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Review

The Role of Political Economy in Energy Access: Public and Private Off-Grid Electrification in Tanzania

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Abstract: Off-grid renewable energy sources are dramatically altering the energy landscape in countries with low energy access. While techno-economic perspectives are already widely discussed, the political economy is largely ignored, particularly regarding the institutions providing electricity. Two of many ways that the task of electrification can be framed are: (1) as the duty of the government to provide a basic service to its people, or (2) as a goods that can be purchased from private players in a market system. Electrification in our country of focus, Tanzania, has developed a promising off-grid market as an increasing number of private players have recently become active there. While grid extension is still a priority for the government, solar home systems, which are estimated to make up more than half of all new connections by 2030, get surprisingly less attention in terms of coordination, political support, and policy frameworks. This is despite the fact that the population is highly dispersed, making grid extension less suitable and more expensive than off-grid, decentralized systems. After an extensive literature review, our method applies a theory-embedded framework of institutional economics to the use of solar home systems for electrification in Tanzania and examines the realizations of the electricity provided. The framework defines key political economy criteria as drivers for energy access and evaluates their respective relevance. We then apply this framework to evaluate 20 selected projects, which have promoted solar home systems in rural off-grid areas in Tanzania since 2000. As a unique contribution to the literature, this research highlights the underappreciated influence of different institutional arrangements on the political economy landscape and on the electricity provided for rural electrification in sub-Saharan Africa.

Keywords: political economy; politics and electricity; power sector reform; liberalization; off-grid energy access; system good; organizational model; institutional economics

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1. Introduction

The quest for energy access is among the most widely discussed development goals, representing a key driver of growth, development, and climate protection for countries in the Global South. In addition, the provision of electricity is undergoing a revolution in terms of new techno-economic possibilities. With energy sources ranging from traditional fuels to fossil fuels to renewables, and technology choices ranging across the continuum from personal 'nano' grids through mini-grids to utility-scale systems, the physical pathways to achieve electrification goals are numerous and varied [1]. In response, a variety of techno-economic solutions and research have been proposed and published in recent years.

Despite this interest, one of the prevailing challenges, which has received far less attention, is the role of politics. In the words of Hughes and Lipscy ([2], p. 464) "politics will play a critical role in determining whether these challenges [securing the supply of reliable and affordable energy; and effecting a rapid and just transformation to a low-carbon, efficient and environmentally benign system of energy supply] will be successfully addressed." Sovacool ([3], p. 279) adds "Nonetheless, despite the multifaceted social and economic benefits of access to electricity and modern forms of energy, the energy poor typically fall between the cracks of singlehandedly private or public efforts".

Almost one decade later, this paper aims to examine the current relevance of political economy aspects to the realization of electricity access. Furthermore, regarding our country of focus, Tanzania, we specifically study the interconnections between the provision of solar home system as a new form of energy access and the various institutional and socio-political dimensions at play.

Prior literature on energy sector reforms has largely focused on top-down techno-economic solutions and market liberalization. Electricity sectors in different countries across Sub-Saharan Africa (SSA) are frequently investigated because of their major structural deficits as well as continuous economic challenges. These sectors were traditionally organized as top-down, state-controlled infrastructure, that grew from colonial vertically integrated utilities.

As the developing world is increasingly confronted with the pressing question of how to achieve universal access to electricity by 2030, another more acute shift is taking the spotlight: Governments and multilateral institutions ask for sustainable (and private) business models to provide the millions of remaining off-grid households with electricity. However, targeting investments for households, which are often in remote and hard-to-reach locations, with restricted financial means and economic growth potential, makes the provision of electricity highly costly, risky and, above all, very unlikely to be profitable. Nevertheless, the increasing maturity of solar photovoltaic (PV) technology—reflected in increasing global deployment rates and considerable reduction of price—has put private players in a unique position to "reshape 'energy geographies', i.e., changing spatial, material, and political dimensions of energy" ([4], p. 10). Furthermore, the access question is pursued by an increasing number of heterogeneous actors (private companies and funds, international donors and agencies, public actors, non-state actors, sub-national actors), creating a need for intensified coordination and engagement across all involved stakeholders.

Our critical and thorough review uses quantitative data and qualitative data, focusing on activities in Tanzania that promote new electricity connections in currently unelectrified populations to map the landscape between private and public service. Both extreme paths can be driven by a single-bottom line economics with a goal of least-cost universal access, but their results diverge. Considering New Institutional Economics theory, especially the organizational model framework for today's electricity access restructuring, our research has three primary objectives.

Our first objective is to review political economy and institutional economics theory in the context of energy and electricity access. In doing so, we provide an extensive overview of literature in this field. Second, we build an organizational model framework to define key features of political economy analysis for the provision of solar home systems. Third, we test this framework against findings from published articles about the use of solar home systems for electrification in Tanzania.

Our examination illustrates the numerous ways by which the diffusion of solar home systems is strongly interconnected with political economy. Given the genuine uncertainty and potential in Tanzania's off-grid market, critical examinations could have a real effect on shaping the implementation of future electrification programs and policies to ensure universal access to affordable, reliable, sustainable, and modern energy for all.

The following sections are organized as follows: The next section explores the literature connecting electricity, electricity access, development, politics, political economy, and historical geography. Section 3 focuses this research to Tanzania providing background on the context. Section 4 provides the methodological background and introduces our proposed framework of analysis, which we apply to selected case studies in Section 5. Conclusions are presented in the final section.

2. Electricity, Politics, and Energy Access

This section presents the various lines of reasoning of the literature the paper draws upon, how the role of political economy has been perceived in the energy sector, and how ideas and frameworks have been considered when analyzing electricity access. We apply a critical review to capture and reflect on the most relevant items of discussion in our research field.

2.1. Tying Politics to Electricity

In the theme of high modernist ideology introduced by Scott [5] where development of the "third world" was driven by faith in scientific and technical progress, energy is typically thought as a purely techno-economic domain [6]. However, literature in historical geography and political economy examines the evolution of electricity (power) in the context of political and social structures (power) [7]. Working with limited resource introduces both technical and socio-political trade-offs, which are decided through power-laden processes [8] such as who makes the decision on who gets electricity, when, and at what price. The spatial magnitude of grid projects often means they have historically been a significant part of state-led development and aid. Their long timeframe of planning, construction, and use allow them to reflect the historical state in which they were designed and built, creating both physical and institutional path dependencies. In the words of Hughes [7]: "Those who seek to control and direct [large centralized electric power grids] must acknowledge the fact that systems are evolving cultural artefacts rather than isolated technologies. As cultural artefacts, they reflect the past as well as the present. Attempting to reform technology without systematically accounting for the shaping context and the intricacies of internal dynamics may well be futile . . . " Energy's importance to economic growth makes it a "commanding height" of society, while daily interactions dependent on energy make it a highly personal issue. Therefore, energy is an ideal lens through which to view how changing political, social, and economic conditions result in different policies, programs, and electrification realities.

2.2. Electricity and Power Sector Reforms

Looking at more than 50 years of reform trends in the energy sector, power sector reforms are the second important dimension to be considered. Much of the literature here can be clustered into three themes: (1) documenting the experiences of specific 'developed' country electricity sectors, (2) global comparisons using panel data for the impacts of political economic variables on energy market liberalizations throughout the world, and (3) documenting the experience of power sector reform in selected countries of the Global South.

2.2.1. Power Sector Reforms in Developed Countries

The power sectors reforms of Australia, New Zealand, Chile, Argentina, England, Wales, and Norway in the 1980s and 1990s are often cited as successful examples of market restructuring. However, the United States' California energy crisis and the 2003 blackouts in New York serve as cautionary illustrations [9,10]. Paul L. Joskow's "*Electricity sectors in transition*" discusses the structural and regulatory changes that were affecting these electricity sectors during that time [11]. While Borenstein and Bushnell [12] and Jamasb and Pollitt [9] document the experience of reform progress in several of the developed countries listed above (the US and the EU respectively), Markard and Truffer [13] use changes in market liberalization to investigate other issues, such as the innovation process in electricity supply. Overall, restructuring has not served as a main driver of investment.

2.2.2. Global Comparisons of the Impact of Political Economic Variables on Energy Liberalizations

Other literature examines global comparisons of the impact of political economic variables on energy liberalizations throughout the world using panel data. For example, Henisz et al. [14] investigated why countries differed in the extent to which they adopted neoliberal, market-oriented reforms in their infrastructure industries specifically looking at coercion, emulation, and competitive mimicry. Their findings suggest that the coercive effect of lending by the International Monetary Fund and World Bank differs for each of four reform elements: privatization of state-owned firms, separation of regulation from the executive branch, elimination of political influence on regulation, and the opening of the market to multiple providers. Erdogdu [15] also investigated the impact of political economic variables on the liberalization process using energy market reform indicators from the European Bank for Reconstruction and Development [16]. The indicators rank the liberalization of electric power sectors from a rank of 1) "Power sector operates as government department with few commercial freedoms or pressures. Average prices well below costs, with extensive cross-subsidies. Monolithic structure, with no separation of different parts of the business", to a rank of 4+) "Tariffs cost-reflective and provide adequate incentives for efficiency improvements. Large-scale private sector involvement in the unbundled and well-regulated sector. Fully liberalized sector with well-functioning arrangements for network access and full competition in generation." Erdogdu's results suggested that dominant influences on energy market liberalization include the relative strength of interest groups, the size of the industry sector, and the size of foreign financial support, government ideology, and the education and profession of the politicians in power.

2.2.3. Power Sector Reforms in Developing Countries

The third cluster of papers analyzes the experiences of power sector reform in developing countries, either as individual case studies such as in Victor and Heller [17] and Newell and Phillips [8] or by revealing patterns among the experiences of all developing countries [10,18–20]. Using literature reviews, structured case studies, and narrative accounts, Victor and Heller [17] evaluate the experiences of Brazil, China, India, Mexico, and South Africa "as they have shifted from state-dominated systems to schemes allowing for a larger private sector role." Williams and Ghanadan [18] use similar methods to Victor and Heller describing common features of non-OECD electricity reform and reappraising reform policies and their underlying assumptions. Newell and Phillips [8] focus on the case of Kenya to examine the relationship between the direction and form of an energy transformation and the political economy within which it is embedded, as well as how a low carbon transformation has been influenced by neoliberalism.

2.3. Energy Access Perspectives

Our third, and major field for review, is the theory and praxis of energy access. There is an increasing number of publications available, which can be generally clustered into four sub-groups: development and politics, decentralization, new forms of energy market liberalizations and scenarios for energy access.

It is important to note that our focus on off-grid electricity provision. While on-grid electrification has been the prevailing approach in developed countries (including on-grid prosumers [21]), perspectives in developing countries, especially in Sub-Sahara Africa, are quite different. Here technological advances and significant cost reductions over the past decade have led to the addition of distributed off-grid solar power as a low-cost option to electrification. Although most of the recent electrification progress has come from public grid expansion, the share of distributed off-grid solar power is increasing rapidly. This includes both stand-alone solar home systems and mini-grid systems. Off-grid systems are local electricity supply solutions that are separate from the national power grid. They are used for self-supply of communities, especially in rural, hard-to-reach areas. Diesel generators have often been used to power them in the past, but the use of solar, hydro and wind power is also becoming increasingly common [22].

2.3.1. Development and Politics

Numerous scholars are emphasizing the importance of linking energy access to development and the role of politics. Khennas [23] links economic growth to infrastructure provision and emphasizes that the factor energy is part of this equation. Long-term programs with sufficient funding and a sound political framework are needed. Sovacool [3] agrees, but specifically points out that the various reasons of energy poverty and lack of progress can be found in the fundamental challenge between private interest, which regards particularly rural access provision as unprofitable and unfeasible non-commercial activity, and the government, which does not tackle the rural challenge trusting in development aid support and preferring to focus on urban areas in the meantime. Furthermore, he adds that social, political, and cultural barriers are still taking a backseat. Scott and Seth [24] elaborate on the fact that energy access is closely linked to politics and governance. Pillot et al. [25] work deals with the social-energy context and the interdisciplinary approach to drive energy access. Bensch [26] attempts to refute this concept with a systematic review where he analyses the linkage between market-based reforms and progress on energy access. His results stresses that the supply side particularly benefits from increased private investments. Despite these selected results, major review studies produce a different perspective. Trotter et al. [27] provide a comprehensive review on electricity planning research. Although institutional factors such as policy, political context, and access to finance are among the most frequented cited barriers for successful energy access programs, only 14% of papers analyzed political criteria in energy planning. Karplus and von Hirschhausen's survey of electrification has an institutional focus, considering both supply-side and demand-side issues [28]. A review in *Renewable and Sustainable Energy Reviews* of 368 journal articles on the topic of "Off-grid systems for rural electrification in developing countries" does not include any reference to papers on the impact of institutional arrangements or political frameworks [29].

2.3.2. Decentralization

Decentralization of electricity provision linked to the deployment of off-grid systems has been popular ever since the technology became available. In general, technology as well as its product, electricity, is not the solution as such for rural electrification but it is the medium to achieve what is needed: using decentralized power appliances to improve livelihood in the local context. Already back in 1992, Foley [30] summarized that rural electrification is mostly about effective local and decentralized policymaking. Besley and Coate [31] address the problematic decision between either centralization or decentralization of a public good. According to Oates Decentralization Theorem they propose that if you cannot count on spill overs, decentralization is better. Centralization and a one-size-fits all approach undermined local perspectives and triggers political agency problems. They conclude that the political decision-making process and defining its details is critical to understand trade-offs between centralization and decentralization. Zalangera [32] applies the decentralization theorem directly to the energy access question by connecting the question of decentralization to the deployment of decentralized energy systems. He agrees that decentralized government triggers energy access with distributed energy systems. However, this is not universally true. For instance, in Kenya due to globalization, international capital and technology flows, policy making is not just local, but strongly coupled to "localized access to and relations with transnational capital and global institutions" ([32], p. 17).

2.3.3. New Forms of Energy Market Liberalization

With new technological achievements and the subsequent reduced costs in solar and batteries, it is now possible to embark on an entirely different and decentralized form of energy market liberalization. Individuals can become entirely independent from the grid by opening the market for the provision of connection. Furthermore, the energy industry is subject to a number of system-relevant innovations, such as digitization, new business models and innovative generation methods. For example, digitization has substantially improved productivity reducing operational costs and increase efficiency [33]. These forms of advancements and liberalizations also open the door for a market where individuals can choose their quality (capacity, reliability, and availability) based on their willingness or ability to pay [34]. This form of liberalization may leave some individuals left out of the system because they are unable to afford entering the various markets [35]. Energy market liberalization could materialize in these and in other ways in places that do not have existing full electrification. In fact, in both the developing and developed world, this "decentralized" future is threatening existing grid archetypes [36].

Baker and Philipps [37] study of the evolution of the energy sector in Sub-Saharan Africa demonstrates that utilities and their monopolies are under great pressure and changes to decentralized approaches create tensions for the incumbent utilities. Hosier [38] provide a detailed answer of one obvious but challenged question: how utilities might react and prepare for decentralization and new forms of electricity supply. Most of all, large scale provision of solar-home-systems (SHS) may only thrive under conditions of competition, where SHSs are defined as small, household-scale, solar-plus-battery systems providing lighting and other low-power electricity services. Concessions, as critical tools of regulation, therefore, should assist and not hinder SHS development. Jacqout [39] describes two drivers that characterize the access challenge. On the one hand, sector reforms. Efficient governance, restructuring distribution, accelerating access and increase of private investment is needed. On the other hand, business models and technology deployment must be sustainable and attract capital to bridge the access gap. Concessions are a smart middle ground. Strong entities and well-designed territorial concessions would provide sufficient incentives for rural electrification. Eberhard and Dyson [40] state that more investment leads to an improvement of the power sector. Therefore, measures to increase private sector investment should be taken. They see that long-term distributional effects among on-grid and off-grid households as the biggest challenge. Shirley and Attia [41] confirm that utilities in Africa cannot continue with a business-as-usual scenario to achieve universal access to electricity. The challenge is dual: sustainability and universal access both must be achieved. Shirley and Attia advocate for improved public–private sector engagement as new approaches are emerging, but slow and inflexible (institutional) structures such as regulation, government, tariffs, and conventional on-grid investment priorities are barriers to transformation.

2.3.4. Scenarios for Energy Access

To stress the relevance of political economy aspects in the context of energy access, we will now examine basic considerations for two extreme scenarios of a fully public utility versus a fully private approach. A summarized characterization appears in Table 1.

Table 1. Characteristics of principal electrification scenarios.

Electrification Scenario	Mission	Actors	Financing	Process of New Connections	Nuances
Public	Universal right to energy service	Government, regulators	Multilateral institutions, public capital	As able, least-cost, strategic	Corruption and "white elephants"
Private	Open new markets, return on investment	Entrepreneurs, private companies	Finance, impact investing, commercial funders	As consumers can afford what is offered	Ethical dilemmas

Public Approach

Public utility scenarios for the provision of electricity and promotion of energy access are traditionally composed of a single vertically integrated monopoly utility for a specific geographic area, which has significant involvement of the state in its planning and operation. The state's involvement influences the utility's core mission to provide for the energy needs of the constituency and the energy requirements of state-led development and industry [3,42]. Large infrastructure projects for expanding electrification and other services have largely been the responsibility of the public sector, which in the African context often implies influence from transnational actors (TNA) such as foreign governments, the World Bank, or the International Monetary Fund [43]. Ideally, the large amount required to build this infrastructure is more concentrated on specific projects and therefore used more efficiently. In addition, later revenues to the state-owned utility from the sale of the electricity are more likely to remain in country for further development of the electricity network or for other public services. The process of connecting new individuals ideally proceeds in a least-cost or greatest-need manner to eventually cover the entire population. Unfortunately, nuances and complications immediately arise when we connect our ideal scenario to other analogous contemporary projects. Three variants of the influence of political barriers to electrification projects include: (1) that electricity may have a lower priority in the administration's limited budget than more basic needs such as water or health; (2) in a developing world context, this scenario is likely heavily reliant on unstable states and their ability to enforce regulation to maintain good quality and low cost electricity; [3,43] and (3) that the prioritization of new connections becomes a political "white elephant" instead of altruistic and equitable [14].

Private Market Approach

A private market scenario for the provision of electricity consists of private for-profit companies manufacturing and selling energy systems in competitive marketplaces for those who are willing and able to pay [3,44]. With increased competition between companies, prices are significantly driven down. Since manufacturing capacity is limited in many of the same places where energy products are most needed, many of the products are manufactured elsewhere [1,12,45]. Since large capital funds are also limited in the target markets, much of this scenario is initially funded by global finance such as from banking, venture capital, or foundations. Therefore, (so far unregulated) profits are unlikely to remain in the recipient country, potentially furthering cycles of underdevelopment. Contrary to the cost-recovery policy in the public scenario, here, each individual user must be able to provide for full-cost-recovery for a connection to be viable. As in the public scenario, nuances and conflicts arise when we look critically at contemporary projects in this scenario. First, although perfect competition can incentivize cost reductions and higher quality products, with insufficient competition and regulation, many of the private options are more expensive and of lower quality than a truly competitive market would provide. Second, most of these companies are still imposed and facilitated by developing country institutions with their own priorities [3] and that may have a more limited local cultural understanding of the places in which they work [46]. Particularly, financial returns of the market institutions can eclipse social priorities of universal access, as there is little incentive to provide electricity to users where there will not be a return on investment [3]. Some have questioned private institutions' motives for entering the field. Are energy products just a way to open new markets for additional consumer products that can now be powered by the electricity produced and sold by the same company? The level of data collected from pay-as-you-go (PAYGO) systems can reduce a customer's bargaining power and lead to predatory behavior [47]. Finally, the lack of suitable legal and regulatory frameworks for the dissemination of systems and long-term conducive policies is a major institutional barrier [46].

2.4. Preliminary Summary of Findings

Our literature review has addressed existing research aspects of electricity, politics, and energy access. Nevertheless, our following research aims to fill a gap that is not sufficiently addressed. First, the current literature addresses the political economy aspects in name, but not in detail or in realizations for energy access. Second, the academic literature does not sufficiently cover the newest forms of energy market liberalization, materializing over the past 10 years, of consumer markets for lighting and electricity products that go beyond just a privatization of generation. This recent shift changes the provision of energy access as well as the realizations of electricity provided. Third, we have examined the theoretical extremes of public and private approaches to electricity access. In reality—as we will demonstrate in the following section—electricity access models are not, and will never be, an either/or situation. They should always be seen as a continuum of public and private mixes.

3. Research Setting: Tanzania

3.1. Energy Landscape

With a geographic area of 947,300 square kilometers and a population of 62.1 million people, Tanzania has the second largest population in East Africa, but the lowest population density. In 2019, only 40% of the population had access to electricity, 23% in rural areas and 71% in urban areas. In fact, despite recent rather favorable macroeconomic conditions, extensive support from official development assistance (ODA) and plenty of natural resources, the state dominated power sector represents one of the key inhibitors to sustainable development in Tanzania. Sector reforms including unbundling and privatization were initiated in the late 1990s but have since been abandoned. Major stakeholders are TANESCO the state-owned utility, which is in charge of the full supply chain, the Government (Ministry of Energy, Rural Energy Agency, and Energy and Water Utilities Regulatory Authority) and three types of private power producers (independent, small, and emergency) [48].

Increasing access to electricity is on the political agenda, but actual progress is moderate. The current electrification plan dates to 2014. The government aims to supply 50% of the population with access to electricity by 2025 and to reach 75% of the population by 2033 [49]. According to a least cost calculation from World Bank, the Energy Sector Management Assistance Program (ESMAP), and KTH Royal Institute of Technology in Stockholm the most effective approach to provide almost 90% of the current off-grid population is the provision of solar home systems [50,51].

3.2. Power Sector Reforms

An examination of the history of electricity in Tanzania exemplifies the connection between politics and the physical form of energy access. Tanzania's political history contains dramatic shifts from colonialism, to postcolonial socialist idealism in Ujamaa (Swahili for "cooperative economics") policy, to reforms that embraced free market policies. The service sector in Tanzania, such as the energy sector, exhibited these shifts from preferential colonial service, to redistributive energy policy through purely state-owned enterprises (SOEs), to the commercialization and privatization of SOE in a neoliberal framework, and recently to a focus on decentralized energy systems. A modern example in the context of energy is Tanzania's Energy and Water Utilities Regulatory Authority, the national regulator, approval of a mini-grid framework that facilitates local and foreign private investment in small power projects (100 kW–10 MW) for energy access [52]. "As one of Africa's most extensive aid recipients—and with energy as a key site of "Development [53] involvement in Africa—Tanzania exemplifies many of ways that international aid and politics are inseparable parts of energy operations and policy" [54]. Therefore, changing conditions on local, national, and global scales play a key role in determining technological outcomes in energy access [8]. With only around 40% of Tanzanian having access to electricity that has remarkably low reliability (a ranking of 5 out of 8 on a reliability of supply and transparency of tariff index [55] this issue will continue to change and be shaped by the historical, political, social, and economic conditions.

3.3. Off-Grid Situation

With unrealistic targets, high debt, and slow, complex administrative procedures, TANESCO has hardly been able to advance access. In 2005, the Rural Electrification Agency was created to tackle the off-grid challenge. The Lighting Africa initiative from the World

Bank has provided support since 2008, and a master plan for the role out of solar home systems was released in 2012. However, except for several pilots the public side, the sector has remained rather inactive.

On the other hand, from 2010 onwards, Tanzania has developed into a high potential off-grid market. Numerous private companies started large-scale distribution of solar systems. Companies such as Mobisol, Sunny Money and Zola Electric experienced a high growth rate. In the period, 2014 to 2019 about 1.8 Mio systems have been sold, though mostly as supplement or additional source of lighting as the majority of systems are small solar torches or lighting kits. In total, 30.4% of Tanzanian households use solar PV as electricity source [49,56]. Nevertheless, more and more market distortions are visible. Mini-grids struggle with new legal procedures and high prices. The large-scale PAYGO SHS distribution is slowing down (e.g., the largest competitor of Zola, the German PAYGO company Mobisol filed for bankruptcy in April 2019 [57]) and distribution seems to be confined to urbanized and economically stronger regions in the Northern parts of the country.

3.4. Financing Landscape

Off-grid electrification in developing countries is highly dominated by international financial flows and transnational actors such as official development assistance (ODA), donors and impact investors are playing a decisive role [58–61].

For Tanzania, Sergi et al. ([60], p. 6) find that for the period 1990 to 2013, 54% of total ODA commitments (USD 4492 million) went to on-grid projects, while only 1% of total ODA was identified for off-grid projects. The study of Kaijage et al. [59] focuses on the period 2008 to 2021, where off-grid funding has slightly increased. Of the total committed USD 1.6 billion for energy access around 11% was assigned to off-grid energy access.

Major international donors in the Tanzanian off-grid access space are the United Kingdom's Department for International Development (DfID), the European Union, AFD —the French Development Agency, and USAID's Power Africa Initiative. Power Africa plans to use only USD 136 million of the total committed USD 4 billion for off-grid projects in the near future [60].

Spending patterns of the Tanzanian government are similar. In the period 2009–2017 the state spent just 2% of its total energy access budget (USD 2 billion) on off-grid solutions [59]. Another important aspect to note is that the major recipients of the funding are most of all international entities. Tanzanian non-governmental organizations (NGO) and local energy small and medium-sized enterprises (SME) only receive fractions of the amount. Especially local energy companies hardly benefit from international donor funding [59].

In short, total available financing does not come close to the actual needed amount to achieve universal access to energy in the next years. In 2015, the International Energy Agency and the World Bank [62] estimated that universal access to electricity in Tanzania needs a minimum of USD 400–500 million investments per year if all new connections represent tier 2 access level a level of access that a solar home system can fulfill according to ESMAP's multi-tier framework [63].

As current commitments add up to about only 10% of the amount needed, with two-thirds of that coming from ODA, we see a very distinct mismatch between actual off-grid opportunities in Tanzania and outdated institutional focus on large-scale on-grid and grid-extension projects.

3.5. Data and Methods

Our following political economy analysis is based on a qualitative-interpretive research position to study laid out research setting in-depth. The main research area is the political-institutional perspective of off-grid electrification in Tanzania. Our methodological concerns have led to a two-directional descriptive and cross-sectional research design: (i) a review and in-depth study of relevant literature and (ii) detailed assessment and ranking of peer-reviewed scientific publication regarding solar home system projects in Tanzania.

First, a qualitative document analysis [64] is followed as underlying generic research method. This qualitative review considers the spectrum of literature on power sector reforms, impact of energy sector liberalization and most importantly perspectives on energy access. It is followed by an assessment of theory and methodological frameworks of Institutional Economics and Political Economy studies.

Our second research path focuses on specific peer-reviewed scientific publications. Comparing scientific articles are a source to understand development and innovation in the sector over an extended period. Web of Science, Google Scholar and Scopus have been used to find relevant articles. Searching for "Tanzania" was combined with all possible declinations and composite word forms deriving from "solar home system", "SHS", "solar PV", "distribution", "company", "barrier", "constraint", "challenge", "pay-as-you-go", "case study" and "project". All searches have been carried out twice to avoid incomplete results. Double-checking reference lists in other reviewed articles have further enhanced our literature search approach. We found more than 1000 relevant publications. We then categorized them according to title and abstract relevance for our chosen search string. All our considered publications have been shortlisted based on the principal criteria of how topical and relevant they are. Then, for our in-depth assessment, 20 peer-reviewed articles been selected, which have been published between 2010 and 2019. All in all, applied data validation and triangulation allowed us to cross-check and validate our findings, as various references do reinforce conclusive qualitative evaluation [65]. We carried forward the evaluation by peer-reviewing results: two researchers have agreed on methodical and analytical approach, independently gathering empirical data, and, in an iterative manner, having jointly examined, reviewed, and agreed on the proposed findings.

4. Methodological Framework

This research is situated in the field of energy sector transformations with perspectives of political economy and institutional economics as major thematic areas. It is at the intersection of both areas, discussing not only the political, but also the institutional economic aspects of electricity provision to reach universal access to energy.

4.1. Institutional Economic Approach: Organizational Models for System Goods

The development of institutions, and their endogenous emergence, determines economic and technological development [66,67]. Ostrom et al. [68] extended this concept to evaluate different institutional models for the development of rural infrastructure. Their approach is rooted in the theory that institutional analysis needs organization and structure due to complexity and heterogeneity of human behavior, such as methodological individualism and the existence of information asymmetries [69–71]. Consequently, a decision model is needed to avoid misallocation by addressing the principal conflict between individual and public good. Beckers et al. [72] describe it as the multi-component nature of a system good. Their system good framework aims to design stylized organizational models to identify and evaluate the problematic interfaces.

Our example of access to electricity with solar home systems represents a particularly complex form of system goods. Not only the hardware but also a variety of services must be produced upstream and offered in parallel. It leads to overlapping and interdependent stages of value creation, as well as the co-production of different products and services. In practice, this means that beyond purely market-based relationships ("sale" of the solar home system"), a comprehensive need for coordination regarding the supply and provision of the system good must be identified and structured. Both the provision, including financing, and the production of therefore require organizational models that go further than a purely "market-based" solution. Information asymmetries may lead to opportunistic behavior, transaction costs, and the need to coordinate. The interaction of individual actors is not only complex, but it always has a socio-political dimension, too, which includes areas such as institutional and political context, environmental and social costs, stakeholder management, governance, financing as well as communication, awareness, and local capabilities.

4.2. Political Framework for Electricity Access

We build on Beckers's analysis of system goods by developing a framework to examine the role played by political economy in this context. The study of political economy has received many interpretations, but the most generic interpretation understands political economy as the interrelationship between economics and politics. Acknowledging that both systems perceived on their own are only abstract models, the interconnections as well as the social processes "in between" economics and politics should be considered. Social behavior is never purely economic nor political driven, but based on individual, collective and, above all, heterogeneous interests. Especially in the context of energy access these forces are highly visible and decisive. As the effects of this constant state of mutual interactions are studied, it is critical to understand, map and analyze the processes by which certain economic outcomes are produced. Our approach aims to determine which policy choice or suggestion emerge from the outlined political economy process [73,74].

The social contract in the electricity sector, which is in fact the principal unit of analysis of this paper, is an exemplifying case: there is the general agreement that utilities as State Owned Enterprises (SOE) provide unprofitable connections to poor households, maintain and operate elaborate and expensive power and grid infrastructure under constant consideration and protection of the environment, as well as invest and drive forward innovation of the systems and services offered. This social contract can be threatened, especially by only profit-orientated private organizations. In fact, a pure private approach represents the extreme opposite and for good reason, there is a general fear in literature that liberalization and privatization in the energy sector are harmful to the poor as number of sources prove [17,75–77]. In response, the institutional context must hold a key function of support but when looking specifically at infrastructure provision the problem that the outcome is highly politically visible is critical, too. High likelihood always exists that the government steps in if the outcome is unsatisfactory and threatening its political position [17]. Due to the nature of poor electricity provision, the importance of efficient regulation cannot be sufficiently stressed. However, seen through the lens of Political Economy the inherent contradiction of regulation becomes evident: regulators must assume the role of outsiders, which puts them naturally in a weakened management position—never possessing all of information needed to efficiently regulate. According to Victor and Heller [17] it results in a hybrid. A "dual market" or, formulated from the actor perspective, "a dual firm" is the result. Power sector reforms and liberalization does not lead to a pure private, market-based approach, but rather to a sort of compromise combining features of liberalization and privatization with the remains of traditional public top-down approach. We may conclude here that it is a highly stylized and incomplete viewpoint, but it provides basic orientation regarding the political economic system in electricity sector.

4.3. Political Economy Framework for Electricity Access

To approach this dilemma further, our following framework maps key elements of the political economy process. As our framework includes the system good analysis as a research and explanatory tool, we intend to address the gap of missing evaluation criteria for most of the already existing frameworks.

A short overview, which is in this form only a very insufficient enumeration, includes the energy-justice decision making tool according to Sovacool and Dworkin ([78], p. 440); frameworks from Zalengera et al. ([32], p. 7 ff.) as well as Scott and Seth ([24], p. 6), which focus on electricity provision adding actor behavior and a focus on distributed energy services, and cross-sectoral frameworks from Byiers et al. ([79], p. 2), which draws a five lenses framework, Stern ([80], p. 62) identifying distribution channels as framework for comparative analysis, and the integrated political-economy framework for policy analysis from Rondinelli et al. ([81], p. 64).

Figure 1 depicts the embedded version of our framework encompassing three layers.

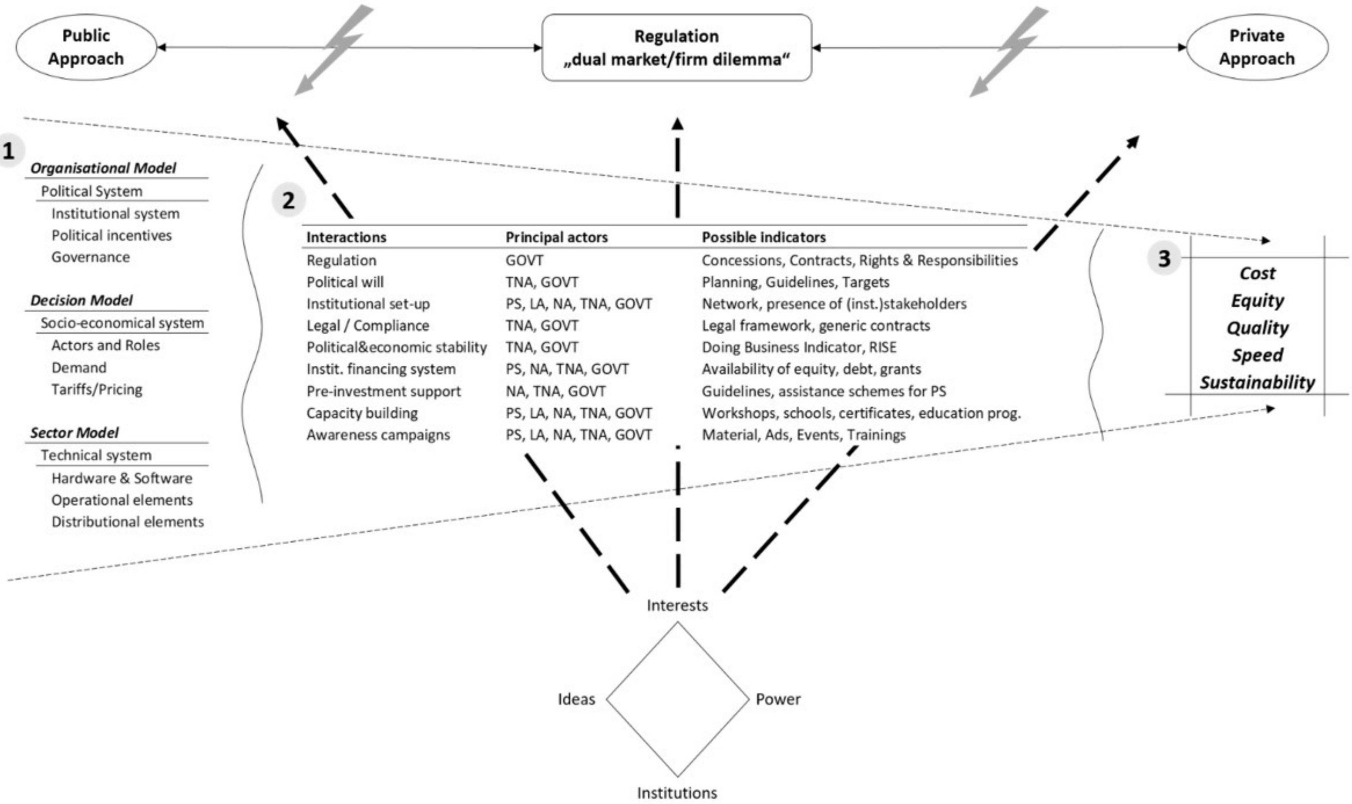

Figure 1. Political economy framework and research tool for electricity access.

The top layer builds on our understanding that the question of designing the organizational model for electricity access is caught between the two extreme poles public and private provision. As introduced above, we locate the task of regulation or, as a more progressive interpretation, the "dual-firm" approach as balancing element between them.

The bottom layer represents the political economy diamond ([82], p. 31). Their institutional framing encompasses the four nodes: Interests, Ideas, Power, and Institutions. Within this diamond, dynamic interactions and cross-interdependencies exist which are influenced by the Political System for the Idea–Interest-Relationship, by the Economic System for the Interest–Power-Relationship, and by the Political Culture for the Ideas–Institution-Relationship.

Our approach sees itself as the extension of this diamond view as it formalizes and evaluates the various interactions and relations. It represents the middle layer, the core of our proposed research design. It applies the system good analysis tool in three steps.

4.3.1. Step 1: Design of the Organizational Model

Building the organizational model from the bottom-up, the starting point is the Sector Model which describes the technical system of the system good, e.g., in our following case study the elements needed to provide solar home systems for electricity access. Elements to be considered are hardware and software features as well as operational and distributional elements. The decision model relates the demand for a good or service (demand function, given as exogenous) with the technical system. It encompasses the socio-economical system defining the different actors and roles. As final step, the Organizational Model level is added. Based on the respective target function and the characteristics of the decision model the political system (institutions, political incentives, will and power, governance) is included. To be able to perform the assigned roles, actors must be equipped with suitable resources, especially in the form of concrete assets or knowledge. Institutions then define the scope of action and rules for the actors.

4.3.2. Step 2: Selection of Key Political Economy Criteria

All three models must be seen as integrated and inter-dependent web of relationships. From the political economy perspective our study has singled out key interaction criterions which are carried out and influenced by principal actors (Private Sector = PS; Local Actor = LA; National Actor = NA; TNA = Transnational Actor; GOVT = Government).

4.3.3. Step 3: Evaluation Using Generalized Indicators

The analysis of these criterions leads to the concluding evaluation. A possible approach is ranking the relevance of each criterion for the outcome, e.g., for the effective provision of solar home systems. Many approaches to formulate qualitative evaluation criteria for infrastructure exists. We formulate our proposed indicators in line with the work of Ostrom et al. [68] and Hankel [83], which consider short-term and long-term efficiency, effectivity and access as evaluation criteria. We cluster them according to the principal characteristics of physical provision of access to electricity: timing/speed of connection, cost, quality, equity and sustainability of electrification. In that way, our framework produces five generalized but indicative indicators for the evaluation of the Political Economy perspective.

5. Case Study: Tanzania

Access to electricity in Tanzania has changed due to new technologies, private and international donor involvement as well as a high number of pilots and projects related to the dissemination of SHSs. In the following, we apply our framework to the case of solar home systems as it represents the most popular off-grid electrification approach in Tanzania. Over the last years, an increasing number of peer-reviewed literature analyzing the dissemination of solar home systems have been published. It provides a rich source to test our framework, assess the relevance of political economy interactions for effective SHS provision, and to provide a different socio-political perspective on access to electricity in Tanzania. Naturally, as selection and evaluation of the case studies have been based on pure peer-to-peer qualitative desk research procedures, we acknowledge that our results must have certain limitations regarding objectivity and quality of data.

Twenty articles have been selected and reviewed. Approaches were clustered according to their delivery model. Out of all, eight projects are public–private partnerships (PPPs) where the implementation/last-mile distribution was carried out by a private company (PPP A). Here private company coding includes social for-profit businesses. Seven projects are PPPs with delivery carried out by NGOs or community-based organizations (CBO) (PPP B). The remaining five projects are fully private models (2) and any other types of distribution approaches (e.g., through churches, schools) (3).

The following empirical analysis follows a 3-step comparative approach: Steps 1 (Table 2) and 2 (Table 3) are generic assessment approaches mixing techno-economic and socio-political factors. Step 3 (Table 5) applies our framework using only socio-political factors.

Table 2. Quantifying drivers and barriers cited in reviewed articles. Note: The driver of "Local distribution model" includes distribution factors such as unbundled distribution, type of actors, role of local initiatives, civil society and local commitments. The driver of "User perception" references openness to new technology, awareness, and education. The barrier of "Negative perception" includes lack of awareness and distrust; The barrier of "Technology" includes technology failure or lack of maintenance. The barrier of "Weak institutions" includes the role of governance structures, management activities, as well as local organizations.

	Model	**PPP A**	**PPP B**	**Overall**
Summary	Scheme	Public–private partnership, delivery by private company	Public–private partnership, delivery by NGO/CBOs	All PPPs, pure private models, and others
	Number articles reviewed	8 (references [84–91])	7 (references [43,92–97])	20 (references [43,84–102])
Drivers	Service (after-sales and pre-sales)	4	3	10
	Affordability	5	2	9
	Local distribution model	4	3	9
	Grant money/Public support	3	4	7
	Market-based distribution	2	2	4
	User perception	1	2	4
	Poor grid, high demand	n/a	2	3
	Quality (technology)	2	n/a	3
	Public framework, government	n/a	1	2
	Flexibility, convenience of use	1	n/a	2
	Trust	1	n/a	1
	Income	n/a	n/a	1
	N/A	1	2	5
Barriers	Negative perception	7	3	14
	Technology	4	4	11
	High cost	5	3	10
	N/A	2	2	7
	Weak institutions	3	2	5
	Financing	2	1	4
	Distribution (incl. geography)	1	2	4
	Non-market approach	n/a	3	4
	Supply (hardware)	n/a	1	1

Table 3. Relevance of political economy realization indicators for access.

Model	**PPP A**	**PPP B**	**Overall**
Scheme	Public–private partnership, delivery by private company	Public–private partnership, delivery by NGO/CBOs	All PPPs, pure private models, and others
Number articles reviewed	8 (references [84–91])	7 (references [43,92–97])	20 (references [43,84–102])
Cost	6	6	12–15
Quality	5	4	12
Speed	4	3	7–8
Sustainability	3	2	6
Equity	2	2	5

Table 4. Ranking of the relevance of political economy criteria. Note: "Capacity building" includes local capabilities, and "Institutional set-up" includes network and context of institutions and other formalized actors.

Model	**PPP A**	**PPP B**	**Overall**
Scheme	Public–private partnership, delivery by private company	Public–private partnership, delivery by NGO/CBOs	All PPPs, pure private models, and others
Number articles reviewed	8 (references [84–91])	7 (references [43,92–97])	20 (references [43,84–102])
Awareness campaigns	8	4	16
Community engagement	8	5	16
Capacity building	7	6	15
Institutional set-up	6	5	14
Institutional financing system	6	4	11

Table 5. Ranking of the relevance of political economy criteria. Note: "Capacity building" includes local capabilities, and "Institutional set-up" includes network and context of institutions and other formalized actors.

Model	PPP A	PPP B	Overall
Scheme	Public–private partnership, delivery by private company	Public–private partnership, delivery by NGO/CBOs	All PPPs, pure private models, and others
Number articles reviewed	8 (references [84–91])	7 (references [43,92–97])	20 (references [43,84–102])
Political and economic stability	5	2	10
Political will	3	4	9
Pre-investment support	6	3	9
Regulation	2	3	7
Legal, compliance	1	2	4

5.1. Driver-Based Assessment

The considered items for our driver-barrier analysis are based on our above literature review. Accordingly, the most common barriers and drivers have been listed. Second, this list has been applied to each short-listed article. Then, the three most cited drivers as well as barriers have been considered resulting in a total score of 60 drivers and 60 barriers and providing a relative weighting of each item accordingly. Our results indicate that the importance of drivers and barriers may largely vary among cases (Table 2). Overall, service, affordability and a local distribution model have received most of the counts, while negative perception, poor technology and high costs are the most frequently cited barriers. Across the two PPP models, principal drivers and barriers are similarly perceived, although you see that (public) funding instead of affordability is the key driver of success for PPP B delivery models.

5.2. Output Indicator Assessment

The five principal output indicators which describe well the different characteristics of physical electricity produced have been tested against all 20 shortlisted articles. Each chosen relevancy score depends on how often each indicator has been regarded as relevant. For PPP A, as 8 articles are considered, the scale is from 1–8, for PPP B from 1–7 and, naturally, for all 20 articles it is 1–20. The assessment produces significant clarity regarding quality, as it has been found as very relevant in all reviewed articles. Speed, sustainability and equity are perceived as having minor relevance (Table 3).

5.3. Testing New Political Economy Criteria

Based on our proposed list of Political Economy criterions each shortlisted article has been assessed. The relevance of each criterion for the effective dissemination of solar home systems have been tested using a systematic binary "relevant" or "not relevant" approach. Table 5 adds up the total score of "relevant" for each criterion.

Overall, criterions that foster local engagement and awareness rank as most relevant. The criterions "awareness building" as well as "community engagement" are first as both criterions scored relevant in 16 out of the 20 reviewed articles. "Capacity building" and "institutional set-up" rank second. Looking at the lower ranks of the table, criterions which require stronger political and executive involvement (regulation, compliance, political will) are all rated as not as relevant.

Once more, comparing criterions across the two different delivery models, differences between results are minimal.

5.4. Discussion

5.4.1. Key Findings

Our results produce insights for improved policy guidelines for effective solar home system provision in Tanzania.

First, our empirical analysis confirms that the most popular delivery models for SHSs are mixed. Public–private partnerships represent 75% of all identified delivery models. The case of Tanzania proves that delivery models for solar home systems cannot be seen through a pure binary lens of public or private approach.

Second, the first two steps of our assessment paints a picture which factors are most relevant for SHS distribution. In line with previous research, the driver-barrier assessment indicates that service, affordability, and local distribution models are key drivers, while high costs, technical issues and negative perception are critical barriers. Measuring the output of across all 20 analyzed projects, speed, sustainability, and equity are not the principal objectives when driving forward solar home systems in Tanzania. Rather, cost and quality are in the center of attention.

Third, both empirical assessments produce striking results regarding weight or relevance of "softer" socio-political factors. Speed, equity and sustainability are explicitly less relevant than cost and quality. From the driver-barrier perspective political support, public and institutional frameworks as well as trust play only secondary roles. Although "negative perception", ranked as principal barrier among all reviewed projects, is an exception.

Step 3, the application of our political economy framework, has just focused on socio-political factors. Local community mobilization is the most relevant concept when looking through the socio-political lens. Pro-active and more direct (political and institutional) interventions are rather of secondary importance.

These results do not indicate clear evaluation how effective SHS in Tanzania are or how much they need improvement. Neither have they specifically defined how the perception of electricity has changed due to new SHSs approaches.

Nevertheless, our political economy assessment gives guidance for which socio-political factors should be most relevant in the moment you want to improve SHS distribution—not from the techno-economic, but from the socio-political perspective, e.g., to design and make policies which specifically consider the political, institutional, and local context.

5.4.2. In-Depth Discussion: Institutional Barriers in Tanzania

Our findings that institutional set-up, availability of financing and political will and stability are relevant correlate with results from other literature. The lack of institutional coordination, planning capacity, and sufficient staff are perceived as important barriers, particularly in Tanzania, where TANESCO has failed to use large amounts of funding available to it [43]. These political factors can form a high barrier depending upon ministerial and departmental decisions about extension [1]. Ghanadan [54] also noted the existence of "white elephant" projects in colonial Tanzania where diesel and hydro facilities were distributed and allocated along colonial administrative priorities. In this sense, the political actors influence the utilities to undertake large-scale development projects that that provide targeted economic benefits to their constituencies "even when the aggregate economic benefits of such projects such as increased output or service quality do not cover the economic (opportunity) costs borne by the broader polity" [14].

5.4.3. In-Depth Discussion: Mixed Delivery Models

The overwhelming majority of our delivery models are public–private partnership based. Informed by our findings, several pilots exist to mix institutional arrangements, which creates new opportunities. Hybrid options may have the ability to complement the strengths and shortcomings of a pure private or public approach [103]. These hybrid options may materialize as concession agreements regions, private-public partnerships, or the "standard model" unbundling of distribution, generation, and transmission, and certainly have technology and ramifications on electrification, too.

Bhattacharyya and Palit [103] used the experience of a five-year project in South Asia to recommend ten policies to promote mini-grids as complementary to grid extension. Their recommendations (in order of preference) are: one size does not fit all, a robust governance structure is a prerequisite, clear rules of the game are essential, strategic and locally adapted support to off-grid electrification is key, an enabling policy environment is essential, capacity development is urgently required, link carefully with rural development activities, eco-system of off-grid electrification solutions, clustering and bundling of initiatives help scale up, organized delivery for scaling-up and replication.

The first official steps in Tanzania have been taken by EWURA—the national regulator—to implement an enabling regulatory environment that facilitates local and foreign private investment in mini-grids (100 kW–10 MW) for complementary energy access [52] and therefore has about 110 mini-grids throughout the country. However, this program still needs more development to be effective; however, such hybrid options require clarity surrounding authority, accountability, and standards. An actor must be chosen to initiate or plan efforts and be accountable for system adequacy and long-term planning. The need for standards ranges from standards for pricing and tariffs, quality, service capabilities, to interconnection rules for all participants.

5.4.4. In-Depth Discussion: Quality and Cost

Our study confirms high relevance of quality and cost. Traditionally, the role of the utility has been to provide a reliable supply of electricity to consumers [37]. Especially in a public scenario, in order for the state to benefit its constituencies through the provision of electricity, the electricity needs to be reliable. Ideally, the quality of electricity (measured by reliability) would be universal and good, however in reality, there is extremely poor and geographically varying reliability throughout the developing world. Tanzania's electricity, via TANESCO, has a ranking of 4 out of 8 on the World Bank Doing Business Survey Reliability of supply and transparency of tariff index. For reference, the US grid has an index of 8 and Sub-Saharan Africa as a region has an index of 0.9. However, these values are based on self-reported data from the dominant utility in the area. The self-reported data can be highly suspect and often varies orders of magnitude from survey results. In practice there are trade-offs between connecting more individuals, providing more reliable service, and cost when planning time and capital for infrastructure is limited. Quality can also be measured through capacity (the size of appliances connectable to a system). Normal products ordered by increasing capacity requirements include lighting, phone charging, televisions, hair trimmers, irons (surprisingly a very common and demanded appliance in sub-Saharan Africa), and refrigerators. Grid infrastructure allows for easy scaling of power consumption of households, whereas off-grid systems are generally optimized to have a lower capacity available and do not scale easily. Capacity is perhaps the most common factor for critics of off-grid systems to note in their support of the grid [3].

In terms of power capacity, pico-lighting-services and solar-home-systems have limited services available. While pico-lighting only provides for lighting services (indicated by their name); solar-home-systems can provide lighting plus television, fans, communication, and limited motive and heat power. Micro-grids can effectively have the same services available as the grid [1]. Although quality (capacity and reliability) has been a focal point for critics of solar-home-systems for the provision of electricity, research expanded upon in Section 2 suggests that solar-home-systems provide electricity that is as or more reliable than the local grid in Tanzania. However, both capacity and reliability in a private market are highly dependent upon the cost of the energy system. For some households, a low-reliability lighting system is their only affordable option but is still a step up the "energy ladder" from using kerosene. With higher ability to pay, the systems become more complex and can offer a higher capacity and reliability.

5.4.5. In-Depth Discussion: Speed

As our study reveals, there is a low relevance of speed for the rollout of solar home systems in Tanzania, and this criterion must be seen in context. First, the majority of SHS projects are early stage or even pilot projects. Naturally, speed ranks lower in the priorities of such test set-ups. Furthermore, one of the prevailing ramifications of the traditional utility model of electrification projects is the timing of connections. Because the sector is accustomed to planning on a 30–40-year time horizon [37], the time to connection for much of the unelectrified population can be decades. Even in cases where there are nearby substations or wires overhead (dubbed "under-the-grid"), the connection of individual households is limited by their ability to access the capital necessary for the connection fee or government subsidy policy for last-mile-connections. If a household readily has access to capital for the connection fee and there is existing nearby infrastructure to connect to, the median duration that TANESCO needs to complete a connection procedure with minimum follow-up and no extra payments is 109 days. Therefore, a dominant advantage of a private market provision of electricity is the speed at which a new connection can be made. With smaller and more off-grid systems provided in a private market, new connections can be made in the order of days especially in the case of solar-home-systems in East Africa and India. A report by Practical Action [104] found that in all studied communities in Kenya, decentralized and off-grid solutions (here only provided in a market) were either "the least-cost option to meet electricity needs the fastest by many years, or both." Their studies in Bangladesh revealed that in three out of four communities, decentralized solutions were the least-cost option, faster, or both.

5.4.6. In-Depth Discussion: Equality and Sustainability

Market-based solutions can provide lower cost systems in a shorter amount of time and thereby expand electricity to many more households, but households only get what they can afford (both in quality and in capacity). There is little equity in the energy access, which can exacerbate existing inequalities. Currently, the price of energy for the rural poor can be as much as 8–10 times as much as for urban customers or other income groups [3,29]. When spatially differentiated electricity pricing is incorporated into the market dynamics for access, this disparate pricing could get worse for those least able to pay. A solar technology distribution approach based on the private market alone is unlikely to reach the broader population in remote poor areas [35]. Those that have more power (and money) get better services [29]. Privatization creates multi-tiered systems with vastly different degrees of quality that serve to 'contain' people in poverty, limiting expectations and restricting access to this important resource [105]. In the words of David A. McDonald in his book Electric Capitalism, "levels of inequality are particularly pronounced (in Africa) due to the inherent unevenness of 'electric capitalism' on the continent" [105].

Another prevailing factor for support of public grid architecture is that the grid can be "a great equalizer". When the entire population is subject to the same rate structures, the same reliability, and the same capacity, there can be a more equitable provision of electricity, which creates a more level playing field for progress throughout communities. However, the existing provision of connection and quality varies enormously. In Tanzania, while thirty percent of the national population is connected to electricity, this number falls to less than eleven percent in rural areas, which make up most of the country. In cities such as Dar es Salaam, the electrification rate can be as high as ninety percent. Even within peri-urban areas such as Arusha, the reliability of electricity (and maintenance of the infrastructure) varies orders of magnitude between industrial areas, low-income residential areas, and high-income residential areas [106].

6. Conclusions

This research fills a gap in the existing literature on rural electrification in sub-Saharan Africa and the influence of different institutional arrangements on both the political economy landscape and the physical ramifications of the electricity provided. We claim that new markets for consumer products for lighting and charging are a fundamentally different form of market liberalization that is not occurring because of intentional intervention by policy reformers, but where many different actors are inadvertently re-defining energy access. Different mission statements, actors, financing, technology choices, and processes of new connections between public and private scenarios result in different timing, quality, cost, and equity of electricity access.

This work shows how energy transformations are uneven social and spatial processes, in which people and places unevenly experience costs and benefits of energy extraction, generation, financing, distribution, and consumption, especially in a market-based framework. The opening of markets in energy has made access to electricity a commodity good instead of a public service or essential infrastructure, thereby creating the conditions for which most rural Tanzanians would be underserved. Today, as the number of technology and programmatic choices increase, decision makers—from multilateral institutions, to governments, to private investors, to utilities of the future, to individual households—will need to have critical and accurate ways of comparing their options. In the case of a market-based solution, consumers will also need to be informed about all aspects of the electricity they are paying for such as timing, quantity, quality, convenience, cost, legality, human and environmental health, safety, and reliability.

As stated, the electricity sector is not, and will never solely be a state or market situation. It must be seen as a continuum of public and private mixes on both the ownership and technology levels. By detailing the strengths and weaknesses of either end of the continuum, we can assist policy-maker decisions in creating intentional mixes of public and private electrification strategies and the impact that would have on the electricity realized by the rural households. By crossing disciplines and peering in at our own from a new light, we find that distributed energy does not necessarily have distributive effects, centralization and decentralization can occur on many intersecting levels in energy systems, the ways in which an efficient market can assist or limit the efficiency of energy access, and finally, that power systems are shaped by power structures in which they are placed. The technology is available for many pathways; therefore, it is the political economy that will shape the implementation and ramifications of electrification policies and projects.

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