Negotiating networked infrastructural inequalities: Governance, electricity access, and space in Rio de Janeiro

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Abstract
In cities of the Global South, universal physical access to networked infrastructures, such as electricity and water, is often presented as enabling the reduction of social and spatial divisions. Whereas most of the discussions in these cities have focused on the obstacles to networked infrastructure expansion, little attention has been paid to the increased universalization of the physical electricity network in several Latin American, Caribbean, and Asian cities. This article unpacks the discussions around the modern infrastructural ideal and its local reshaping by building on the case of Rio de Janeiro, which has achieved universal grid electricity coverage, but where strong urban inequalities remain. By focusing on electricity grid management in favelas, this article analyzes how infrastructural inequalities emerge within the network. It suggests that, in order to understand how urban inequalities are reproduced or mitigated through networked infrastructure, it is important to consider the governance aspects of managing infrastructure. It develops this argument by focusing on the multi-level and heterogeneous spaces of infrastructure governance, including both national and institutionalized arenas, and local everyday practices between local actors on the ground. This analysis shows how networked infrastructural inequalities emerge from negotiation processes in which the fragmented nature of the urban environment is embedded. Through this analysis, the article contributes to current discussions on the urban geography and techno-politics of infrastructure by highlighting the negotiated nature of infrastructural inequalities beyond the modern infrastructural ideal.

Keywords
Electricity infrastructure, informal settlements, urban governance, urban inequalities

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Introduction

When we consider the urban electricity access rate, the divide between cities in the North and the South seems to be growing progressively narrower. The urban electrification rate in particular has increased considerably over the last few years. Whereas on the African continent, universalizing access to electricity remains a considerable challenge, in Latin American and Caribbean cities, and in Asian cities, coverage is between 95 and 100% (IEA, 2017). Behind these figures, there are undoubtedly very different urban contexts and conditions of electricity access. Poor quality electricity services, power outages, and affordability are just a few of the challenges that still have to be considered when exploring the conditions of electricity access in cities of the South. These electrification rates figures, however, provide a fruitful starting point for contributing to ongoing discussions on networked urban infrastructures and urban inequalities. How does the increased network coverage translate ideals of urban cohesion embedded in the so-called “modern infrastructural ideal” (Graham and Marvin, 2001)?

In cities of the Global South, this question has not yet received much attention. In fact, research has predominantly focused on providing fruitful analysis of the factors that limit the universalization of networked infrastructure such as when attempting to translate the networked city model through water and sanitation systems, for example (Monstadt and Schramm, 2017). Challenges universalizing networked infrastructures are particularly significant in informal areas, where poverty, precarious legal land tenure, along with technical and political reasons, are often presented as central obstacles for servicing these areas. Thus, research has explored the way in which utility providers find technical, social, and commercial strategies to extend or regularize access to the electricity network in these areas (Baptista, 2018; Criqui, 2015; de Bercegol and Monstadt, 2018; Pilo’, 2015; Zaki, 2010). However, there is limited knowledge and conceptualization of how spatial inequalities emerge within the electricity network in terms of access and electricity provision, as this is generally limited to affordability or the regressive effects of sector reforms such as privatization on the urban poor. Yet, I argue that it is important to consider the processes that contribute to characterizing the emergence of such inequalities because they enable us to understand the mutual reshaping of the electricity network and the urban political environment.

This article explores how networked infrastructural inequalities are produced, negotiated, and institutionalized, building on the case of Rio de Janeiro that provides particularly fertile ground for understanding the local reshaping of the uniform networked infrastructural ideal. In fact, the electricity network can be considered as universal in terms of coverage and electricity connections as 100% of the population is connected to the grid (IBGE, 2010). However, as in many other cities, irregular connections, infrastructure improvisations, and power disruptions considerably shape such an ideal. In order to conceptualize how infrastructural inequalities emerge within the network, this paper approaches them as being produced through processes of negotiation between heterogeneous forms of governance. By focusing on electricity management in favelas, I suggest that, in order to understand how urban inequalities are reproduced or mitigated through networked infrastructure, it is important to pay attention to both multi-level governance logics within institutionalized arenas and everyday governance practices between local actors on the ground. This enables us to consider the functioning and shape of networked infrastructures as being produced through a plurality of governance actors within urban and institutional spaces.

Through this analysis, this paper aims to expand on recent work on the urban geography and techno-politics of electricity infrastructure (Baptista, 2015; Luque-Ayala and Silver,
It helps to reveal how infrastructural inequalities emerge from the rationalities of different governance actors, political choices, technical objects, urban categorizations, and electricity management practices. This makes it possible to more broadly consider the interaction between urban fragmentation, technical performance, and commercial logics. I will develop this argument by considering the negotiations that take place between the electricity provider and local governance actors in favelas (residents’ association, gangs, politicians, etc.) on the one hand, and between the electricity provider and the national electricity regulator (Agência Nacional de Energia Elétrica, ANEEL), on the other.

This analysis draws on a total of 11 months of fieldwork conducted between 2009 and 2011, and in 2016, on the governance of electricity infrastructure in Rio de Janeiro’s favelas. This empirical research covered different socio-political events in the city, including a security program called Pacifying Police Units (UPP) in which the state of Rio occupied several favelas through a permanent police presence intended to disrupt local gangs’ control over these areas (from 2008) and a financial crisis in the State of Rio in 2016, which led to these security measures being considerably scaled back. Thus, during my fieldwork, I empirically documented the governance of electricity infrastructure within these more recent and different socio-political contexts.

The following section of this article examines the insights that can be gained from bringing together discussions on networked infrastructures and governance to help build an understanding of urban networked infrastructural inequalities. This is followed by a presentation of Rio de Janeiro’s electricity grid and the changes in electricity infrastructure governance that have occurred since the market-oriented reforms of the electricity sector were introduced during the 1990s. Sections Everyday governance: negotiating technical and commercial order and Spatial inequalities and Electricity provision: the categorization of “risk areas” then provide an understanding of the multilevel negotiations surrounding the management of electricity infrastructure. They show how electricity management operations are part of a negotiated process in which the quality of service provision, spatial categorization, commercial performance, and urban violence contribute to the formation of infrastructural inequalities.

**Questioning networked infrastructural inequalities through governance**

Infrastructure has become an important focus of examination for understanding the political nature of urban inequalities. As it plays a key role in governing cities, studying infrastructure can help reveal how politics and power relations shift (McFarlane and Rutherford, 2008). Debates on infrastructural urban inequalities have analyzed the connection between the form and organization of infrastructure and the ways it is accessed and physically deployed in the urban space. What Graham and Marvin (2001) termed the “modern infrastructural ideal”—the idea of a monopolistic, integrated, and standardized provision of networked infrastructures—has doubtless consolidated a positive connection between networked infrastructure and social and spatial urban cohesion (chapter 2 in Graham and Marvin, 2001). Standardized technological grids are considered “ideal” because they build on the imagination of a fixed physical network that provides possibilities for social and spatial connection, whereas their absence can be considered a source urban fragmentation (Graham and Marvin, 2001).

This idea is nowadays being challenged and the “myth” of the modern infrastructural ideal has partially waned. The idea of a post-networked city emerged in the North whereas, in the South, several studies have shown that this ideal has failed or has never been achieved (Kooy and Bakker, 2008; Zérah, 2008). The ongoing processes of fragmentation that these
cities experience and their socio-political context (Mackillop and Boquet, 2006), considerably affect infrastructural differentiation and fragmentation, whereas infrastructural privatizations seem to have a limited role (see themed issue 39.6 of *Geoforum*). Thus, criticisms of certain assumptions related to the modern infrastructural ideal have emerged as part not only of a pragmatic shift but also of a more ontological understanding of infrastructure. Jaglin (2008), for example, analyzes the differentiation of basic services in Cape Town as a “pragmatic move towards accommodating social and spatial disparities in a polarized city,” contrasting the idea that an homogenous service would be more progressive and cohesive. More recently, the association between networked infrastructure and solidarity has also been questioned. Cesfasky (2017: 158) argues that the idea of “infrastructural solidarity” builds upon a troubled imagination that infrastructures are “static formal arrangements that concretize relations and enforce social cohesion or fragmentation.” In a different way, but linked to this argument, research on repairs and maintenance also prompts us to reconsider certain assumptions of this ideal, including the “myth of order” embedded in such idealization (Graham and Thrift, 2007). By opening the black-box of infrastructural operations, this research shows how the performance, the functioning and the disruption of infrastructures are deeply embedded in the uncertainties and instability of the context in which they perform (Kallianos, 2017). This is why maintenance and repair operations and infrastructure disruptions in highly unequal societies can deepen and reveal urban inequalities (McFarlane, 2010; Silver, 2016), and how electricity providers deal with heterogeneity, including urban “informality” (Baptista, 2018).

These different bodies of research invite us to consider networked infrastructures as systems whose performance, socio-political meaning, and capacity to reshape urban inequalities are embedded in the local context in which they operate. Here, I expand on these discussions by considering the governance processes that affect the meaning and the performance of the electricity grid and how they connect with urban inequalities. By focusing on the governance-related factors that affect the spatial differentiation of electricity provision and access, I put forward the idea of “negotiated infrastructural inequalities” to highlight how these emerge from formal and informal arrangements surrounding the spatial management of electricity infrastructure. I suggest that this approach enables us to consider a more dynamic approach to inequalities as resulting from compromises between different actors, with different resources within power relations.

Despite governance being a polysemous concept, the following general aspects are useful for considering the multi-level processes involved in managing infrastructure, as well as its broader interaction with other urban dynamics. Coutard (2002) suggests looking at the governance of infrastructure as the interaction between technological systems and societal patterns at different levels. Dubresson and Jaglin (2005) also draw attention to the local processes of regulation and territorialization when analyzing the governance of urban services. By approaching the governance of specific urban areas as an assembly of localized compromises, discourses, and power relations, they consider the provision of urban services as part and product of these strategies of territorialization. These definitions invite us to consider both the multi-level processes involved in managing infrastructure, and their interaction with other socio-political local structures. In fact, not only do sector-specific regulatory frameworks govern these systems, often at the national level, but urban actors also influence local infrastructure-related practices. Emerging literature that adopts an everyday perspective to governance from an anthropological viewpoint helps to approach these processes from the micro and local levels (Blundo and Meur, 2009). Focusing on the sets of interactions between different actors on the ground, these studies provide an understanding of governance as a negotiated process in which heterogeneous norms are at play. Recently,
this everyday perspective has been helping to build an understanding of the entanglement between urban inequalities and infrastructural development within the field of urban political ecology (UPE) (Cornea et al., 2017; Truelove, 2016). This everyday perspective makes it possible to engage with the heterogeneous logics, rationalities, and instruments through which actors negotiate within the urban environments in which they operate.

The remainder of the paper explores the techno-political negotiations that take place between actors within different levels and heterogeneous arenas around the management of the electricity grid in favelas. Through this focus, the article provides an understanding of the connection between the production of networked infrastructural inequalities, in terms of access and quality of electricity provision, and the governance structures that shape them. This also enables us to consider the performance(s) of networked electricity infrastructure as being co-produced through negotiated power relations, and consequently as being political in nature.

The electricity network in Rio de Janeiro’s favelas: A hybrid universalized network

As mentioned above, physical access to the electricity grid in the city of Rio de Janeiro and urban areas of the State is considered universal since 2004.4 Within the Brazilian electricity sector, the notion of universalization refers to physical coverage and connection to the electricity grid, which includes the process of delivering the service (Fugimoto, 2005). Behind this technical definition, however, there are heterogeneous configurations of access in terms of quality and access practices. Thus, a complementary characterization of the “universalized grid” in Rio would need to consider its hybrid nature. In fact, this universalization is made up of official and unofficial practices and materialities used to access the grid. This is not an insignificant factor as it is central to understanding the entanglement between the governance of electricity access and urban inequalities, as outlined later in the article. To understand the political nature of the grid and its expansion in the favelas, it is necessary to first take a step back in time and review the recent history of electricity infrastructure in favelas.

The official electrification of the favelas took place at the end of the 1970s, when the public electricity provider, Light, implemented what was known as the “social interest electrification program” (Bronstein, 1982). Whereas, historically, public authorities had always refused to allow the favelas to be officially connected to the public electricity grid because of their irregular land status, the favela inhabitants’ struggles to access public resources, combined with a political openness during the end of the dictatorship, resulted in their official connection to the public grid between 1979 and 1984 (Vasconcellos, 1984). This program not only provided more secure access to the service, but it also led to the establishment of a public provider-user relationship whereas, previously, different territorial and political powers regulated access to electricity (see Conn, 1968).5 The electrification program included a strong political aspect linked to the recognition of favelas as rightful spaces for electricity provision. It also established an official and non-mediated commercial relationship with the electricity provider. During the years that followed this electrification program, however, this commercial relationship seems to have progressively encountered resistance from residents. The interviews and documents I collected about that period describe a fall in electricity payments and conflicts between residents and the provider’s agents up to the mid-1980s.6 Thus, the so-called gatos7 (illegal connections) were already common practice during the public provider management period.

Since then, universalization of the electricity grid has progressively been achieved through heterogeneous configurations of access in which irregular connections without meters, strategies to bypass the meters, and formal connections co-exist. These practices are largely used
by all classes and in all areas, including luxury condominiums. In favelas, however, they reinforce a specific image of the city as being divided into legal and illegal spaces. Although the aim of this article is not to discuss the irregular practices employed to access the electricity network (Fabricius, 2008; Yaccoub, 2010), their materiality is important for understanding the urban energy landscape (Castán Broto et al., 2014) in favelas. In fact, these practices take on the material form of anarchic cables that make-up a visible and distinctive electricity network in which the boundaries between the company’s official network and irregular cables are blurred (Figure 1).

This universalized network is entangled and produced within different governance structures that attempt to govern not only the way the grid is accessed, but also its technical and commercial performance. In the following sections, I will discuss the negotiations surrounding infrastructure, starting from the privatization of the electricity sector, a reform that has considerably changed the provider’s management practices in favelas.

**Governing electricity access during privatization: The new ideal of a “regularized” network**

The national market-oriented reforms implemented during the 1990s8 directly affected the way in which electricity infrastructure was managed at urban level. They introduced what can be considered a new electricity infrastructure ideal, that I call here the “regularized network.” This can be defined as a grid to which access is mediated by uncorrupted metered systems and regulated by market-based commercial logics. Simply put, this ideal envisions the compliance with and respect of commercial rules through registered connections. It emerged from different key changes introduced by the reforms: the liberalization of the distribution sector, which enabled private companies to become providers (concession law 8.987/1995); and the tariff system reform, which introduced the full cost pricing principle (the so-called price cap).

Since these reforms, the providers’ activity has been underpinned by the principle of economic profitability, and the tariff system allows utilities to charge customers a realistic price that reflects the power generation, transmission, and distribution costs (Cachapuz, 2006). Consequently, tariffs should ensure the economic and financial viability of the
concession. These structural and organizational transformations implied giving priority to reducing so-called commercial losses, which was one of the major challenges for the recently privatized provider in Rio. In fact, when the private company first took over, the technical and economic performances of the electricity grid were directly hampered by the incompleteness of the customer register, and by the practices employed by residents to access the service, as explained by a Light agent during that period:

When I arrived at Light in 1998, there were more than 400,000 houses without a meter installed in the favelas. And this was only in the metropolitan region. It can be said that three-quarters were without a meter, and 25% of those with a meter were in an irregular situation: either non-payment or fraud on the meter (“gato”). In short, we had to start all over again. But this was not a situation unique to the favelas. In the Baixada Fluminense, which is a very poor area too, the service was very precarious and most of the inhabitants were not registered...

Despite this configuration, the decision to regularize electricity access or even service favelas was not an obvious choice. In fact, these areas were seen both as a potential commercial risk and an opportunity for expanding the customer base. On the one hand, the legislation at that time did not clearly set out obligations requiring electricity providers to serve the entire market, or ensure they did not exclude potentially unprofitable users or areas, such as low-income and rural areas (Fugimoto, 2005). On the other hand, however, the high commercial losses recorded throughout the concession area doubtless drove the company to come up with strategies to recover these customers.

In 1998, Light created a specific unit to develop an approach to regularize illegal connections and build a commercial relationship in the favelas: the “Community Management” unit (Gerência de Atendimento as comunidades). A manager, social community agents, and technicians were appointed to this unit that today continues to act as the main communication channel with low-income communities. Light implemented its first electricity regularization program between 1999 and 2002, the “Informal Settlement Normalization Programme” (PRONAI, Programa de Normalização de Áreas Informais), as part of its corporate social responsibility policy. Its aim was “to establish a methodology for electricity delivery in low-income areas, with the objective of reducing the indicators of commercial and technical losses” (Light, 1998: 3, quoted by Franca, 1999: 51). In practice, this involved implementing various operations to establish individual commercial relationships: carrying out a census of inhabitants, installing individual meters and introducing a technical network model adapted to the morphological characteristics of the type of housing (for the favelas located on hills in particular).

Moreover, the company defined appropriate commercial measures to minimize the potential commercial risks posed by the poor financial circumstances of this customer segment. This included the installation of customer service agencies in favelas and the possibility for customers to set up payment plans. Since 2001, under the national energy efficiency policy, companies are also encouraged to set up energy efficiency projects, through the replacement of certain appliances (fridges and bulbs), in order to help users reduce their consumption (Pilo’, 2016). The program ultimately covered 240 favelas and about 260,000 clients (Light, 2010).

The privatization has consequently triggered an important shift when compared to the public period. Although there were irregular connections in place after the electrification program, these were tolerated as part of a social and spatial contract due to the human and financial costs that efforts to combat irregular connections would incur. In contrast, regularizing electricity access became one of the priorities of the recently privatized provider,
embedding the ideal of technical and commercial order. This ideal, however, had to overcome different governance challenges linked to the urban context in which the provider operates.

**Everyday governance: Negotiating technical and commercial order**

Almost 20 years ago, the French weekly journal Marianne, published an article titled “Comment les favelas ont débrançé EDF” (How the favelas disconnected EDF) (Kalouguine, 2002). This piece went on to describe the continuous presence of irregular connections despite the electricity company’s efforts to regularize electricity access. These issues continue to remain relevant today, despite Light’s major shareholder having changed. The enduring issue of commercial losses can be explained by highlighting different potential determining factors, such as the increase in electricity tariffs following privatization, for example. However, I would like here to analyze the governance-related determining factors underlying commercial losses: how commercial losses are entangled in complex structures that affect both the provider’s practices and infrastructural inequalities.

As several company agents explained in interviews, efforts to execute regularization measures and operations on the grid must have the support of local actors. This can be linked to practical reasons, such as providing guidance to the company’s agents inside the favelas but is also a way to build more structural relationships. Regularization operations, in particular, are implemented through different measures, including community meetings that require the mediation of local actors who often serve as the interface between institutional actors and residents. The company generally relies on residents’ associations, but it can also draw support from local leaders or NGOs that have visibility and legitimacy among residents. The rise of violent gangs linked to drug trafficking in favelas is also a significant phenomenon that the company has had to integrate in its management strategies. When the private provider first arrived in Rio during the 1990s, gangs linked with drug trafficking already had a consolidated presence in the favelas. Moreover, the rapid expansion of militias during the 2000s, mostly composed of current and former police officers, introduced a new form of organized crime into the favelas. These actors affect favela residents’ everyday lives and emerge as local forms of governance that enforce territorialized norms, which enable them to build their territorial power (Arias, 2017; Lilyblad, 2014; Machado da Silva, 2008). Although non-violent governance in favelas is central to fully understanding favela governance (Fahlberg, 2018), the presence of violent actors also affects electricity management practices as the provider has to directly or indirectly negotiate to ensure it can access the favelas.

Consequently, the regularization and grid operations depend on the company’s ability to build relationships with local organizations, and on the security environment, which can be highly specific to each favela. In this context, infrastructure–related operations, particularly the most sensitive activities, such as disconnections for non-payment or maintenance and repairs in the event of black-outs, provide key opportunities for understanding the link between governance and infrastructural performance. In interviews with various agents working for the company and with residents in favelas, the breakdown of a transformer emerged as a specific point of negotiation. In fact, although local electricians can undertake minor interventions on the installations, particularly at residential level, the larger grid maintenance operations require direct intervention by the electricity company. For residents, this can be the opportunity to claim further improvements to the electricity system whereas, for the company, it can be used to negotiate and improve a failing commercial relationship. Thus, these interventions can acquire specific meanings depending on the actor.
For local leaders, electricity breakdowns can be used as evidence to support demands for improvements to enhance the performance of the electricity grid, by replacing a transformer for example, in order to prevent future breakdowns. In contexts in which requests from individual residents have less chance of receiving a prompt response, specific actors can become mediators of the inhabitants–provider relationship, particularly around technical issues that can concern the favela as a whole, or even just a specific part. Politicians can also mediate requests to improve electricity infrastructure, often as part of patronage practices, as already underlined by Goirand during the 1990s (Goirand, 1999). However, periods when problems occur are also when conflicting visions of the weak performance of the grid emerge. The provider often attributes the difficulties in maintaining an adequate service to the irregular practices used by residents and to the context of violence, whereas residents see in breakdowns the expression of the company’s lack of willingness to provide adequate infrastructure.

The way in which electricity infrastructure is managed forms part of a “negotiated order” in which actors’ practices and commercial and technical performances come together. In fact, in areas with high commercial losses, improvements to the grid can entail negotiations with local actors in order to set up payment plans,15 in a context in which disconnecting non-paying customers poses different challenges. Gangs can directly hamper agents’ efforts to cut off irregular electricity connections by preventing their entrance to the favelas. This can be interpreted as a way of asserting their territorial control by creating an environment in which residents can continue to access electricity for free or at lower prices. At the same time, operations to disconnect customers can also fail due to conflict between residents and agents or are just not effective because the illegal connections are rapidly re-installed as soon as the agents leave.

The ability of the company to disconnect non-paying customers, however, does not only depend on contingent governance structures, but also on the technical system used to regularize access. Since 2009, the company has started to regularize electricity access through a “smart metering system” that automates the most sensitive customer operations. These smart meters make it possible to disconnect non-paying customers remotely from the company’s headquarters through a telemetry system. In favelas, the installation of this system has been linked to the security policy implemented by the State of Rio de Janeiro since 2008 in a certain number of favelas, the Pacifying Police Units (UPP). This smart metering system has been largely installed in areas with high commercial losses both in and outside the favelas and is considered to be the most efficient loss reduction technical instrument. In favelas in which a smart metering system has been installed, disconnections have become easier to execute. Installation of this system has also reshaped the power relations between consumers and the provider as it has introduced the automation and protection of infrastructure, leading to several conflicts between the company and consumers in and outside the favelas (Pilo’, 2017).

During the first few years of the UPP security policy’s implementation, the permanent presence of the police provided a more “secure” environment for the company to implement these socio-technical measures. The financial and security crisis that has been affecting the State of Rio de Janeiro since 2016, however, has considerably shaped the conditions under which the company now operates. In particular, since the Federal government took over the security of Rio de Janeiro in 2018, military operations have multiplied in favelas with the goal of disrupting gang control. These military operations have also been occurring in favelas previously considered as “pacified.” These operations can considerably disrupt the functioning of the electricity system. Already in 2016, when confrontations between gangs
and police started to intensify, shootings caused 268 electricity service interruptions, essentially in favelas (Bastos, 2017).

The management of electricity infrastructure, including maintenance, repair, and disconnection operations, is intrinsically entangled in governance structures in which actors negotiate technical and commercial arrangements. Thus, the materiality of the grid and its performance can reflect localized compromises. However, it also expresses arrangements that are negotiated in more institutionalized arenas. As we will see in the next section, bringing together these two levels of negotiations is essential for understanding the way in which spatial relations and inequalities are reproduced and institutionalized through infrastructure.

**Spatial inequalities and electricity provision: The categorization of “risk areas”**

These differentiated local governance practices also raise questions around the way in which infrastructure reflects and reproduces urban inequality (McFarlane, 2010). As explored in detail in this section, in practical terms, these inequalities are manifested through what I call here a policy of “non-disconnection” and a differentiated quality of electricity provision. These two dimensions are, in fact, related as they are both linked to the difficulties the company encounters in both reducing commercial losses and maintaining an adequate level of quality of electricity provision. In particular, the context of unpredictable violence in a large number of favelas is presented as one of the main obstacles to operating in these areas. This is a central issue for understanding the emergence of a new categorical device, namely the definition of “risk areas,” as both a revelator and a producer of infrastructure inequalities.

The territorialization of drug trafficking has helped create an image of Rio de Janeiro as a socio-politically fragmented city, and of the favelas as a locus of urban violence, contributing to their designation as “risk areas” (Lopes Souza, 2008). The company also uses this categorization within its management practices. The “risk area” (área de risco) categorization is used to identify the favelas considered to pose a physical danger for the utility’s agents during day-to-day operations. It is defined as follows: “Areas (neighborhoods, streets, buildings, etc.), where the operational service requires different actions because of a physical threat and the presence of informal authorities, weighing on the agents of the Light” (Galvão, 2006).

In 2011, the company mapped 496 “risk areas,” covering 580,000 customers (Light, 2011: 17). In order to understand the scale of this categorization in relation to the broader segment of “low-income communities,” Table 1 presents the number of communities classified as “risk areas” and “non-risk areas” and the number of clients.

As Table 1 shows, the vast majority of customers (83%)—i.e. those people who have a contract with the electricity provider and have had a meter installed—live in zones classified as risk areas. The increase in violence and the worsening security conditions seen in the city since 2016 have considerably affected this classification and the number of customers in

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Source: Developed by the author from Light’s data (2011: 17).
“risk areas” has substantially increased. In 2018, the company affirms that 883,000 customers live in “risk areas,” which corresponds to 20.5% of Light’s total customers.¹⁶

This “risk area” category can be viewed as a pragmatic way of implementing differentiated electricity management routines, i.e. identifying areas that pose risks to staff when attempting to cut-off non-paying customers, or when a broken transformer needs to be changed, for example. However, this everyday governance category also plays a role in negotiations with the national electricity regulator, ANEEL, particularly as part of discussions to redefine the provider’s contractual obligation in these areas in terms of reducing commercial losses and improving the quality of electricity provision. These negotiations shed a light on the meaning of this categorization, bringing together physical and commercial risks.

In fact, the national electricity regulator, ANEEL, sets commercial loss reduction targets to be achieved by each distribution company each year in order to encourage the providers to proactively work to optimize the electricity distribution system. This should also distribute the financial cost of the commercial losses more fairly between providers and customers. In fact, the regulatory system stipulates that part of the cost of commercial losses is to be paid by the electricity provider, while the remainder is to be shared between customers within the concession area through electricity tariff revisions. The size of each percentage is not defined in advance. Instead, this forms part of negotiations between ANEEL and each electricity provider and there are several aspects that are considered to be determining factors for achieving the commercial loss reduction targets. In this context, the “risk area” category becomes an important instrument for demonstrating to the national regulator the difficulties involved in reducing commercial losses in these areas, and for negotiating loss-related cost-sharing. In the case of Light, the percentage of commercial losses absorbed by tariffs is about 30% on average.

In “risk areas” the quality of electricity provision is also compromised when compared with other areas of the city. Disparities emerge when we analyze the electricity provision quality indicators at intra-urban level. In fact, each concession area is divided into “electricity neighborhood sets” (conjuntos elétricos) in which different maximum numbers of hours of supply interruptions are allowed by ANEEL.¹⁷ During the years 2000, the difficulties Light encountered in maintaining a certain quality of electricity provision in favelas were used to justify the need to categorize several favelas as separate “electricity neighborhood sets.” In these areas, the number and duration of electricity interruptions tolerated by the national regulator was generally considerably higher than in all other urban areas (O Dia, 2009; Pessanha et al., 2007; Pilo’, 2018). As an example, the maximum duration of supply interruptions allowed by ANEEL between 2002 and 2008 in Ricinha-Vidigal, two favelas in the southern area, were 23 hours per year. In contrast, for Leblon and São Conrado, the wealthy neighborhoods in which these favelas are located, it was only 3 hours per year (source: public indicators of duration and interruption of the electricity service, ANEEL).

Favelas are now no longer classified as separate conjunto elétricos, which makes it more difficult to track inequalities in the quality of electricity supply through public data. However, Light is currently trying to negotiate different electricity provision quality targets in “risk areas” with ANEEL by attesting to difficulties in maintaining an adequate level of quality in electricity supply and reducing commercial losses (ANEEL, 2017). The favelas that have formally installed a UPP and that have been de-classified as “risk areas” over the past few years can also now once again be defined as “risk areas” if they are considered to have a strong gang presence and if there are frequent confrontations with the police.
The “risk area” categorization emerges at the intersection of different rationalities, linked to the provider’s reading of the environment, its negotiations with the regulator, and (im) possibilities for regularizing customers. It is produced through socio-technical processes that bring together different indicators and material infrastructure. Aspects such as the level of violence, income inequality, degree of informality, and quality of infrastructure are combined with documents (pictures, newspaper articles, etc.) that provide evidence of company agents being threatened when attempting to carry out disconnections, and the difficulties involved in providing electricity infrastructure of adequate quality. The material components of infrastructure help in constructing this categorization as specific transformers fitted with meters are located at the edges of the favelas in order to provide a more accurate reading of how much electricity is being distributed and, consequently, obtain more precise information on the commercial losses incurred within a specific area.

Thus, this dynamic shows how infrastructural inequalities are produced through a multi-level governance process in which urban violence, technical and commercial performances come together to define infrastructural performance and access, which reinforces the idea of urban infrastructural inequalities as matter of negotiation.

**Conclusion**

This article has explored the urban geography and techno-politics of infrastructure by examining the spatial inequalities produced within the electricity network in Rio de Janeiro. The case of Rio has provided opportunities to consider a context in which physical access to the electricity network is near universal, but specific urban governance patterns reshape the assumptions embedded in the modern infrastructural ideal. Approaching networked infrastructural inequalities through governance has helped reveal how they emerge from negotiations, between different actors at different levels, that directly or indirectly define the technical and commercial performances of the network. Thus, the article has sought to consider the meaning and performance of the infrastructural ideal as being deeply embedded in the urban political context.

Research on infrastructures and urban fragmentation has focused attention on the effects of privatization reforms on service delivery and access to urban services through a focus on its institutional aspects. However, little attention has been paid to the spatial reshaping of the modern infrastructural ideal within urban fragmentation processes and privatization reforms. In this paper, I have argued that this is a central issue for considering the concrete performances, meanings, and the unequal impacts of the electricity grid. In Rio de Janeiro, privatization has reshaped the ideal of the networked city into a new ideal: the “regularized network.” By analyzing the specific urban developments in which a “regularized network” has been implemented, this paper has demonstrated that the electricity network is entangled in heterogeneous power relations that negotiate forms of spatial inequalities. The analysis has also revealed how these inequalities are simultaneously negotiated within local and urban contexts and within more institutionalized, national arenas. Thus, the materiality of the electricity grid in favelas is both the product and a producer of spatial inequalities created through a multi-scalar process in which power and spatial relations are reshaped through material, commercial, and institutional negotiations.

This partially responds to the criticism Cesafsky (2017) made vis-à-vis fragmentation research: “by connecting ‘bad’ infrastructural forms to various social and political ‘bads,’ fragmentation research does little to challenge the common-sense imagination that walls divide and channels connect” (p. 149). Instead, by approaching the heterogeneous governance structures in which the grid operates, this article has taken the fragmented nature of
the city of Rio de Janeiro as a starting point for questioning the meaning of a near universal network. Focusing on the larger governance structures in which the grid’s management practices take shape has revealed that these negotiations respond to different rationalities and that the socio-political nature of the urban environment is embedded in the utility’s socio-technical arrangements.

Finally, the example of Rio de Janeiro suggests that the meaning of connections and the politics of non-disconnection should be analyzed together to understand the way in which infrastructure shapes spatial differentiation. These are relevant questions because, as I hope to have shown in this paper, the failure of the ideal of the “regularized network” combined with the current backdrop of urban violence, is increasing urban inequalities, not only in terms of quality of electricity provision but also, and more symbolically, in terms of infrastructural decadence. This suggests that, in order to understand how urban inequalities change through infrastructure, it is important to look beyond the form and organization of infrastructure, and investigate its contextual meaning within unstable power relations.

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Notes

1. With the exception of Myanmar and Pakistan.
2. This research builds on participant observation in two favelas, as well as semi-structured interviews with residents and community leaders, and interviews with a range of different actors within the electricity company at various levels that covered various aspects of electricity infrastructure governance in favelas (98 interviews in total). These interviews were conducted with technicians in charge of different operations, such as network maintenance, repairs and disconnections, and agents in charge of the relationship between the company and the favelas, which the company refers to internally as “low-income communities.” I combine these qualitative data that document electricity infrastructure management practices in favelas with an analysis of the legislative framework surrounding these practices, particularly legislation pertaining to the quality of the electricity service.
3. In February 2018, Michel Temer, who became the president of Brazil in August 2016 after the Senate ousted Dilma Rousseff in an impeachment vote, signed a decree that put the military in charge of security in Rio de Janeiro due to the state of Rio de Janeiro’s increasing inability to
maintain public order. Under this federal intervention, which has been denounced both nationally and internationally as threatening Brazil’s already fragile democracy and favela residents’ human rights, violent military operations have multiplied in favelas. Favela residents have been experiencing the militarization of their everyday life, not only through military attacks but also operations to check ID cards, and photograph and register residents.

4. Indicators available at: http://www.aneel.gov.br/anos-de-universalizacao

5. Historical documents from Light reveal that favela inhabitants had already had access to the electricity grid since 1905 (Light, 1987). This is not much later than the emergence of the first favelas in around 1890 and the electrification of the rest of the city at the end of the 1800s (Cachapuz, 2006). At that time, however, public authorities essentially tolerated electricity provision to the favelas without officially sanctioning it. Access was precariously provided through meters installed at the borders of favelas. Since then, different policies have been introduced, which have varied depending on the government and the political period (including the dictatorship), that have redefined the management of electricity access in favelas. However, we can say that until the official electrification during the 1980s, access to the electricity network was governed by both tolerance and patronage-based arrangements but was not recognized as a right. For an exhaustive overview of access to electricity from the beginning of the XX century, see Pilo’ (2015).

6. Interview with the Light’s superintendent of “Social Electrification Program” during the 1980s, 21 September 2011.

7. In Brazil, “gato,” which literally means “cat,” is a practice of “bypassing” the electricity meter and thus recording lower consumption than the actual consumption.

8. As in several other countries, particularly in Latin America, the Brazilian electricity sector underwent reforms based on the principles of privatization and of reducing the traditional role of the state as the main provider of urban services.

9. Commercial losses, also referred to as “non-technical losses,” are caused by fraud or incorrect meter readings and are therefore directly related to the commercial management of the service. This is electricity supplied but not billed.

10. Two foreign companies won the tender for the city of Rio de Janeiro concession area: the American company AES Corporation—Reliant Energy and the French firm Électricité de France (EDF). In 2002, EDF became the major stakeholder of Light before deciding to sell 80% of its shares to the Brazilian Rio Minas consortium in 2006.


13. The social community agents are directly involved in projects on the ground and are key points of liaison with the inhabitants and main leaders within the favelas.

14. Interview with the Light’s superintendent of “Social Electrification Program” during the 1980s, 21 September 2011.


16. Personal communication.

17. An “electricity neighborhood set” consists of groups of consumers located in the same area and its demarcation takes into account a range of technical criteria, such as the type and quality of the network, the number of consumers in the area, and the economic value of a specific area, i.e. the economic losses that an interruption in electricity provision would incur, for example in business district areas.

References


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