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Enabling equitable energy access for Mozambique? Heterogeneous energy infrastructures in Maputo's growing urban periphery

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ABSTRACT

This article concerns the relationship between uneven peri-urban growth and heterogeneous energy infrastructures in Metropolitan Maputo, Mozambique. Much research has documented how the diversity and overlap of different energy configurations define energy access in African cities. However, very little attention has been given to how urban growth dynamics shape heterogeneity and vice versa. A growing concern in African cities is highly uneven growth patterns, the rise of middle classes, and the selective forms of infrastructural connectivity linked to such spatial dynamics. However, urban growth is often approached through distinct settlements such as gated or enclave communities. The growth dynamics of energy access in more typical peri-urban neighbourhoods with mixed socio-economic characteristics remains an underexplored theme. Therefore, the critical question of this article is whether heterogeneous energy infrastructures contribute to uneven peri-urban development patterns, or does heterogeneity offer a more pragmatic solution to energy access in such spaces? This question is explored in three mixed-dynamics peri-urban neighbourhoods in Maputo. We find that infrastructural heterogeneity results from the increasingly commercial electrification procedures that privilege urban density and from private solar-home-system providers who privilege higher paying customers. Both phenomena respond to, and subsequently reinforce, divergent underlying social conditions and the divergent demand for energy services. However, we also find that heterogeneous energy configurations embody the considerable capacities and pragmatism of local communities. While we conclude that infrastructural heterogeneity contributes to uneven urban growth, we also suggest that policy-makers work more closely with local actors to distribute the benefits of energy access more equitably.

1. Introduction

“If there is no energy people *phandar*, as they say in popular slang, someone buys a pole and wire, but there is still no energy from the network”. This is a quote from one of Maputo's peri-urban residents. ‘Phandar’ is a Changana word, a language spoken in Southern Mozambique. Its meaning is not precise in English but can formally mean “getting by” but less formally refers to the “hustle and bustle” of surviving in a big city [1]. Interestingly, *Phandar's* meaning is concretised here as relating to a specific set of strategies and processes surrounding energy infrastructures. The first is for residents to start building the electricity network themselves. This is a ubiquitous phenomenon accepted and encouraged by the electric utility but not consistently successful. The second is to mobilise collectively, protest, lobby key institutions, form groups, and enact orchestrated displays of compliance or defiance with dominant electrification procedures. The third is to use illicit means such as extending wiring from a neighbour's plot. The last strategy is closer to the literal translation of *phandar*, which is to navigate heterogeneous means of energy access.

Phandar encompasses the increasingly complex dynamics of energy access, electrification, and peri-urbanism in African cities. Peri-urban growth is an increasingly common feature of cities in sub-Saharan Africa (SSA) [2]. Rising demand, increasing wealth levels, more accessible land, and gentrification of urban centres are factors fuelling growth. Such expansion is mainly occurring through residential zones, and as such, some argue African cities are increasingly suburban [3]. This is not a ubiquitous or simple phenomenon, however. According to Buire this ‘last decade of accelerated urbanisation in Africa has led to an unprecedented variety of urban forms that reach beyond and reconfigure […] centre-periphery dualities’ [4]. Seemingly, earlier concern with the ‘rapidly growing and unregulated peri-urban areas of cities’ [5] and ‘urban sprawl’ [6] is being superseded by concern with urban growth

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corridors, satellite cities, 'megacities', metropolitan regions that layer new socio-spatial dynamics on top of old ones.

Despite increased academic interest, according to Buire, 'suburbs in Africa have not been problematised as a meaningful field of investigation' [4]. The thematic focus of peri-urban research has been on topics such as land transactions [7], land conflicts [8], food security, 'suburbanism' and peri-urban identities/aesthetics [9,10]. Peri-urban areas are considered 'transitional zones where urban and rural features interact' [8], drawing attention to the conflicts (or potential synergies) between rural and urban features or inhabitants. Conversely, the significance of peri-urban areas as a distinct space of *infrastructural transformation* (i.e., energy), particularly in the Global South, is underexplored. Overarching reviews have suggested that 'suburban' infrastructures are fragmented through highly selective forms of innovation which 'make suburbs fertile spawning grounds for new infrastructure solutions' [11]. Some argue peri-urban areas have a high potential for increased connectivity due to the density of populations and proximity to transmission lines. [12].

In studies of urban infrastructures in cities of the Global South, however, there is an increasing concern with the relation between 'heterogeneous urban environments' [13] and the observed diversity and overlaps of socio-technical infrastructure configurations such as non-networked technologies [10]. Some see heterogeneity as embodying cross-cutting principles of energy access and urban manoeuvring [14,15]. However, others are cautious about legitimising asymmetrical forms of infrastructure delivery [2,16]. Arguably, peri-urban spaces amplify the importance of this tension [17]. Most developments in peri-urban settlements in SSA are 'self-constructed, often on a plot-by-plot basis' [2], in contexts of significant social differences between newer immigrants and in-situ populations [18] and, in contexts such as Mozambique, complex land access arrangements [19]. Moreover, many infrastructures are organised by individuals or actors outside of public institutions and beyond municipal/national networks [17,20]. Generally, it remains unclear what role the inherent heterogeneity of energy infrastructures plays in encouraging/constraining peri-urban growth, addressing energy needs, or leading to uneven spatial developments in such spaces.

Therefore, this paper is concerned with an expanded view of uneven urban development in African cities, observed through the relation between peri-urban growth patterns and heterogeneous energy infrastructures. Focusing on infrastructural heterogeneity and electrification, we aim to elucidate the wider relations between energy interventions and peri-urban development patterns. We focus empirically on three peri-urban neighbourhoods at the 'edge' of the formal electricity network in Maputo. Three questions guide our approach: To what extent do energy infrastructures contribute to uneven peri-urban growth? Secondly, how do key energy actors and interventions contribute to the heterogeneity of available energy configurations? Finally, what are the 'conditions of coexistence' [13], or protentional for coevolution, between heterogeneous energy infrastructure configuration in peri-urban spaces (i.e. can overlapping energy configurations address equitable energy access)?

2. Literature review

2.1. Peri-urban growth in African cities and the role of energy infrastructures

Recently, there has been a resurgence of scholarly interest in peri-urban spaces and growth [2]. The traditional research neglect of peri-urban spaces resulted from the dominant view of such areas as 'transitional' and ambiguously situated vis-à-vis governance responsibilities [2]. The renewed interest, particularly in SSA, has partly arisen due to the rapid changes in such regions and the sharp juxtapositions emerging between different social classes [6]. Part of this interest concerns the uneven levels of infrastructure access, including energy [18,21,22]. Some argue that in African cities energy supply is 'collapsing under the weight of rapid development' [22] suggesting urban growth is outpacing the capabilities of municipal networks to provide services, increasingly necessitating alternative socio-technical solutions such as solar systems (solar PV, solar water heaters), hybridised on/off grid systems, and multiple fuel use. More generally, according to Bloch it is in 'Africa's new suburbs', where 'new spatial forms are emerging: the new suburbs […] are increasingly connected to the global economy, and even wider and larger city corridors or city clusters' [6]. However, despite such interest, some contend that research in peri-urban contexts in SSA has not problematised prevailing notions of the 'peri'- or 'sub'-urban [4], understandings derived mainly from Western experiences.

One unmistakable feature of literature on peri-urban spaces is the plethora of concepts and terminology [23]. In part, this speaks to the different settlement types encountered, such as gated communities, townships, suburbs, condominiums, low-income communities, satellite cities [6,24]. Conversely, different concepts represent divergent perspectives on how and why to approach such spaces. Debates have centred on the assumed global universality of 'suburbanisation' patterns [2,11], where suburbanisation is considered a combination of increases in non-central residential populations and economic activity and an 'intensification of urban features' [2]. Critique has been levelled at how African urban developments have been considered a 'sub-form' of suburbanisation experiences predominantly from North America and Europe [2]. Mercier [3] has instead used the term 'postcolonial suburb' in Dar es Salaam, which she argues decentres notions of the 'established frames of the Anglo-American suburb' [3]. In her view, a distinctive feature of African peri-urban growth is the incremental, self-built character and orientation *both* to the urban and rural through social-cultural ties and utilisation of 'traditional' land tenure systems. This resonates with Bartels et al. [2], who use the term 'peri-urbanisation' to denote 'self-built settlements developed plot-by-plot' which are characterised by 'a mixture of urban and rural land uses' [2]. In Maputo, the unique institutional arrangements surrounding land access in the post-socialist era have acted as a constraint on growth patterns, allowing broader social groups to access land [19].

Notions of 'periphery' and 'edge' have been forwarded surrounding what Mabin et al. observe as a 'growing number of centralities' [23] in African cities. According to Bloch, 'this process has started, again in the last decade or so, to create a truly polycentric urban form with multiple functional cores' [17]. While some have focused on new centralities as sites of high (inter)national interest and selective large-scale investments (often in infrastructures) connecting 'nodes' to global capital flows [24], others have focused on new centralities as sites of cultural production [9]. Thus, tension is evident between peri-urban spaces as autonomous sites of cultural or economic production and highly segregated forms of urban development (including infrastructures). One nuance concerns the 'politics of scale' [24]. The polycentricity of peri-urban spaces often results from a disjuncture in scales and types of investments between 'strategic' and 'everyday' spaces. Therefore, some argue that 'edge' spaces are a 'paradoxical mix of exclusion and opportunity' [25]. Bartels et al. [2] argue that while the 'suburb' has a concrete meaning as 'an urban residential zone', experience in SSA cities is often instead of overlapping rural/urban land uses and infill developments, creating '(sub)urban pockets' [2]. We thus find it useful to adopt a working definition of 'peri-urban' similar to Bartels et al. [2] as a 'dynamic, transitional area with a mix of urban and rural features located at the geographical fringe of cities'.

Many studies in such spaces reference (energy) infrastructures. However, infrastructure is not always an explicit focus of such research. Instead, infrastructures are often assumed to contribute to broader spatial development processes/patterns (e.g., corridor or enclave formation, new urban aesthetics, uncontrolled urban growth) or considered their result. Some highlight the highly selective state rollout of infrastructures, particularly roads [17], through growth corridors [3,19,22], through incentives in construction [22], bridges and ports

[19]. Others highlight how enclaves/gated communities develop through segregated infrastructure systems that bypass surrounding areas [18]. Concerning water, in Maputo peri-urban growth has partly been enabled by ‘both self-financed and formally delegated small-scale service providers’ [20]. Thus, this diversity of spatial form and different infrastructures makes generalisation difficult. The role of energy infrastructures in peri-urban growth dynamics is generally underexplored compared to other infrastructures such as road and water. Generally, researchers seem to converge on the notion that infrastructures in peri-urban spaces are characterised by fragmentation due to the ‘juxtaposition of oversupply and undersupply’ [11].

2.2. Interventions in peri-urban energy infrastructures

One common concern is the increasingly complex social dynamics in such spaces and the equally complex interventions of residents, communities, and service providers in energy infrastructures [26]. Although a contested notion, much attention has been placed on role of the rising ‘middle-class’ in African urban developments [3,6,17]. According to Melo and Jenkins [17], ‘the growth of the middle class has inevitably been introducing new urban dynamics in both policymaking and the praxis of planning’. In Maputo, spatial expansion has been substantiated through new housing developments (with distinct infrastructure systems) either explicitly constructed for the middle (or upper) classes or ‘captured’ by them [10,17]. While such phenomenon is explained through broad settlement types, reflection is needed on the efficacy of concepts and processes presumed to have global universality [2].

Some actors intervene in peri-urban spaces through resource exploitation as a means to create economic opportunities through infrastructure development [27], such as groundwater extraction. Research on water in India highlights the importance of how (often nefarious) land acquisition by newer immigrants leads to asymmetrical forms of infrastructure access [28]. In Accra, pressure on forests surrounding cities has contributed to the transition to more diversified energy sources/infrastructures [29]. Others argue that access to resources (both within peri-urban spaces and from the flow of resources from urban and rural areas) creates livelihood opportunities and leads to innovations among peri-urban populations [26]. Energy researchers have found non-uniform levels of energy access *within* peri-urban spaces, related not necessarily to distance from urban centres as conventionally thought, but instead socio-economic status and the political influence of local communities [21]. Kanai & Schindler [24] argue more broadly that the strategic importance of infrastructures in peri-urban areas has led to selective investments and interventions, and therefore selective connectivity, whereby ‘bypassed territories and sites’ low connectivity levels are peripheralized [19]. Such patterns underscore a concern with the ‘growing gap between everyday and large infrastructural planning that underpins peri-urbanising processes’ [17].

Furthermore, peri-urban growth is enabled in many contexts through infrastructure provision outside of public institutions or municipal networks such as standalone solar systems, generators, and mini-grids. Questions surround whether such forms of infrastructure delivery are ‘collective’ or ‘commercial’ [30]. Nevertheless, a common feature is the increasing diversity of actors in infrastructure delivery, including NGOs, private companies/developers, communities, and individuals [15]. Recently, debates have examined the ‘heterogeneity’ of infrastructure systems in Global South cities [13–15,31]. Researchers highlight the increasing importance of the diversity/overlap of energy provision channels, the hybridisation of networked models of infrastructure access, and the incremental quality of many infrastructural interventions [32].

2.3. The evolution of heterogeneous energy configurations in peri-urban spaces

One focus of research on infrastructural heterogeneity has been to examine the relation between (intra-)urban ‘conditions’ and socio-technical ‘configurations’ [12]. For Jaglin, referring mostly to electricity, infrastructural diversity is ‘mutually constitutive’ with ‘heterogeneous urban environments’ [12], that is, the underlying diversity of socio-spatial conditions. This focus encourages close consideration of the socio-spatial contingency of infrastructural heterogeneity. Infrastructural diversity has been viewed with caution and even criticism. For some, such diversity risks legitimising ‘intra-urban inequalities with a risk of locking deprived communities in substandard supply systems dissociated from premium networked areas’ [16]. A related concern is whether autonomous infrastructural solutions represent ‘ingenuity’ by inhabitants or a response to precarity [26,33]. In Mozambique, some argue that the tendency to conceive of distinct energy ‘configurations’ underplays how residents navigate and produce diversity to manage changing political, and socio-material conditions [14]. One limitation is research contributing to these debates has largely focused on low-income settlements, leaving the energy dynamics in peri-urban spaces (particularly those with mixed social characteristics) largely unexplored.

Concerning energy access debates, international donors and national policies in Africa have almost exclusively focused on ‘distinct’, spatially explicit, technological or energy source-based approaches [14,21]. For urban areas, energy access is seen as extending grid-level electricity access and access to ‘clean fuels’. For rural areas, energy access is often approached through decentralised technological solutions (such as solar-home systems, mini-grids etc.) [34]. This distinction, which largely disregards peri-urban areas, is often mirrored in national institutional arrangements. In Mozambique, urban energy access is largely governed by Electricidade de Moçambique (EDM), the national electricity utility. In contrast, rural energy access is the mandate of Fundo de Energia (FUNAE), a public body under the tutelage of the Ministry of Mineral Resources and Energy (MIRME). Some argue that these ‘highly uneven governmental logics’ have resulted in ‘fragmented and diverse forms of energy access’ [34]. Moreover, such divisions have led to blind spots concerning peri-urban residents where ‘many peri-urban residents lack grid access and fall outside FUNAE's state subsidized rural energy initiatives’ [35]. Moreover, energy actors often struggle to define ‘peri-urban’ [21].

Peri-urban energy access, therefore, poses severe practical and conceptual challenges in cities such as Maputo, and its relation to urban growth remains poorly understood. One key concern is that raised by Jaglin to understand the ‘conditions of coexistence between all service delivery channels and to regulate their interactions, the possible scenarios being juxtaposition, integration or coordination’ [13]. This encourages further sub-questions; how can heightened private-provision of infrastructures in peri-urban areas be regulated or coordinated? Are diverse energy provision channels ‘transitional’ or long-term sustainable solutions to infrastructure access? Are different energy infrastructure configurations reflective of, or do they reinforce, growing social differentiations? These questions suggest a need for better understanding and tools to approach infrastructural heterogeneity in peri-urban spaces and their relation to uneven growth. Therefore, this paper concerns the ‘conditions of coexistence’ between diverse energy infrastructures in peri-urban Maputo. Focus on heterogeneity encourages pragmatism surrounding energy access in areas not served by formal networks or public institutions. Few accounts document how overlapping state and non-state actors intervene in energy infrastructures in mixed-dynamics peri-urban spaces and the socio-spatial dynamics of peri-urban communities.

3. Methods

We chose three neighbourhood case studies to address these questions and to capture the diversity of peri-urban growth and energy access patterns across Maputo - *Chalí*, *Maracuene*, and *Zilinga*. Each neighbourhood was selected through discussions with local research collaborators and a preliminary literature review based on the following criteria: (a) neighbourhoods known not to be covered (in part) by the electricity network or where the electricity network ended, (b) neighbourhoods on the periphery of Metropolitan Maputo, and (c) neighbourhoods with mixed (and transitioning) land use dynamics and social characteristics. We aimed not to be constrained by administrative boundaries (Fig. 1). This approach intended to capture divergent land-use dynamics, energy access patterns, and the relation between the two. Specifically, we aimed to (a) map and understand the limits of the existing electricity network (with other energy infrastructures), (b) document the land-use dynamics and energy access patterns within and beyond the grid limits, and (c) to understand the key energy interventions made by key actors across the neighbourhoods.

We took a three-step methodology in each neighbourhood. Firstly, we interviewed the *secretário do bairro* (neighbourhood secretary), the lowest official government representative. Neighbourhood secretaries typically have a broad overview of social and land-use dynamics within their neighbourhoods. Moreover, *secretários* are often important figures concerning energy access, serving as an interface between residents and energy providers (i.e., EDM). Secondly, we conducted a transect walk with the secretary through the respective neighbourhoods, to map the 'edge' of the electricity network, energy use and access practices, and broader land-use dynamics. In the final step, we conducted 15 semi-structured interviews (5 in each neighbourhood). We deployed a purposive sampling approach targeted at both residents who (a) had recently become connected the grid (typically in the last 2–3 years) or (b) lived just outside the range of the grid. The number of interviews was chosen to illicit longer-form, in-depth responses on the experiences of energy access and interventions. Insights concerning broader spatial patterns were substantiated through the methods above and desk-based methods where possible. Neighbourhood interviews and transect walks were conducted in Portuguese by a research assistant. A second complementary aspect (in addition to the three steps above) was to capture the institutional perspectives, interventions, and practices concerning peri-urban energy access. This was done through 6 key-informant interviews with EDM staff working in the electrification, distribution, and social access departments. Additionally, insights were generated from a 'communities of practice' meeting held with key municipal and energy governance actors in July 2019.

4. Results

4.1. Metropolitan Maputo: peri-urban spaces and energy use

The population of Metropolitan Maputo (including the municipalities of Maputo, Matola and districts of Boane, and Marracuene) was 2.54 million in 2017 (AMT 2017). This increased from 1.95 million in 2007 [36]. In Maputo City alone, the population declined by 40,000 inhabitants from 2007 to 2017. This is a pattern of urban growth, predominantly in surrounding rural areas and inner-city decline, supported by the declining availability of land plots in Maputo city [18] and migration to peri-urban areas among residents of central Maputo [37]. Andersen et al. [36] suggest urban expansion in Maputo has been into 'proto-urban' areas outside municipal administrative boundaries yet connected to the city. While Andersen et al. [32] find such growth has occurred beyond official plans, recent selective planning interventions, such as 'mass land regularisation' programs and public-private interventions such as condominium housing developments, have taken hold [18,37].

However, growth has chiefly been through 'residents' homemaking practices, making home spaces the unit of urban organisation [38]. The reference to 'home spaces', alluding to a significant cross-sectional study of Maputo [39], underlines the central role of citizens and private actors in housing and infrastructure provision. More recently, Melo and Jenkins argue that 'the government […] has become openly proactive in state land planning and demarcation directed at an emerging middle class' [18]. There are important relations with infrastructures as 'areas allocated to upper- and middle-class groups are mostly located along major roads […] where such urban development has more probability of market success' [18]. Melo and Jenkins detail statistics showing that infrastructure access (including electricity) has increased much faster in outlying districts of Metropolitan Maputo than in Maputo City. Despite accounts suggesting residents are attracted to such peri-urban developments by better-quality infrastructures [36], research has also found that the quality of electricity supply is actually lower in peripheral areas [40].

Such studies give an overall impression of city-level urban-energy dynamics. However, no studies explicitly focus on energy infrastructures in peri-urban areas. One reason is that the 'peri' has shifted rapidly, as has the electricity grid. Following independence, networked electricity supplied only the 'colonial' city [41]. The most significant transformations were experienced from 2005 to 2015 when network connectivity significantly increased in Maputo city and, to a lesser extent, Matola [41,42]. Researchers have explained this through the introduction of prepayment meters and the agency of citizens who intervened and lobbied for higher connectivity [38,41]. Following this period, concern was on the highly uneven electricity access rates between urban and rural areas [34,43]. Generally, due to the high cost and increasing unreliability of electricity, there is a complex layering of energy sources and configurations [14]. For example, although transitions have occurred among wealthier groups to gas and electricity, the same groups continue to use charcoal and wood simultaneously [44].

To better understand energy use patterns in peri-urban areas, we analyzed 2017 national census data concerning energy use in Maputo Province (Fig. 2). The analysis shows two critical dynamics: very high and high networked electricity access in Maputo and Matola and mixed electricity connectivity rates in districts incorporated into Metropolitan Maputo (60% and 66% in Boane and Marracuene, respectively). The district-level figures conceal considerable variations in electricity use within districts at a neighbourhood level (cf. following sections). Boane and Marracuene are two districts where attention has been placed on middle- and upper-class enclave formation. However, our analysis suggests alternative energy sources such as solar, petroleum, and candles are a significant part of the energy mix.

4.2. Energy infrastructures and urban growth in the three neighbourhoods

The following sections analyse the three neighbourhoods in-depth concerning growth patterns, socio-economic characteristics, energy infrastructures and use, and the relation between electrification and urban development. As Table 1 shows, each neighbourhood is growing rapidly, yet levels of energy access vary.

4.2.1. Bairro de Chalí: Katembe

Chalí, in the Maputo district of Katembe, south of the Umbuluzi river, was historically poorly accessible due to sporadic ferry services despite its proximity to central Maputo. This changed in 2018 following a major new bridge opening, following a (US)$1 billion investment by the *China Road and Bridge Corporation* and *Chinese Exim Bank*. This bridge is part of an ambitious land-use plan for the area. Katembe is the only district in Maputo (city) where the Municipal Assembly has recently approved an official land use plan[1] [46]. This plan aims to create a new urban centre called 'Nova KaTembe', which one planning document describes as 'A city for the Future' [47]. The plan aims to construct 'more than 2,000 housing units intended primarily for the growing middle-class, as well as several official buildings and public plazas, including a "Heroes' Square" (Praca dos Heroes) designed by Chinese architects' [48]. To date, little

[1] Many more 'structure plans' and land use plans have been implemented in Matola and neighbouring districts/municipalities speaking to the expansion of Maputo [18].

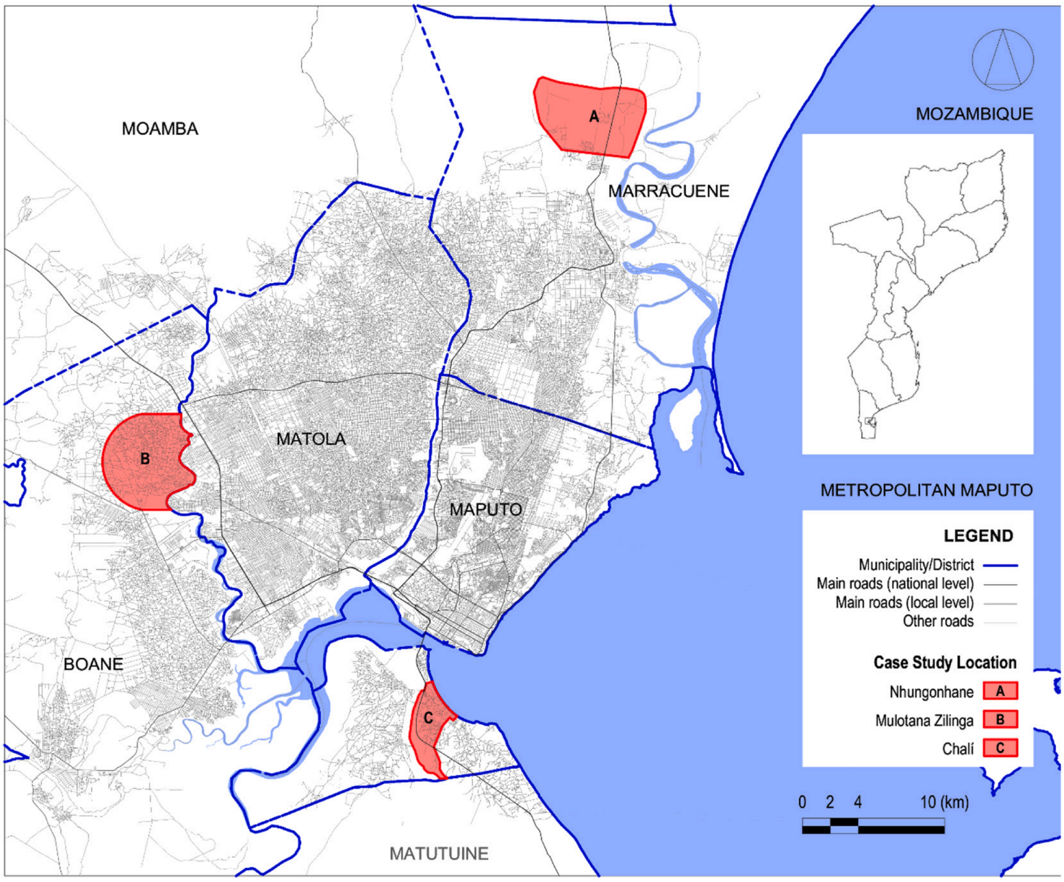

Fig. 1. Map of Metropolitan Maputo showing the proximal location of the three case study sites. Source, Author based on data from OpenStreetMap. https://www.openstreetmap.org/.

of this plan has materialised into practice, although research suggests 360 households have been resettled [49]. Despite such ambitious land use plans, the neighbourhood secretary described how currently the 'basis of survival is agriculture, family farming also has some associations, fishing and trade' (Interview 22).

However, land use may be changing not necessarily due to the above plans or speculation surrounding them, but rather due to more general processes of population increase [50]. Earlier population increases were predominantly due to rural-urban migration and 'spontaneous land occupation' [51]. In interviews, the secretary and residents indicated that this pattern had shifted to immigration of wealthier groups from central Maputo. The secretary stated that "day after day we see that the land is being occupied," adding that "the population of my neighbourhood tends to develop, now we hardly find families living in precarious homes [...] the Katembe from yesterday is no longer" (Interview 22). Additionally, anticipation of the bridge to provide better road access to central Maputo has fuelled interest from public and private land developers.

Such growth has ironically provided a challenge for official plans. Conflict has arisen between EDM and planning agencies concerning electricity provision [49]. Clauses in plans allowed for private electricity (and water) provision in the area [49]. Not only does this conflict with EDM's role as a monopoly provider in urban areas, but practically, the electricity network has already been installed in much of the areas earmarked for the plans. During the transect walk, we identified that the formal electricity grid ended predominantly along the arterial road (Fig. 3). Thus, the grid extends uniformly outwards from the centre. In line with other findings (cf. following sections), local leaders and residents reported that connectivity depended on 'urban density'. Unconnected areas were essentially less densely built-up and populated than those connected. Interestingly, we observed similar housing developments on both sides of the grid limits, predominantly large, 2-story houses built with permanent materials, surrounded by concrete walls. Among residents building beyond the grid, there was an expectation of future electricity connectivity. One common issue reported by the secretary and connected residents was the poor quality of electricity supply (frequent blackouts and surges), said to result from a lack of transformers.

4.2.2. Bairro da Mulotana Zilinga: Boane

Speaking to the rapid expansion of Metropolitan Maputo, Zilinga is technically in the *localidade* of Mulotana, within the *district* of Boane, 21 km Northwest of Maputo. Zilinga is a mixed lower and middle-income neighbourhood. Much like *Chalí*, this neighbourhood is transforming rapidly. However, such transformations are more recent and fuelled less by speculation. As the secretary emphasised, "We are increasingly receiving new families, and we still have many works under construction [...] day after day we are welcoming new families". The district's population has more than doubled in 10 years (Table 1).

The secretary revealed two contrasting land-use dynamics in the area. The first is original small and medium-scale (low-density) farmers who are long-term inhabitants. The second is the increasing influx of new families, predominantly those who construct better quality housing in higher density. This has important implications for energy infrastructures. As shown in Table 1, only 14% of households use public-network electricity for lighting, with a higher percentage using solar systems (19%). Like *Chalí*, residents and the secretary detailed how 'density' was the most important criteria for public-network electricity connectivity. The secretary lamented how "these people [long-term inhabitants] were not covered due to the lack of many houses, because of

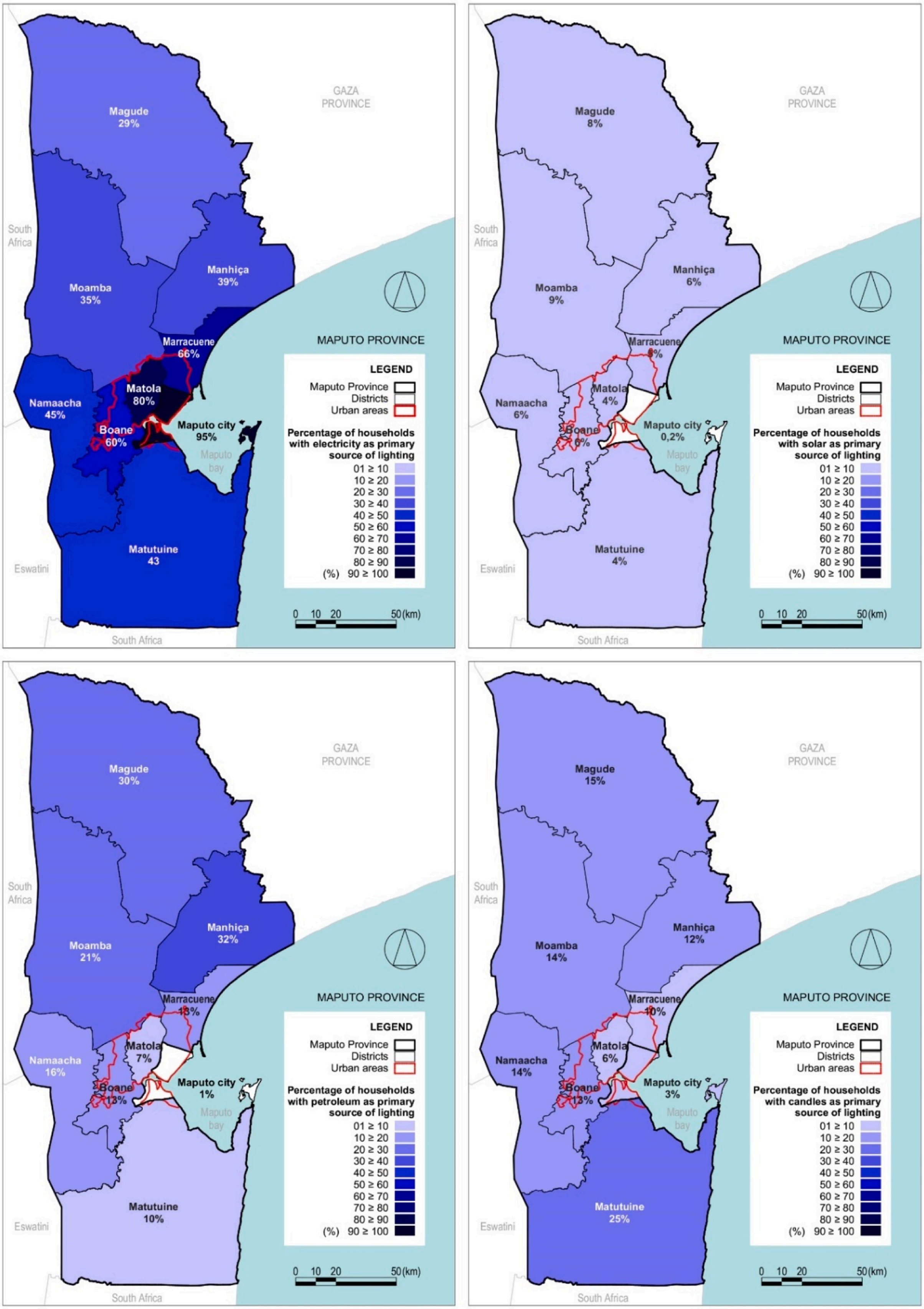

Fig. 2. Energy access levels in Maputo Province as measured by the 2017 national census. Source: Developed by authors from [45].

Table 1
Population figures and energy access rates in each neighbourhood.

Case study location	Mulotana Zilinga	Chalí	Nhomgonhane
District	*Boane*	*Katembe (Maputo)*	*Marracuene*
Population (district)	210,367	28,788	218,788
Population change (2007–2017) (district)	105%	44%	157%
Population density of district (residents/km^2)	177	236	460
Residents using electricity[a]	14%	84%	30%
Residents using solar[a]	19%[b]	1%	11%

[a] The census data records 'principal source of energy used for lighting' and does not account for overlapping energy use.
[b] The National average is 3.1%. Source: Developed by author from [45].

in the area, also contributing to the overlapping use of different energy sources and configurations (Fig. 4).

4.2.3. *Bairro de Nhomgonhane: Marracuene*

Nhomgonhane is a generally low-income neighbourhood in the district of Marracuene. The neighbourhood secretary described how historically a large 'native' population lived in the area depending on agriculture. However, this population was displaced by conflict during the civil war and major national flooding events of 2000. Afterward, the government encouraged them to return, and the area was 'requalified', a formal planning procedure where a grid-like pattern of (unpaved) roads is introduced, and people's plots (limits and boundaries) are reorganised. Since then, the major land-use and social changes have been inward immigration, both from residents of central Maputo and South Africa.[3] Such migration has produced a social stratification between the generally wealthier newer immigrants and the in-situ population. The secretary described how many of the latter group were extremely poor, relying on support from the National Institute of Social Action (INAS) and living in poor-quality housing.

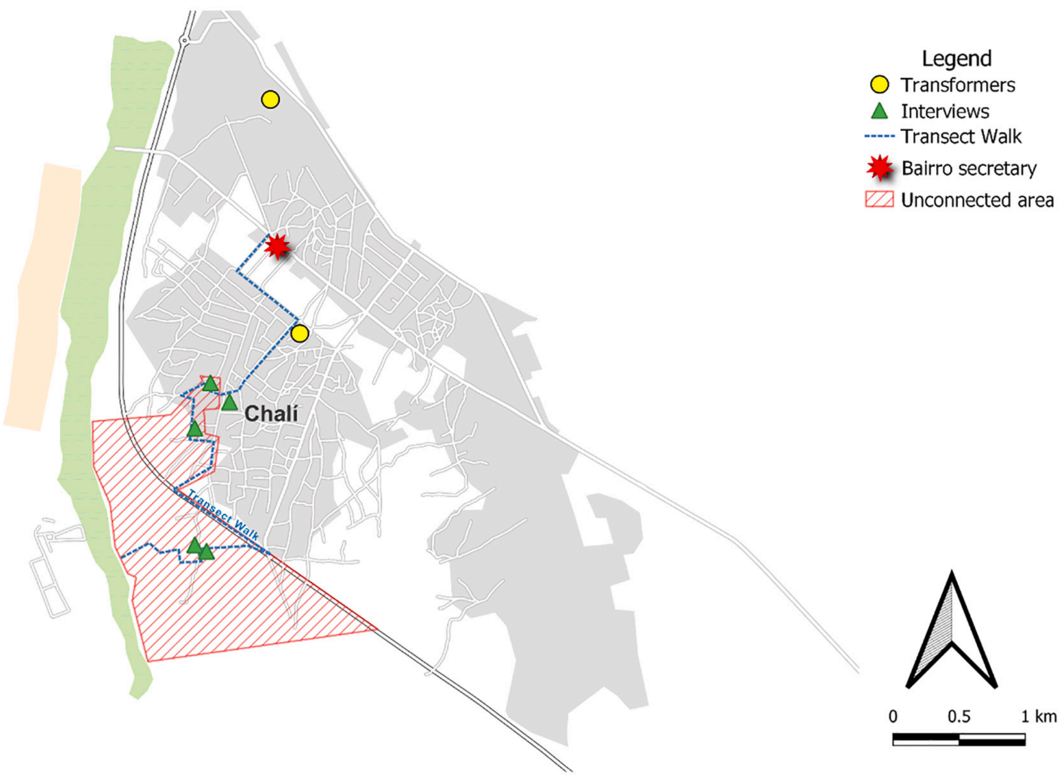

Fig. 3. Map of Chalí showing location of transect walk and key energy features.

the farms. EDM prioritise where there is a lot of accumulated population and then these [long-term inhabitants] will be the last ones".

Concerning the grid limits, unlike Chalí, we identified that unconnected areas formed an 'island' surrounded by connected areas. The unconnected areas were far away from the main road(s) in the neighbourhood, the only areas where EDM had installed transformers. Interestingly, at the southern edge of this 'island' is a significant electricity sub-station dedicated to serving the Mozal Aluminum smelting plant, which consumes 60% of all electricity generated at the Cahora Bassa hydropower dam [52].[2] Summarising, therefore, priority is given to the 'accumulated population' (new residents) and those closer to main roads. Conversely, other populations and low-density land uses receive less priority, leading to the fragmented electricity connectivity

Concerning the relation between electrification and land-use dynamics, an initial section of the neighbourhood was electrified sometime after independence (after 1975) closest to the N1 road, a major national highway. Until recently, few connections were made beyond this point. The secretary described a situation whereby if residents wished to become connected (independently), they had to pay unreasonably high amounts to EDM (and in some instances, this did not necessarily secure a connection). What has changed is that Nhomgonhane was recently chosen as a neighbourhood to benefit from an electrification project called 'ProEnergia'. At the time of fieldwork, work was underway to map

[2] The Mozal plant is served by dedicated lines (via South Africa) by Motraco, one of the very few independent transmission companies operating in Mozambique [59].

[3] This refers predominantly to return migrants. In adjacent areas along the coast, many South African citizens own resorts.

Fig. 4. Map of Zilinga showing the location of transect walk and key energy features.

the neighbourhood, mark houses to receive new connections, install electricity poles, and sensitise the local population, with extensions expected to be completed by October 2021.

Several interesting dynamics relate to the implementation of the ProEnergia project. Firstly, not all houses in the neighbourhood will receive connections. The reason provided by EDM to residents is that not all houses are on official land-use maps. Secondly, leading up to the ProEnergia implementation, many residents had initiated independent connections at substantial cost and time (in one case, 10 years), which the ProEnergia project has now superseded. Lastly, while (lack of) 'urban density' was, once again, reported as the reason EDM did not previously extend electricity connections, *Nhomgonhane* has a relatively sparse population (Table 1). The secretary expressed that this low density and the new availability of electricity had increased interest in land/construction in the area. He described how "there are many works […] with this project [ProEnergia] they are already coming en masse to build". This was despite other services (particularly water) being unavailable in many parts of the neighbourhood.

During the transect walk, one significant observation was made concerning electricity infrastructures. In 2019, a Heineken brewery was opened in a neighbouring area to Nhomgonhane, served with a dedicated (high-voltage) line that traverses Nhomgonhane and an electricity sub-station situated within the neighbourhood. However, this line does not supply the neighbourhood (residential areas), and several households lost land in the construction process of such lines. According to the secretary, while "some families were affected," EDM gave the affected families compensation and engaged the local community in a series of dialogues. The secretary described this as an important step to open communication and relation with EDM.

4.2.4. The relation between energy infrastructures and peri-urban growth

Synthesising the above findings, peri-urban growth is generally outpacing electrification in the cases studied. Some evidence suggests that *some* peri-urban development is speculative. In Katembe, new plan (s) and a new bridge have undoubtedly increased speculation. In Nhomgonhane the ProEnergia project has also seemingly increased the neighbourhood's attractiveness. However, growth results from a more latent demand for housing and land. In all neighbourhoods, new residents acquire land and construct houses in areas not supplied by infrastructures (electricity and water, for example). Reportedly, much of this growth is from (typically) wealthier groups migrating from central (and other areas of) Maputo. Despite concern in the literature [18,37], such findings suggest much more dispersed 'suburbanisation' patterns beyond middle-class residential 'enclave' and condominium formation. The key drivers include the (a) availability of land (b) the proximity to main roads that allow transport (cars) to Maputo, and (c) the opportunity to construct (what was often termed by interviewees) as "your own house".

Newer migrants rely on two major energy access strategies. The first is the implicit expectation that a critical mass of new inhabitants, coupled with local collective advocacy and individual interventions (discussed in greater detail in the following sections), will ultimately encourage EDM to extend the electricity grid. Most newer residents are pragmatic about this process, accepting that it may take years and considerable cost, and thus they use alternative energy configurations (solar, charcoal, gas, kerosene, etc.). There is both a culture of incremental housing construction and pragmatism about networked services. However, some private individuals and small groups pay to circumvent such processes. In one case, a resident of Nhomgonhane stated he paid 50,000 Meticais ($786 US) to receive an independent electricity connection. Such interventions contribute to pockets of uneven electricity access. The second primary strategy is to contract commercial solar companies. As Table 1 shows, the number of households using solar is much higher than the national (and district) average in two of the neighbourhoods.

Urban density is a crucial dynamic. Density is the most important criterion EDM uses for electrification in peri-urban spaces. In Zilinga, this rigid requirement has led to tensions and social differentiations between newer immigrants and in-situ populations. However, we generally found no apparent spatial differentiation at an (intra-)neighbourhood level, but rather fine-grained socio-spatial distinctions within neighbourhoods. Thus, despite interest in enclave formation among middle- and upper-income groups [23] and the distorting role of growth corridors [6], in Maputo, we find processes much closer to what [53] in the context of Kumasi, Ghana and also [2] have described as the 'mosaic peri-urbanisation'. Simultaneously, we also encountered fragments of broader energy developments contributing to uneven socio-spatial outcomes. In each neighbourhood, we observed electrification processes that either planned to or directly circumvented local populations. In Zilinga and Nhomgonhane this was for major businesses served with dedicated lines. In Katembe, a planned middle-class residential enclave intends to develop spatially and institutionally independent energy supply systems. Such developments essentially bypass existing residential areas rather than forming integrated 'edge' spaces, speaking to the importance of a 'cross-scalar explanation' [24].

4.3. The uneven production of peri-urban space: key actors' interventions in energy infrastructures

4.3.1. The institutional response: EDM

EDM is the primary organisation responsible for peri-urban energy access. It does not, however, have a specific strategy for peri-urban areas. Mozambique's primary national energy goal is to universalise energy access by 2030, aligning to the Sustainable Development Goals [54]. However, financial limitations, dependence on foreign donors, poor maintenance of the grid, and increasing frequency of blackouts are some factors that cast doubt on the feasibility of achieving this goal [34]. In 2019, the Mozambican government received funding from the World Bank and other international donors for the 'Mozambique Energy for All' (ProEnergia) project, discussed earlier. ProEnergia is one of the first major electrification projects to explicitly include peri-urban areas. The government and EDM used ProEnergia as an umbrella to consolidate existing energy access strategies, projects, and funds [55] into three major 'components' (Fig. 5). The first, implemented by EDM, focuses on 'densification' of the existing grid in targeted rural and peri-urban locations, initially through 350,000 new connections and new medium-voltage distribution lines and transformers [56]. Most (75%) new connections in the first phase are anticipated in 'rural' areas [56], with peri-urban a less prominent part. The second component focuses on the national, high-voltage network, connecting unconnected districts, and unifying the grid. The third component, led by FUNAE, focuses on off-grid technologies (typically solar mini-grids and solar-home-systems (SHS)) in areas perceived to be too far from the existing grid.

Peri-urban areas essentially fall within the densification strategy (Fig. 5). Upon deciding which peri-urban areas to connect first, preference is given to denser neighbourhoods, closest to existing infrastructures (interview 1). EDM staff outlined how "the first aim is to drive electrification for denser areas with industrial potential, like natural reserves with fishing potential, agriculture potential" (interview 2). Strategic decisions are therefore important [55], as are demands of other social (e.g. hospitals) and technical (e.g. water) infrastructures (interview 2). However, we found that EDM largely views this strategy as the most commercially viable. As stipulated by one EDM employee, "we need to invest less and connect more" (Interview 1). A further employee highlighted how EDM was "looking for profit […] in these peri-urban areas it's easy to achieve those profits because we don't have to invest as much" (Interview 2).

Two logics, therefore, underpin the densification strategy in peri-urban areas. First, that increased connectivity surrounding *existing* electricity infrastructures is a more pragmatic, "quick win" solution that meets funders' requirements for rapid electrification. Secondly, that a critical mass of electricity users can cover upstream costs (such as maintenance) and potentially fuel economic opportunities/other infrastructure developments. This strategy is distinguishable from 'rural' electrification. One EDM worker described how, "for rural electrification projects, they are projects where donors and EDM put money on the table, then we do the project. We are not looking for viable projects; it's mostly to develop rural areas and reduce inequity" (interview 2), adding that "at the end of the day, the power needs to be paid in such a way that we can cover the maintenance costs". The consequences are the absence of, and slower electrification rates for, *some* peri-urban areas considered less commercially 'viable', contributing to variable access rates across neighbourhoods (as found in previous sections). Moreover, the anticipated number of new connections in the initially funded phase of

			Indicative Design Parameters		
System	**Methodology**	**Settlement Type**	**D = Distance from EDM Grid**	**P = Demand per household (kVA)**	**Population Density**
On-grid	Connection of new users to existing LV network (220 – 400V)	Urban and peri-urban	D < 10m	3.0 < P < 5.0	High
	Densification (LV and urban MV extension)	Urban and peri-urban	10m<D<5km	3.0 < P < 5.0	High
	3-phase rural MV (main and laterals) and LV extension	Rural	5km<D<30km	2.0 < P < 3.0	High
	3-phase rural MV (main), SWER (19kV) for laterals and LV extension	Rural	10km<D<30km	1.0 < P < 2.0	Medium
Off-grid	Mini-grid; i.e. centralized generation and LV network	Rural	D > 30km	0.1 < P < 1.0	Medium
	Solar home system (SHS)	Rural	D > 30km	0.1	Low

Fig. 5. Figure detailing the parameters for EDM's major electrification strategies. Peri-urban areas fall distinctly under the first two strategies. Source: screengrab from [57].

ProEnergia is considerably lower than actual demand from peri-urban populations. Therefore, those in less dense areas, and those further from the grid, are largely excluded and left to private or collective means to access networked electricity or other energy infrastructures.

4.3.2. Local residents

In the article's opening, we discussed several energy access strategies initiated by peri-urban residents relating to *phandar*, examined here in greater detail. The first strategy is *hybrid electrification*, whereby residents intervene in the physical, technical, and financial electrification process. For example, one resident asked about the process of 'connecting' to electricity described how "it consisted of buying poles and even the cable itself, from where it ends until here" (interview 19). After residents have bought and installed such equipment, EDM engineers make local inspections and decide whether to complete the connection. Most interviewees had intervened to purchase and construct electricity infrastructures or knew someone who did, suggesting such practices are ubiquitous and not necessarily limited to wealthier residents. Neither were such practices ad-hoc. Respondents detailed how organised markets existed whereby the same companies who provided wooden poles to EDM, would also sell directly to residents (Photo 1).

Such processes are *encouraged* by EDM. As one respondent described, "I went [to EDM], and they told me that my house is far from the road, so they told me I had to look for a way to have a pole so they can come turn on the power. I mounted the poles and went to tell them […] they said, 'we will come'. 'We will come' is always the answer" (interview 8). As this response shows, this strategy does not always result in connections (while encouraged). In many cases, residents reported that physical interventions must be coupled with 'extra' amounts paid to EDM to install further equipment, finalise the bureaucratic connection process, or sometimes make the process 'go quicker'.

The consequences of hybrid electrification are a subtle differentiation between those able to pay and those not. While evident, several phenomena dampen this effect. First, many interventions by residents are organised collectively (i.e., pooled finance). Moreover, there can be secondary benefits for residents surrounding the houses of individuals who intervene in such ways. For example, a resident recently connected through such means stated residents surrounding his home, "couldn't buy poles, including the neighbour next to me […] because she's an old woman who lives alone. Coming to assemble energy in my house made it easier for her to connect to energy" (Interview 8). Furthermore, one resident paid a substantial amount ($1571 US) to EDM to receive a 'better quality' connection through an independent line.

The above phenomena relate strongly to the second major *phandar* process, collective mobilisation. One respondent, describing the electrification process, stated that "we had to gather some people there and then we went to EDM to ask" (Interview 7). "Going to EDM" can encompass several strategies such as advocacy through local government representatives, letters, or even political protests. For example, a respondent described how "we got together and marched to EDM to request that we get energy" (Interview 14). In a further instance, a resident detailed how "when we go to EDM they say we have to make a letter from the people, a petition to deliver to EDM, so that the director can respond" (Interview 9). Such actions fall between low-level political contestation and collective social action. Residents (must) agitate around the techno-commercial notions of 'density' described in the previous section.

4.3.3. Local leaders/government

The collective mobilisation described above is nearly always mediated by local leaders/government officials, commonly neighbourhood secretaries and block chiefs. In one example, it was explained how "the block chief called the whole population to make a letter to deliver [to EDM] but we went three months without an answer" (Interview 9). A separate resident detailed how "for us to get the connection we had to make an effort with the block bosses, we created a neighbourhood statement to submit to EDM and paid 3500 MT, then they turned on the electricity" (Interview 13). Secretaries and block chiefs often have better

Photo 1. An example of a pole bought and installed by residents. Residents installed the poll because an initial electrification project did not cover their houses.

knowledge of the electrification process and better connections to officials and engineers at EDM. Moreover, local figures give legitimacy to the interventions of residents described above. For example, they can highlight to EDM which areas are without connections, sites of poor-quality connections, etc. One secretary described their role as, "we check the document and send to EDM, and EDM sends the technicians and calls us to go identify where there is a problem or lack of electric current" (Interview 23).

Generally, therefore, local leaders advocate for their populations. Nevertheless, their power is limited and varies depending on disposition and the pressure received from local people. For example, one secretary stated that "when we receive the citizens here, for the sake of transparency we advise to make themselves present at EDM, to present directly to the institution their concerns, and in turn, we talk to the institution" (Interview 22). All three secretaries articulated a sense of frustration in their dealings with EDM surrounding the pace of electrification. The role of other governance actors, such as municipalities, was limited, predominantly related to providing land-use deeds and requalification of some neighbourhoods.

4.3.4. *Private solar companies*

We encountered several large solar companies targeting peri-urban areas as a market for their products. Respondents in all three neighbourhoods reported that the same companies, SolarWorks Mozambique, Fenix International, and Solar Oak, offered solar-home systems (SHS). All three companies sell 'packages', typically including solar panels, batteries or converters, wiring, and often the electricity using devices (lights, phone chargers, and in some cases TVs). These packages use sim cards and various digital payment platforms to monitor usage and faults. Differently priced packages are sold, ranging from 6500 meticais ($102 US) to 60,000 meticais ($943 US).[4]

Interestingly, we found such companies were establishing networks of agents and offices in peri-urban locations. SolarWorks, for example, has three regional offices in districts surrounding Maputo (Matola, Moamba, and Manhiça). Fenix International was recently bought by the French energy giant Engie and states that it aims to "operate every province of Mozambique within the next three years and expects to reach over 200,000 households with clean energy and inclusive financial services". Both SolarWorks and Fenix International have previously received funding from international donors. Previous research has highlighted how SHS are typically installed in 'off-grid', rural areas through developmentalist logics [58]. However, the higher prevalence of solar in some neighbourhoods indicate how this agenda has shifted to a commercial agenda for peri-urban spaces. SHS companies have essentially developed various packages which reflect and capitalise on the divergent underlying social conditions in peri-urban settlements between unconnected higher income groups and unconnected lower-income groups.

Packages not only range in costs but by energy services provided. Lower cost packages offer very basic energy services such as phone charging and lighting for intermittent periods. More expensive packages enable more continuous energy use and different services such as cooling (fans) entertainment (TV and music). Residents reported two major frustrations with SHSs. First, such systems were perceived as expensive and locked customers into a regular monthly fee (often difficult to pay). Second, the energy services offered were limited and intermittent. For example, one respondent stated how "I had solar panels from Solar oak, but I used them only for two months because it was expensive depending on my devices [phone and lighting]". A further respondent detailed how, "we are living in the dark, we depend on solar, when there is no sun we are forced to stay in the dark, for example, fridge what… we can't use it" (Interview 11).

[4] Public information concerning Solar Oak was not available.

5. Discussion: uneven peri-urban growth and energy infrastructures

The relationship between peri-urban growth and energy infrastructures is characterised by rapid, fragmented growth patterns, overlapping with uneven and heterogeneous forms of energy access. While concurring with Melo and Jenkins that peri-urban settlements in Maputo are 'heterogeneous and imbricated spaces', we do not find that peri-urban development is solely characterised by 'middle-class advances' along roads or in areas which have 'more probability of market success' [18]. Instead, growth is incremental, mainly through residential property development among relatively wealthier groups. Our findings emphasise two crucial dynamics: centre-to-periphery migration and that infrastructure access is not a prerequisite for such migration. Some newer immigrants choose to live well beyond the boundaries of the electricity network (and other infrastructures), emphasising how access to large plots for housing developments is a key driver. However, the reverse can also be true where areas earmarked for electrification become more desirable. This may lead to a cumulative effect where proximity to the existing electricity network and roads is advantageous and fuels further urbanisation.

The result is a 'mosaic' of housing types and energy infrastructures that vary on a plot-by-plot basis. This urban form is produced by an intermixing of relatively wealthier households, which generally build better-quality housing, with higher (and different) energy demands, *alongside* poorer quality housing and other land uses among 'original' inhabitants or in-situ populations [2]. EDM's fixed techno-commercial logics for electrification in peri-urban areas have contributed to this fragmented urban growth pattern. Disparities in networked electricity connectivity exist between and within neighbourhoods, with some peri-urban neighbourhoods largely excluded. Moreover, the political prioritising of extension decisions, purportedly for industrialisation and economic growth purposes, also contributes to such disparities. We find large businesses are supplied with dedicated lines suggesting bypass and failures/unwillingness to integrate private business developments with residential developments. Thus, uneven urban developments are produced through a disjuncture in scales of investments in infrastructures and the imposition of commercial logics in electrification procedures.

We have forwarded unique insights into electrification procedures in peri-urban areas. 'Hybrid electrification' represents a decentring of responsibility for electrification away from the utility to private individuals and communities. Similar to other research, this phenomenon displays the considerable capacities of local communities to find innovative solutions to energy access challenges [26]. However, while such innovations are often collectively organised and with benefits for surrounding populations, access (outside of funded projects) is increasingly based on people's ability to pay, local knowledge, and political or institutional connections. Crudely, such a phenomenon may be considered a 'smart' strategy for achieving rapid electrification. It leverages the capacities of local communities and the high demand for networked electricity in peri-urban settlements [12]. However, the consequences are conflictual politics surrounding urban 'density', including frustration among local people/leaders, left 'figuratively' disconnected from public institutions. It also leads to low-level rent-seeking among EDM engineers as the boundaries between locally mediated and 'official' extensions become blurred.

Generally, the consequence is that peri-urban electricity access is shaped by a commercial logic and depends on the 'political influence and lobbying ability' (p. 24) of local communities, which can vary considerably. Moreover, the privileging of densely populated areas in electrification typically disregards poorer residents living in less dense areas. This is a fundamental fragmentation of the ideal of universal energy access, purported as the primary energy goal in Mozambique. Despite these cautions, however, there may indeed be *greater* potential for EDM to work *differently* with local communities. This includes mapping and documenting unconnected households, poor quality supply, and through mobilising the considerable financial, labour, and knowledge capacities of local communities to distribute the benefits of electrification more evenly such as through grouped extensions (multiple households) that are planned at a neighbourhood level with local leaders/representatives. Strategically and politically, greater priority must be given by the State and EDM to poorer residents in less dense peri-urban areas not covered by existing projects (e.g. ProEnergia), such as by subsidising connection fees. The state should also consider measures to reduce and equalise the high costs of standalone solar systems through micro-financing and measures to reduce purchase and distribution costs.

6. Conclusion

Infrastructural heterogeneity and uneven electrification procedures are therefore contributing to uneven peri-urban development. The dominant 'configurations' of energy access in peri-urban areas can be categorised as follows: (a) 'premium network spaces' (large-scale businesses served with dedicated infrastructures, and to a much lesser extent, wealthier individual inhabitants), (b) 'regular' electricity connections, (c) poor quality electricity connections (i.e., areas at the network edge where services are limited and intermittent), (d) solar-home systems, and (e) a range of non-electricity-based configurations. While such configurations are not unique to peri-urban settlements, one distinct facet is higher use and diversity of solar configurations linked to the rise of private solar providers. Summarising, we find that heterogeneous infrastructures and interventions, emerge due to, and reinforce, socio-spatial differences in energy access and living conditions.

A crucial aspect is the heterogeneous and incremental nature of the electrification process. This makes peri-urban areas distinct in that there is often a unique set of 'outcomes' that determine how quickly residents become connected, which energy services are enabled, the quality of supply, and how other configurations are juxtaposed with networked electricity. Concerning energy use and services, grid-electricity was viewed as highly preferable and key to the 'urban' ideal of being symbolically and physically 'connected' to the city. Therefore, there is a significant challenge to coordinate SHSs with networked electricity concerning sustainability as the former is perceived as temporary due to high costs and limited/intermittent supply. Conversely, the poor quality of electricity supply (frequent blackouts and uneven currents) and the high costs sustain the need for multiple energy solutions.

These findings highlight two senses of how and why infrastructural heterogeneity is produced in peri-urban settlements and how different configurations coexist/coevolve. First, the commercialisation of solar and electrification procedures has exploited and reinforced the underlying social heterogeneity of peri-urban spaces (i.e., the variable ability of residents to pay for energy services/infrastructures). The second sense is produced through local individuals and communities' pragmatism, capacities, and resourcefulness, who often navigate substandard technological availability, unreliable and intermittent supply, and the politically mediated nature of energy supply. Greater coordination is undoubtedly possible across heterogeneous energy access channels. For example, independent solar is recognised in EDM's long-term planning documents as a significant supply source, yet little regulation, support, or coordination exists between networked electricity and solar. The dogmatic quest for rapid electrification, with peri-urban areas considered commercially 'viable', has eroded universal access principles, and produced a blind spot concerning working with communities for more just forms of energy access.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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