incredibly high clean electricity share, with 98% of its electricity generated from low-carbon sources in 2024, predominantly hydropower (89%) (Statkraft, 2024). Its total per capita electricity consumption in 2023 was approximately 23,000 kWh (Statistics Norway, 2024). This near-complete reliance on clean electricity means that heating, cooking, lighting, and virtually all modern conveniences are powered by renewable sources (Statkraft, 2024). **Canada**: In 2023, Canada's per capita electricity consumption was around 14,906 kWh, with clean energy sources, primarily hydro (57%), nuclear (14.1%), and wind (6.4%), contributing significantly to its electricity mix (Natural Resources Canada, 2024). While still relying on fossil fuels for a portion of its total energy, Canada's electricity sector is heavily decarbonised (Natural Resources Canada, 2024). **United States**: In 2023, the US had a per capita electricity consumption of approximately 12,986 kWh (U.S. Energy Information Administration, 2024). While clean energy sources are rapidly growing, the US still has a notable reliance on fossil fuels for its overall energy consumption. However, the trajectory is towards increasing clean energy integration across various sectors (U.S. Energy Information Administration, 2024). **South Africa**: In 2023, South Africa's per capita electricity consumption was approximately 3,546 kWh (Statistics South Africa, 2024). However, a staggering 82.8% of its electricity in 2023/2024 was generated from coal, with renewable energy providing only 8.8% (Eskom, 2024). Despite relatively higher per capita consumption compared to some African peers, the energy mix is heavily reliant on polluting sources, leading to significant load shedding and environmental concerns (Eskom, 2024). To consume the electricity a Canadian uses in a year, a South African would need approximately 4.2 years at their current rate (Statistics South Africa, 2024; Natural Resources Canada, 2024). **Kenya**: In 2023, Kenya's per capita electricity consumption was a modest 162 kWh (Kenya National Bureau of Statistics, 2024). However, Kenya stands out for its high clean energy share: in 2023, nearly 90% of its electricity generation came from renewable sources, predominantly geothermal (47%), hydro (21%), and wind (16%) (Kenya Power, 2024). Despite this impressive clean energy mix, the absolute consumption remains very low (Kenya National Bureau of Statistics, 2024). For a Kenyan to consume the electricity a Canadian use in a year, it would take approximately 78.5 years at their current rate (Kenya National Bureau of Statistics, 2024; Natural Resources Canada, 2024). **Tanzania**: In 2023, Tanzania's total per capita electricity consumption was around 95 kWh (Ministry of Energy, 2023). While there are efforts to increase clean energy, a significant portion of its electricity generation still relies on fossil fuels (Ministry of Energy, 2023). To consume the electricity a Canadian use in a year, a Tanzanian would need approximately 89.3 years at their current rate (Ministry of Energy, 2023; Natural Resources Canada, 2024). Clean energy, when available, is often used for basic lighting, with a substantial portion of the population still lacking reliable access (Ministry of Energy, 2023). Generally, the developing countries, especially in Africa face a critical clean energy

consumption conundrum, stemming from poor production capacities, unaffordable tariffs, and unreliable supply, all acting as significant brakes on development (African Development Bank, 2023). Further statistics show the average per capita clean energy consumption in SSA to be 488kWh (International Energy Agency, 2021). The situation is even more dire in specific countries, with 2023 figures showing Eritrea at a paltry 51 kWh, Central African Republic 36 kWh, Liberia 69, Uganda 70 kWh, Chad 16 kWh, and Guinea-Bissau 17 kWh (World Bank, 2023). Despite some progress, SSA has seen only moderate improvement in energy access, increasing from 26.5% to 37.5% (International Energy Agency, 2021). This still translates to a staggering 609 million people (six out of every ten) remaining without reliable clean energy services, a negligible reduction from 620 million people in 2015 (International Energy Agency, 2021). This profound lack of clean energy connection dramatically impacts health outcomes, limits income generation, constrains opportunities, and ultimately widens the already vast gap between the poor and the rich (United Nations Development Programme, 2020). This is precisely where the innovative model of energy co-operatives emerges as a profoundly promising, even transformative, new pathway for Tanzania and other nations facing similar challenges.

Why Energy Co-operatives is a Matter of Concern: Empowering local communities to collectively own, manage, and benefit from their clean energy infrastructure, particularly through decentralised solutions like mini-grids in off-grid or underserved rural areas, energy co-operatives can directly tackle the persistent issues of unreliable supply, unaffordable costs, and poor quality (International Renewable Energy Agency, 2019). Energy cooperatives are organisations where members are both owners and beneficiaries. They operate on principles of democratic governance, where each member has a say in decision-making processes, and the profits are typically reinvested into the cooperative or distributed among members (Bauwens, 2018). In the energy sector, these cooperatives focus on generating, distributing, and selling energy often through renewable sources like solar or wind (Bauwens, 2018). Globally, energy cooperatives have been used successfully in countries like Germany, Denmark, and the United States. These cooperatives have demonstrated that decentralized, community-driven approaches can contribute significantly to the energy mix while ensuring local economic development and environmental sustainability (Gronewold, 2014; Lowitzsch et al., 2020; National Rural Electric Cooperative Association, 2024). This approach fosters a sense of local ownership and control, moving away from distant, centralised utilities (Gronewold, 2014). When communities themselves are stakeholders in their energy systems, it encourages greater responsibility, sustainable practices, and the development of solutions tailored to their specific needs (International Renewable Energy Agency, 2019). Ultimately, energy co-operatives can offer a potent mechanism to accelerate genuine, community-driven socio-economic development by putting the power of clean energy directly into the hands of the people (Bauwens, 2018).

Problem Statement: Tanzania is endowed with abundant renewable energy resources, including solar, wind, and biomass. These resources present an opportunity for the country to develop decentralised energy solutions that can complement the national grid and provide power to underserved areas (Ministry of Energy, 2023). The government has recognised the potential of renewables, as evidenced by the adoption of the National Energy Policy and the Rural Electrification Master Plan, which emphasise the role of renewable energy in achieving universal access (Ministry of Energy, 2023). Energy access is a critical enabler of economic development, social progress, and environmental sustainability (United Nations, 2023). In

Tanzania, the quest for reliable and affordable energy has been a persistent challenge, particularly in rural areas where grid extension remains limited (World Bank, 2021). While significant efforts have been made to increase electricity access, over half of the rural population remains unconnected, relying on traditional biomass for cooking and kerosene for lighting (Ministry of Energy, 2023). This not only impedes economic development but also has adverse health and environmental impacts (International Renewable Energy Agency, 2019). Whether energy cooperatives offer a novel approach to addressing clean energy challenges remains equivocal. Co-operatives leverage the principles of collective ownership and local empowerment and can provide decentralised energy solutions tailored to the specific needs of communities, but who knows? This paper explores whether energy cooperatives can bring a new pathway to energy supply in Tanzania, documenting the success stories and whether the approach can be adopted in Tanzania. The role of cooperatives in economic and social development is well documented. In sectors such as agriculture and finance, cooperatives have played a crucial role in mobilising resources, enhancing productivity, and improving livelihoods (Birchall, 2004). Extending this model to the energy sector could unlock new opportunities for sustainable development, contributing to Tanzania's goals of universal energy access and increased use of renewable energy sources (International Renewable Energy Agency, 2019). The paper is guided by two critical questions: first, is the energy co-operative model a success in other countries? Second: is the model feasible in the context of Tanzania?

METHODOLOGY

This is an exploratory study aimed at understanding the multifaceted aspects of energy co-operatives globally and their potential applicability in the context of Tanzania. Data collection involved a comprehensive desk review to gather information on global success stories of energy co-operatives. It was done by reviewing academic literature (journal articles, reports, research papers) on energy co-operatives, focusing on their establishment, operational models, and impact on energy access (Bauwens, 2018; International Renewable Energy Agency, 2019; Lowitzsch et al., 2020). It also involved analysing policy documents, reports from international organisations, and case studies detailing the experiences of countries with strong energy co-operative sectors, particularly Denmark, Germany, and the United States of America (Gronewold, 2014; National Rural Electric Cooperative Association, 2024; Danish Energy Agency, 2023). The review was conducted to identify key success factors for energy co-operatives in the globally. To understand the feasibility of the energy co-operative model in Tanzania, semi-structured interviews were conducted with key stakeholders to gather qualitative data. The interviewees were selected based on their expertise and involvement in the energy sector, co-operative development, policy-making, or community energy initiatives in Tanzania. They included representatives from relevant government ministries and regulatory bodies (Ministry of Energy, Rural Energy Agency, EWURA). Also, representatives from the co-operatives were interviewed for a wider perspective. Others were experts in renewable energy technologies and sustainable development from public organisations. The qualitative data collected from both the desk review and semi-structured interviews were subjected to thematic analysis, where, after data familiarization, key themes emerging from the data were categorised and meanings were developed using key codes established during the data collection (Braun & Clarke, 2006). An interview guide was developed with open-ended questions to explore opportunities in

expanding energy access in Tanzania and the potential for financial support and technological adoption for the energy co-operative model.

RESULTS AND DISCUSSION

The success of energy co-operatives in different countries: The study explored energy cooperatives across various countries, aiming to identify key success stories and glean insights into their contributions to clean energy transitions. The findings reveal a diverse landscape, with some nations showcasing robust cooperative movements significantly contributing to renewable energy generation and citizen participation. From the high number of cooperatives in the USA and Germany to the substantial percentage of clean energy derived from cooperative efforts in China and Germany, the data highlights the potential for this community-driven model to play a pivotal role in decentralised energy systems (Lowitzsch et al., 2020; National Rural Electric Cooperative Association, 2024). The analysis further illuminates the dominant clean technologies favoured by energy cooperatives in different regions, ranging from wind and solar in many countries to hydropower in Norway (International Renewable Energy Agency, 2019; Statkraft, 2024). While the direct percentage of the population accessing clean energy via cooperatives varies considerably, the sheer number of cooperatives in some countries, like Denmark, suggests a deep-rooted commitment to local energy ownership (Danish Energy Agency, 2023). This overview sets the stage for a deeper dive into the specific characteristics and enabling environments that have fostered these successes, as well as the challenges that persist for energy cooperatives globally.

Table 1: Energy co-operative practices for clean energy

Country	Number of Energy Co-ops	% of clean Energy from Co-ops or Power Generated	Dominant Clean Tech in Co-ops	% of Population Accessing Clean Energy via Co-ops
USA	850	22%	wind/solar	12%
Germany	862	46%	Solar, wind, smaller hydro & biomass	10-12%
UK	30	5% (320 MW)	wind and solar, some biomass/hydro	2%
France	252	-(245 GWh) annual supply)	hydro, solar, wind	3%
Canada	45	NIL	Wind (e.g., Wind Share), solar, biomass	2%
Norway	30	NIL	hydro-centric	NIL
Australia	100	19,000 MWh	Wind, solar	3%
Belgium	14	—	Solar, wind	—
Spain	85	11.8 GWh	Solar, wind	2.5%

Switzerland	120	NIL	hydro/solar	5%
Portugal	12	NIL	Solar and wind	4%
Turkey	5	500MW	Solar	0.1
Denmark	633	52%(45,000-47,000 MWh annually)	Wind	NIL

Compiled from utility websites (2023-2025): The results (Table 1) reveal a striking global disparity in the development and impact of energy cooperatives. Countries like Germany, Denmark, and the USA stand out as clear leaders, where enabling policies, community ownership models, and strong support for decentralised energy have allowed cooperatives to flourish (Lowitzsch et al., 2020; National Rural Electric Cooperative Association, 2024; Danish Energy Agency, 2023). In Germany, for instance, nearly 46% of clean energy comes from co-ops, supported by over 860 cooperatives, while in the USA, around 22% of clean energy is linked to co-ops, with over 850 such organisations operating and reaching 12% of the population (Lowitzsch et al., 2020; National Rural Electric Cooperative Association, 2024). Denmark demonstrates exceptional cooperative engagement in wind energy, with 52% of its wind power coming from cooperatively owned sources, despite its smaller number of cooperatives compared to Germany or the USA (Danish Energy Agency, 2023). By contrast, countries like France, the UK, Australia, and Canada show moderate development. These nations have implemented co-op models, particularly in solar and wind, but the scale remains modest (International Renewable Energy Agency, 2019). Population coverage ranges from 2–4%, and despite making meaningful contributions in specific regions or pilot projects, systemic barriers, such as centralised utility control, inconsistent subsidies, or a lack of grassroots organisation, limit the broader impact (International Renewable Energy Agency, 2019). For example, France's 252 co-ops generate around 245 GWh annually, but reach only about 3% of the population (Enercoop, 2023). Similarly, Australia's 100 co-ops collectively produce around 19,000 MWh, covering just 3% of its citizens (Community Power Agency, 2023). The lagging category includes Turkey, Norway, Portugal, and to some extent, Switzerland, where the cooperative presence is minimal or symbolic. In Turkey, despite having co-ops involved in 500 MW of solar capacity, fewer than 0.1% of the population benefits, suggesting that operational capacity or outreach is severely limited (Solarbaba, 2022). In Norway, a country with one of the world's cleanest energy grids (primarily hydropower), cooperative models have made a relatively small contribution, likely due to the dominance of national utilities and centralised planning (Statkraft, 2024). Portugal and Switzerland show slight progress, with co-ops reaching around 4–5% of the population, but their contributions to overall generation remain negligible (European Federation of Renewable Energy Co-operatives, 2023). Overall, the data suggests that while energy cooperatives can play a transformative role in democratising clean energy, their success is heavily dependent on regulatory frameworks, political will, and public engagement mechanisms (International Renewable Energy Agency, 2019). Countries that provide favourable conditions, such as feed-in tariffs, grid access, subsidies, and cooperative law, see much broader adoption and impact (Gronewold, 2014; Lowitzsch et al., 2020). Conversely, where such support is absent or weak, co-ops remain marginal players despite growing

interest in clean, localised energy solutions (International Renewable Energy Agency, 2019). Moreover, another striking factor for energy co-operatives to succeed is the energy policy that invites decentralisation of energy supply by other partners. Information in Table 2 shows that decentralisation of energy production is also done through energy co-operatives.

Table 2: Decentralized system for clean energy stream

Country	Degree of Energy Decentralisation	Key Features of Policy Framework	Role of Local Authorities	Role of Energy Cooperatives in Decentralisation
USA	High	Federal structure with strong state-level autonomy in energy planning and regulation.	States set energy targets, regulate utilities, and promote local renewable initiatives.	Energy co-ops are foundational, major drivers of rural electrification and clean energy access.
Germany	High	Energiewende policy supports decentralised, citizen-owned renewables.	Municipalities and citizen groups manage local utilities and projects.	Energy co-ops play a central role in the ownership and operation of clean energy systems.
UK	Moderate	National grid with devolved planning powers in Scotland, Wales, and Northern Ireland.	Local councils develop partnerships and lead community energy schemes.	Community co-ops lead small-scale solar, wind, and hydro projects.
France	Moderate	Centralised grid with gradual opening to local energy communities.	Municipalities engage in local planning and manage concessions.	Co-ops support local clean energy production, though still a minor role.
Canada	High	Province's control energy; each has distinct policies and utilities.	Provinces regulate utilities and support community energy development.	Co-ops support small-scale clean energy, with community-focused models.
Norway	Moderate to High	Energy dominated by public and	Municipalities own and manage	Few co-ops exist; decentralisation occurs mainly

Country	Degree of Energy Decentralisation	Key Features of Policy Framework	Role of Local Authorities	Role of Energy Cooperatives in Decentralisation
		municipal utilities, mostly hydro.	significant portions of hydropower assets.	through municipal ownership.
Australia	High	State-level governance enables localised RE deployment and microgrids.	States and councils fund and support off-grid and rural RE.	Co-ops promote wind, solar, and battery storage at the community level.
Belgium	Moderate	Energy policies devolved to regions (Flanders, Wallonia, Brussels).	Regional authorities manage subsidies and local energy initiatives.	Citizen co-ops help develop wind and solar parks.
Spain	Moderate	Autonomous regions lead energy planning within the national framework.	Regions manage licensing, incentives, and grid integration.	Co-ops like Som Energia engage citizens in collective RE ownership.
Switzerland	High	Long-standing tradition of municipal and cooperative utilities.	Local authorities operate many utilities independently.	Energy co-ops supplement local grids with solar/hydro solutions.
Portugal	Moderate	National planning with new laws supporting citizen energy.	Municipalities involved in energy transition planning.	Small co-op presence: new energy communities are emerging.
Turkey	Low	Centralised control by the national energy authority.	Local authorities have limited autonomy.	Co-ops are minimal, limited to pilot solar projects with regulatory constraints.
Denmark	High	Policy emphasises on	Municipalities lead planning	Co-ops are foundational to

Country	Degree of Energy Decentralisation	Key Features of Policy Framework	Role of Local Authorities	Role of Energy Cooperatives in Decentralisation
		community wind and local energy independence.	and support co-op energy.	wind power ownership; key drivers of decentralisation.
Bangladesh	Moderate	Central planning under the Power Division with a rural focus via the REB.	Local implementation by PBSs, NGOs, and community groups.	70+ Palli Bidyut Samities (PBSs) operate as rural electric co-ops, reaching millions with subsidised, decentralised electricity services.

Compiled from utility websites (2023-2025): Information in Table 2 shows that countries like the USA, Germany, Denmark, and Australia exhibit high levels of decentralisation, where federal or state-level governance actively supports community energy initiatives (Lowitzsch et al., 2020; National Rural Electric Cooperative Association, 2024; Danish Energy Agency, 2023; Community Power Agency, 2023). In these settings, energy cooperatives are vital, often pioneering rural electrification, renewable energy generation, and local energy ownership (International Renewable Energy Agency, 2019). For instance, Germany's Energiewende (energy transition) and Denmark's emphasis on wind energy highlight how co-ops have become central to national energy transitions (Gronewold, 2014; Danish Energy Agency, 2023). Moderate decentralisation is evident in countries like the UK, France, Belgium, and Bangladesh. Here, energy cooperatives exist within supportive but not fully liberalised frameworks (International Renewable Energy Agency, 2019; Enercoop, 2023; REScoop.eu, 2023; Bangladesh Rural Electrification Board, 2023). Bangladesh stands out with its vast network of Palli Bidyut Samities (PBSs) (rural electric cooperatives in Bangladesh) providing decentralised electricity to millions (Bangladesh Rural Electrification Board, 2023). Conversely, countries like Turkey, with a low level of decentralisation, limit local authority roles and hinder co-op development due to rigid national controls (Solarbaba, 2022). Overall, the effectiveness of energy cooperatives in promoting decentralisation strongly correlates with policy support and the autonomy of local authorities (International Renewable Energy Agency, 2019). Where governance structures empower communities and provide policy space, co-ops flourish as engines of clean, locally owned energy systems. Where centralisation persists, their role remains peripheral or symbolic. A unique lesson is that in Bangladesh is that the co-operatives (PBSs) are affiliated with REB. While autonomous in operations, PBSs are technically and financially supported by the Bangladesh Rural Electrification Board, which was created in 1977 (Bangladesh Rural Electrification Board, 2023). Over 70 PBSs exist, serving more than 100 million rural people, reaching approximately 80% of rural households **(Box 1).** The PBSs provide subsidised electricity, maintain infrastructure, and collect revenue locally, fostering accountability and responsiveness (Bangladesh Rural Electrification Board, 2023).

Box 1: Overview of Energy Co-operatives in Bangladesh

Before the rural electrification programme under Bangladesh's Rural Electrification Board(REB) began in 1977, Bangladesh's electrification programme was carried out by the Bangladesh Power Development Board and was mainly limited to urban centres. The REB (Rural Electrification Board) is the only government institution that has been able to expand electricity access to rural areas. It is regarded by many as one of the most successful rural electrification programmes within developing countries. Bangladesh now has 70 rural electricity societies known as Palli Bidyut Samities (PBSs). About 30 million people in rural areas now have electricity through the 5.2 million metres installed under this programme. These connections bring electricity to rural farms and supply electricity to more than 114,000 irrigation pumping stations.

Cooperative model. The PBSs are independent, privately owned cooperatives that develop and distribute electricity. In a typical PBS, customers are members of the cooperative, which draws up the electrification master plan for the area it covers. The member consumers participate in decision-making through elected representatives to the PBS governing body. Retail tariffs are set by each cooperative and approved by the REB. Cross-subsidies are permitted, but average tariffs should at least cover costs for operation, maintenance, depreciation, and financing.

Coordination and training. The REB assists communities in establishing PBSs through initial organizational activities, training of manpower, operational and management activities, procurement of funds, liaising with the energy utilities and other relevant agencies, and conducting elections.

Financial support. The PBSs receive subsidized financing through low-interest loans with long repayment periods. During the start-up period (up to six years), cooperatives with losses receive direct subsidies, and a common revolving fund allows them to benefit from cross-subsidies. Cooperatives also receive subsidies for investments in distribution infrastructures and buy power from the national grid at a subsidised rate, negotiated by the REB.

Management control. The PBSs operate in a financially sustainable manner under the direct control of the REB. There is also a strict system of 'checks and balances' in the area of procurement. The REB instils strict discipline into the process through comprehensive training in the areas of management, rules and regulations. A Performance Target Agreement is signed every year to improve on the previous year, based on criteria such as increasing revenue, decreasing system losses, and increasing the number of connections.

Source: REB website, http://www.reb.gov.bd and Adam Mickiewicz University Law Books no. 21 of 2023

Adoption of the energy co-operative model by Tanzania: In Tanzania, where energy access remains a challenge for both urban and rural populations. As of 2022, only about 39% of rural households have access to electricity compared to 75% in urban areas (Ministry of Energy, 2023). Thus, innovative approaches are needed to address the energy supply gap. One such approach is through energy cooperatives or community-based organisations that pool resources to produce, distribute, and manage energy. While these cooperatives have already proven successful in many parts of the world, they have the potential to offer a new pathway to energy in Tanzania (International Renewable Energy Agency, 2019). The adoption of the energy co-operative model as a lesson learnt from other parts of the world aims at increasing the rate of clean energy access, boosting social and economic development, and reducing overdependence on climate-inducing energy sources (International Renewable Energy Agency, 2019). The country still relies heavily on hydropower and fossil fuels, with renewable energy sources such as solar, wind, and biomass contributing a smaller share (Ministry of Energy, 2023). Additionally, the high cost of extending the national grid to remote areas poses a challenge for universal access to clean energy (World Bank, 2021). Tanzania's growing, geographically dispersed population needs a people-centred, scalable energy model, and energy cooperatives are ideal. Tanzania should adopt context-specific energy cooperative typologies based on:

a) Geographic location (off-grid vs peri-urban)
b) Resource availability (solar, hydro, biomass)
c) Institutional strength (active AMCOS, SACCOs, CBOs)
d) Demand (productive, domestic energy use)

Typologies of energy co-operatives to be adopted in Tanzania: Energy co-operatives can take various forms depending on their scope, ownership structure, operational focus, and target beneficiaries (Bauwens, 2018). Below are the main typologies that Tanzania can adopt to advance community-led energy access, especially in underserved rural and peri-urban areas.

Table 3: Typologies of Energy Co-operatives for Tanzania

Type of Energy Co-operative	Description	Key Features	Relevance to Tanzania
Generation Energy Co-operatives	Primarily involved in the production of electricity or thermal energy using renewable sources (solar, hydro, biomass, wind, biogas). They do not manage distribution or retail, but sell power to the national grid or local users.	- Ownership of power generation infrastructure. -Can sell electricity to TANESCO, REA-sponsored mini-grids, or directly to consumers (if permitted). - Often require Power Purchase Agreements (PPAs) or Feed-in Tariffs.	- Suitable for regions with strong renewable resource potential (e.g., solar in Dodoma, micro-hydro in Njombe) - AMCOS or farmer groups can invest in small-scale solar or biomass plants for income diversification.
Distribution-Only Energy Co-operatives	Manage the distribution and retail of electricity, but do not necessarily generate it. They purchase power from other producers (TANESCO or IPPs) and handle delivery, metering, billing, and customer service.	- Manage energy flow from source to end-user. - Focused on operation, maintenance, and customer interface. - May use existing or newly built local distribution infrastructure.	- Useful in peri-urban settlements and newly electrified villages. - Can reduce operational burden on TANESCO while ensuring local responsiveness. - Enhances efficiency and transparency through cooperative governance.
Integrated Generation and Distribution Co-operatives	Fully integrated energy co-operatives that generate and distribute electricity within their defined geographic area, serving as self-contained energy providers.	- Complete control over the energy value chain within a local area. -Provide electricity for household, commercial, and productive uses. - Ideal for off-grid and mini-grid setups.	- Best suited for remote villages, islands, and clustered settlements (e.g., Lake Zone, Lindi, Mafia Island). - Enable community control, tailored pricing models, and localised innovation.
Consumer or User-Owned Energy Co-operatives	Formed by energy consumers to secure affordable and	- Focus on demand-side empowerment. - Collective ownership	- Suitable for urban low-income communities or refugee camps.

	reliable access to energy. They pool resources to invest in shared energy solutions or negotiate better services.	of solar home systems, shared microgrids, or clean cooking technologies. - Emphasize affordability, reliability, and user governance.	- Can be used to support solar lighting in schools, clinics, or shared business premises. - Encourages inclusion of women and marginalized groups in energy planning.
Service and Maintenance Co-operatives	Worker-owned or technician-based co-operatives that provide installation, repair, and maintenance services for renewable energy systems. They may also offer consultancy, system design, and training.	- Provide technical support to other co-ops or institutions. - Generate employment and capacity building. - Strengthen the sustainability of energy projects.	- Essential for long-term sustainability of solar or mini-grid systems in remote regions - Can absorb graduates from VETA, MOCU, or energy training programs. - Promotes youth entrepreneurship and local job creation.
Agricultural Energy Co-operatives	Typically, producer co-operatives that integrate clean energy solutions into agricultural value chains—for example, powering irrigation pumps, grain mills, milk coolers, or dryers.	- Focus on energy for productive use. - Increases agricultural efficiency, reduces post-harvest losses. - Co-owned by farmers or agro-processors.	- Highly relevant in areas like Morogoro, Mbeya, Iringa, and Arusha where agriculture dominates. - Supports food security and rural income diversification.
Renewable Energy Equipment Sharing Co-operatives	Provide shared access to energy technologies like solar panels, battery banks, biogas digesters, and cooking stoves for communities that cannot afford individual ownership.	- Co-ops purchase in bulk and lease, sell, or rent equipment to members. - Enable communities to pool resources and overcome affordability barriers. - May include appliance financing or rent-to-own schemes.	- Supports women and marginalized groups with clean cooking solutions (e.g., improved stoves, solar cookers). - Reduces upfront costs for renewable energy adoption in rural and peri-urban households - Aligns with clean cooking initiatives and SDG 13 (climate action).
Hybrid and Multi-Purpose Energy Co-operatives	Integrate multiple energy functions (generation, distribution, training, and financing) with other social or economic services.	- Highly flexible and adaptive to local needs. - Offer bundled services such as solar energy plus microcredit or energy plus agribusiness.	- Relevant in regions with mature co-operative ecosystems, where combining services strengthens sustainability. - For example, a dairy co-op in Tanga could generate biogas, distribute it for cooking, and sell excess power.

Potentials for energy co-operatives in Tanzania: Energy co-operatives offer significant potential for expanding access to clean, affordable, and sustainable energy across Tanzania. With over 60% of the population lacking access to reliable electricity, especially in rural and peri-urban areas, energy co-operatives can play a transformative role (Table 4)

Table 4: Potentials of energy co-operatives

Opportunity	Description
Off-grid Electrification	Over 60% of rural areas lack grid electricity, and energy co-ops can provide solar, mini-hydro, or wind solutions to these underserved populations
Abundant Renewable Resources	Tanzania has high solar radiation, potential for micro-hydro, biomass from agriculture, and geothermal in the Rift Valley zone
Existing Cooperative Network	Thousands of registered AMCOS and SACCOs across the country offer ready-made organisational structures and trust capital in rural communities
Supportive Development Partners	Tanzania receives funding from the World Bank, GIZ, UNDP, AfDB, NORAD, etc., many of whom prioritise decentralised clean energy initiatives
Youth Employment and Skills Development	Energy co-ops can absorb and train youth in areas like solar installation, electrical maintenance, and cooperative management
Climate Change and Green Economy Goals	Energy co-ops help reduce reliance on charcoal and fossil fuels, supporting climate resilience and green economic transformation
Digital and Mobile Money Platforms	Widespread use of mobile money (e.g., M-Pesa, Tigo Pesa) enables efficient billing and payment systems for energy services
Policy Alignment (REA, TDV 2050, SDGs)	The model aligns with Tanzania's ambition to reach universal access to electricity and promote local development through inclusive models

Lessons Learnt from a globally successful energy co-operative model: As Tanzania strives to expand access to affordable, reliable, and sustainable energy, particularly in rural and underserved areas, energy co-operatives present a promising solution. These community-owned models have proven successful in various parts of the world by fostering local ownership, enhancing service delivery, and promoting the use of clean energy. By studying how other countries have implemented and scaled energy co-operatives, Tanzania can identify practical strategies to adapt and apply within its own socio-economic and institutional context. The following highlights key lessons Tanzania can learn from successful countries to inform the development of its energy co-operative model.

Table 5: Lesson for adopting the energy co-operatives model

Lesson Area	What Tanzania Can Learn
Policy & Legal Frameworks	From the USA and Germany, Tanzania can learn the importance of granting autonomy to local authorities and cooperatives through strong legal and regulatory frameworks. Clear mandates for energy planning at the regional level foster innovation and local investment.
Role of Energy Cooperatives	The USA's rural electric cooperatives and Bangladesh's Palli Bidyut Samities show how energy co-ops can electrify underserved areas. Tanzania can empower AMCOS and SACCOs to invest in solar, mini-hydro, or biogas projects.
Capacity Building	Germany and Canada invest heavily in training and capacity development for local energy stakeholders. Tanzania can collaborate with universities like MOCU to create tailored energy co-op training programmes.
Finance & Incentives	Countries like India and South Africa provide grants, low-interest loans, and tax

	incentives for renewable energy co-ops. Tanzania can design similar mechanisms through TADB or public-private partnerships.
Technology and Innovation	China and the UK have embraced smart grids, off-grid solar, and digital metering. Tanzania can promote these through local innovation hubs, allowing co-ops to deploy scalable, cost-effective clean energy tech in rural areas.
Community Participation	Bangladesh emphasises bottom-up planning with strong community ownership. Tanzania should promote inclusive participation of villages and co-op members in designing, owning, and managing energy systems.
Integration into National Plans	Mini-grids and co-op-driven systems are integrated into national electrification plans. Tanzania should ensure that co-op energy initiatives are aligned with TDV 2050 and the Rural Energy Agency (REA) strategy.

Tanzania can adopt the energy co-operative model by empowering communities to jointly invest in and manage renewable energy systems. In rural areas, co-operatives can develop solar mini-grids, while urban groups can focus on rooftop solar. Leveraging existing co-operatives like SACCOS will aid mobilisation. Government support through policy, technical assistance, and financing is key. Energy co-operatives promote affordability, local ownership, and sustainability. Clear legal recognition and integration into national energy plans will ensure their success in expanding access to clean energy.

CONCLUSION AND RECOMMENDATIONS

Adopting the energy co-operative model provides Tanzania with a practical and inclusive solution to expand access to clean, affordable, and sustainable energy, especially in underserved rural and urban areas. Energy co-operatives promote community ownership, local participation, and shared responsibility, thereby contributing to national energy targets and broader socio-economic development. To realise this potential, Tanzania should establish a supportive legal framework, integrate co-operatives into national and local energy strategies, and invest in targeted capacity building and financing to empower communities and ensure the long-term sustainability of these energy initiatives.

Declaration: The paper was edited using AI and Grammarly tools, partly AI was used for a quick search of information, which was verified through relevant websites.

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The Co-operative University of Kenya
P.O. Box 24814-00502, KAREN, NAIROBI
TEL: +254 202430127/202679256
Mobile(office): +254 724311606
Conference link: https://conference.cuk.ac.ke/