Rio de Janeiro: An (Inequitably) Connected City?

Electricity Provision and Spatial Division

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Translated from the French by Oliver Waine

The tangled webs of electrical wires, a symbol of the favelas*, are also the sign of an electricity service that remains profoundly unequal and uncertain in Brazilian cities. Francesca Pilo' considers the varying quality of electricity distribution in Rio de Janeiro, and shows how this network contributes to dynamics of urban fragmentation that go beyond the simple dichotomy between shanty towns and prosperous neighborhoods.*

Despite the universal nature of electricity provision, in terms of territorial coverage and physical access, the centralized electricity network in Rio de Janeiro only partially fulfills its function of supplying a homogeneous service across its territory—in which it is supposed to help increase solidarity and equality (Dupuy 1985). The mass of overhead electrical cables visible throughout Rio's *favelas* is the first thing that hints towards a "fragmented network" (Kooy and Bakker 2008) and suggests the existence of an urban fragmentation ("splintering urbanism") process due to the "unbundling" of previously integrated infrastructures (Graham and Marvin 2001).[1] In the context of Brazilian cities, the material precariousness of the electricity network on an intraurban scale has very rarely been analyzed as a possible vector of sociospatial fragmentation[2] (one exception being the 2011 study by Zanotelli and Galvão), and little attention has been accorded to the sensitive question of service quality (outages and brownouts), generally considered one of the consequences of a physically deteriorated network. And yet, in Rio, analyses of the technical, institutional and political factors that create differentiated service quality levels—in terms of both regularity and continuity of supply—are possible, and enable us to specify the dynamics of spatial division at play in the city.

[1] Here, I refer to a debate in the literature on urban infrastructure, in particular surrounding the splintering urbanism thesis put forward by Steve Graham and Simon Marvin (2001). According to these authors, following reforms to liberalize national utilities monopolies, there has been a deterioration of infrastructures that exacerbates dynamics of sociospatial fragmentation in cities. Several empirical studies, however, have shown the limitations of this thesis, particularly in cities in the Global South (in this regard, I would refer readers to works produced by members of the LATTS research unit, such as Jaglin (2005) and Coutard (2006), as well as the issue of *Geoforum* titled "Placing Splintering Urbanism", 2008). While I am unable here to consider this debate and its relevance to the Brazilian context in greater detail, my research suggests that differentiated forms of electricity supply management observed after reforms of the Brazilian electricity sector in the 1990s tend to follow and reinforce fragmentation processes already under way (Pilo' 2015).

[2] This notion refers to urban situations that stand out because of their dispersed forms, their heterogeneity, and their lack of interconnection, both in functional and visual terms (Navez-Bouchanine 2002).

Figure 1. Electricity network in the *favela* of Cantagalo, in the South Zone of Rio de Janeiro

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The deteriorating quality of power supply

The quality of electricity supply is a major issue in Brazil, as it is essential for economic development, as well as for the quality of life of a population that is now extensively connected to the electricity grid, particularly in urban areas, including low-income households (97.5% of the population; World Bank 2016). Its importance results in contractual obligations in terms of continuity of supply, imposed on electricity distribution companies by ANEEL, the Brazilian electricity regulator.[3] These obligations are expressed in terms of the maximum power outage rate,

[3] ANEEL: Agência Nacional de Energia Elétrica (National Electrical Energy Agency) is an administrative authority that is independent of public bodies whose function is to regulate the electricity sector on a national level. It was

using two indicators: the DEC (*duração equivalente de interrupção por unidade consumidora*, or equivalent outage duration per consumer unit), which measures the duration of power outage (in hours per year[4]) and the FEC (*freqüência equivalente de interrupção por unidade consumidora*, or equivalent outage frequency per consumer unit), which measures how often power outages occur. Each year, it is therefore possible to observe the cumulative frequency and duration of power cuts recorded in different concession areas and compare these figures with the maximum acceptable values defined by the regulator.

An analysis of these indicators for the concession area of Light, the electricity distribution company for the city of Rio de Janeiro, highlights its mediocre performance. In 2012, stood in 32nd place (out of 35) in the league table of companies for the quality of electricity supply, published annually by ANEEL, and 34th place in 2013. While ANEEL demands continual improvements in service quality, reflected in the downward trend in maximum permitted DEC and FEC values visible in the table below, the reality is that service quality levels generally deteriorated throughout the 2000s.

Table 1. Service quality in the Light concession area, 2000–2012

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
DEC recorded	6.89	7.06	10.05	8.74	8.30	8.77	7.99	9.09	11.06	14.03	11.33	16.73	18.15
Max. permitted DEC	29.03	11.47	11.28	11.09	11.04	10.92	10.76	10.61	10.59	10.28	9.97	9.68	9.37
FEC recorded	6.66	6.10	6.93	6.22	6.34	7.67	6.30	6.39	6.74	7.13	5.76	7.76	8.39
Max. permitted FEC	41.82	10.20	10.02	9.91	9.97	9.91	9.78	9.73	9.76	9.47	8.78	8.15	7.52

DEC: duration of power outages in hours per year.

FEC: number of outages per year.

Source: author's work based on data from the ANEEL website.[5]

"Electricity sectors": a tool for dividing urban space

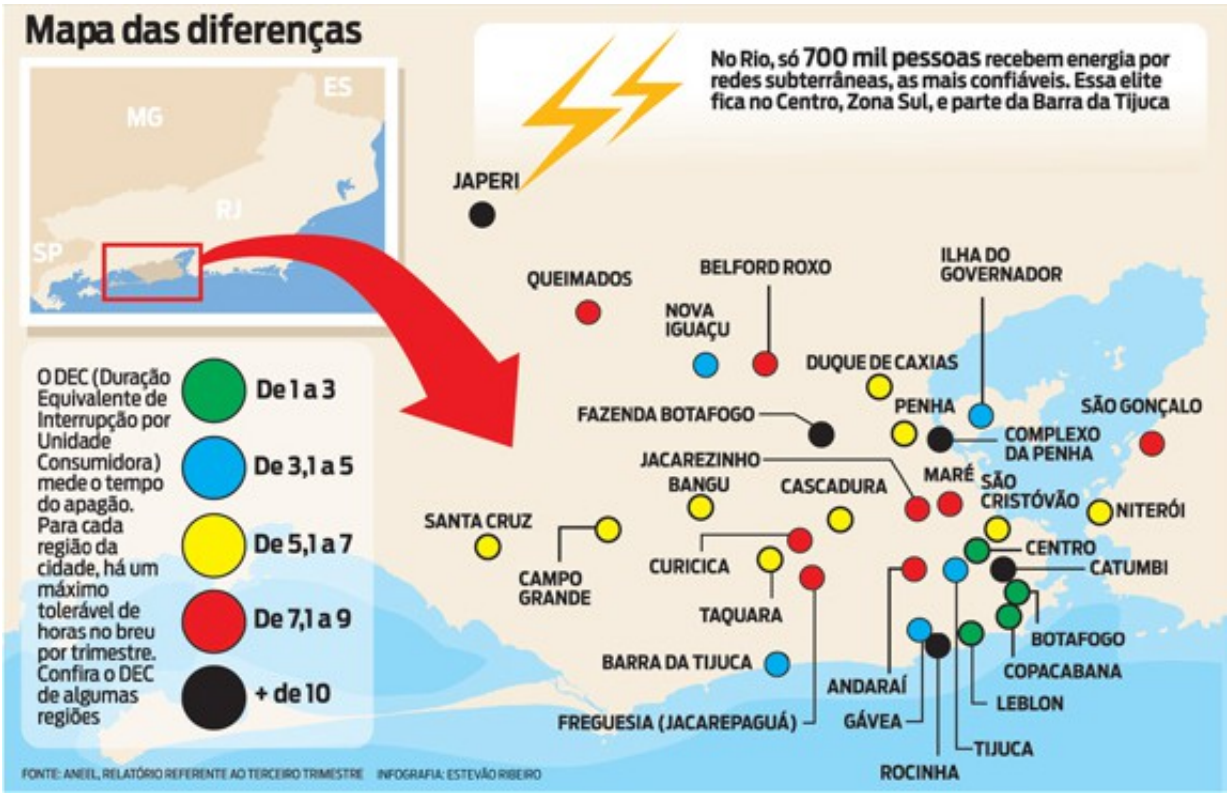
However, these indicators give only a partial view of the day-to-day situation in different parts of the Light concession area. In reality, quality levels observed vary greatly from one neighborhood to another. The most affluent areas (in the South Zone of the city) and central Rio enjoy much higher service quality levels than other districts. This can be explained first of all by an institutional process that creates a sociotechnical division of the city: the concession area is subdivided into *conjuntos elétricos* ("electricity sectors"), each of which covers a group of consumers in a particular geographical area. What the concession-wide figures mask is that these sectors each have their own maximum acceptable outage rates, defined by ANEEL, which vary considerably from one sector to another. A map published in an article in regional daily newspaper *O Dia* titled "The social division of the electricity network" ("*A divisão social da rede elétrica*"; Barreto and Moniz Ribeiro 2009) illustrates these intraurban variations.

created in 1996, following a restructuring of the Brazilian electricity sector. It has its own resources and revenues, obtained through contributions from bodies in the electricity sector (distribution, transport, and production). The aim of this reform was to eliminate the risk of politicization and pressurization by public authorities (Defeuilley, Cauret and de Gouvello 1999). Owing to its supposed neutrality, ANEEL is theoretically responsible for regulating conflicts, protecting consumers, and ensuring companies in the sector respect contractual rules and, in the case if electricity distribution companies, changes in energy tariffs.

4 It should be pointed out here that other, more nuanced, indicators are also produced by ANEEL, in particular monthly service interruption indicators and individual indicators for each consumer.

5 On the ANEEL website, all service continuity indicators can be consulted using the "*Indicadores de Continuidade*" tool. See: www.aneel.gov.br/aplicacoes/indicadores_de_qualidade/pesquisa.cfm?regiao=SE.

Figure 2. Maximum power-outage durations tolerated by ANEEL in different areas of greater Rio de Janeiro



Key (total quarterly "tolerated" duration of power outages):

green: 1–3 hours; blue: 3.1–5 hours; yellow: 5.1–7 hours; red: 7.1–9 hours; black: over 10 hours.

The green dots correspond to the very affluent neighborhoods of Leblon, Copacabana, and Botafogo, in the South Zone of the city, as well as downtown Rio. At the other end of the spectrum, the black dots mostly correspond to *favelas*: such as Rocinha (also in the South Zone), Complexo da Penha (in the North Zone), and Catumbi, an area of central Rio that contains a large number of *favelas*.

Source: Barreto and Moniz Ribeiro 2009.

The way these electricity sectors are defined is linked to technical and economic issues: the distribution company (in this case, Light) submits a list of sectors to ANEEL, drawn up using criteria that are in part technical, such as the type of network and the number of consumers in each sector, and in part economic, based on estimates of the financial losses that a power cut could incur.[6] Furthermore, an analysis of the names of these sectors partially reveals the political dimension of these divisions, as certain *favelas* are officially classed as electricity sectors in their own right.

The institutionalization of differentiated service quality in Rio's *favelas*

Of the 70 electricity sectors in Light's concession area in 2001, 12 covered *favelas*, including some of the largest such districts (Pessanha, Souza and Laurencel 2007). The quality of electricity supply in these areas is closer to that observed in rural areas and in the Baixada Fluminense region, on the northern edge of Rio, than in other neighborhoods of the city.

[6] Source: interview with an electrical engineer at CREA-RJ (Conselho Regional de Engenharia e Agronomia do Rio de Janeiro – Regional Council of Engineering and Agronomy of Rio de Janeiro), November 10, 2010.

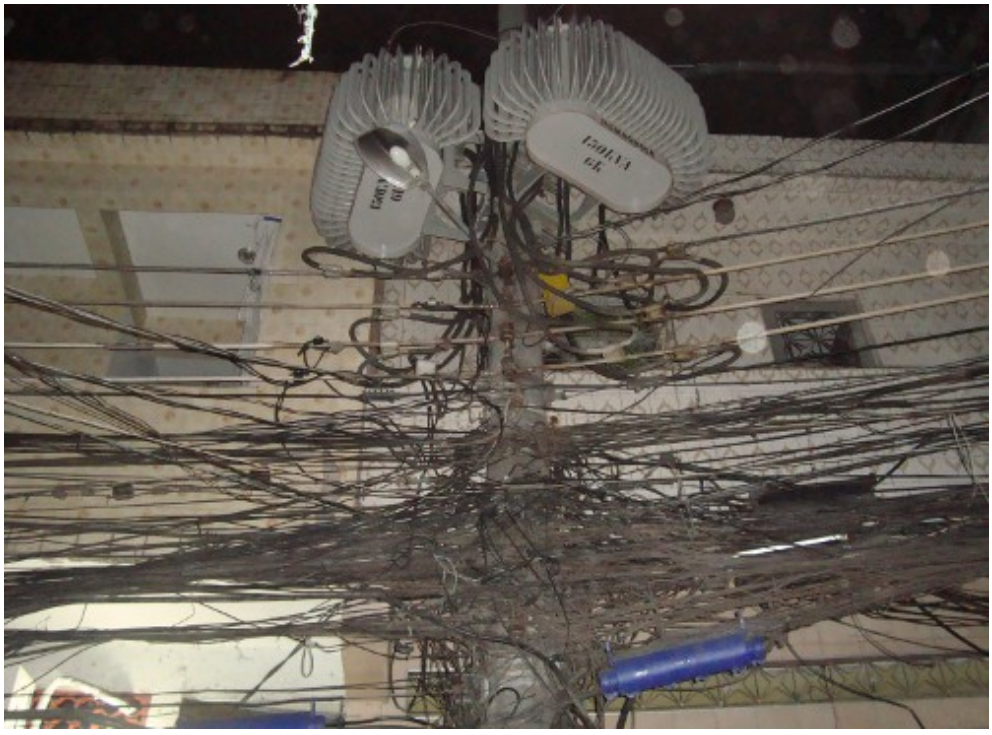
Table 2. Recorded DEC and FEC values by region – Light (2001)

Region	Number of electricity sectors	DEC	FEC	Installed capacity (MVA)	Number of consumers
Rural areas	11	17.43	14.57	458	138,702
Favelas	12	12.54	6.54	181	139,563
Rio de Janeiro	27	5.46	5.00	7,344	2,038,859
Baixada Fluminense	10	10.34	8.86	1,758	837,569
Sul [South] Fluminense	10	4.67	5.88	1,504	243,529

Source: Pessanha, Souza and Laurencel 2007.

Analysis of the maximum accepted and actually recorded DEC and FEC values throughout the 2000s reveals a form of institutionalization of lower quality levels when it comes to electricity supply in those sectors that cover *favelas*. The maximum numbers and durations of power outages accepted by ANEEL are generally higher there than in other urban sectors—and, over the last 10 years, these limits have not really been reduced.[7] It should be noted, however, that the recorded duration of power outages varies from year to year, and does not always exceed the limits set by ANEEL. For example, the maximum permitted outage duration in Rocinha–Vidigal, two *favelas* grouped together in the same electricity sector, was fixed at 23 hours between 2002 and 2008, but in 2002 and 2003 "only" 13 hours of outages were recorded in this sector; by contrast, 27 hours of power cuts were recorded in 2004, and 20 hours in 2009. Another example concerns the *favela* of Jacarezinho (in the north of the city), where the maximum permitted outage duration between 2004 and 2007 varied between 25 and 28 hours, whereas the actual duration of power cuts recorded ranged between 13 and 19 hours.

Figure 3. An electrical transformer in the Manguinhos district



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[7] I analyzed DEC and FEC indicators between 2000 and 2013 for the electricity sectors corresponding to *favelas* using data available online via ANEEL's "*Indicadores de Continuidade*" tool. See: www.aneel.gov.br/aplicacoes/indicadores_de_qualidade/pesquisa.cfm?regiao=SE.

The spatial fragmentation effect with regard to power supply quality is even more marked if we consider the fact that many of these *favelas* border the most affluent area of the city, which benefits from much lower permitted outage thresholds. In this respect, the example of the Rocinha–Vidigal electricity sector is edifying: while ANEEL's maximum permitted DEC value for this sector between 2002 and 2008 was fixed at 23 hours per year, the corresponding value in neighboring Leblon and São Conrado was set at just 3 hours per year.

Rio has between 600 and 1,000 *favelas* according to official statistics. The fact that only eight of these (in 2010) were defined as electricity sectors in their own right could minimize the importance of this institutional division. What is more, the number of sectors allocated to *favelas* within the Light concession has declined slightly, from nine in 2002 to eight between 2003 and 2010[8]). However, on the one hand, this division concerns large *favelas*, and thus a large number of habitants;[9] on the other hand, the official nomenclature of electricity sectors only partially takes account of the process of spatial differentiation with regard to service quality: for example, the number and duration of power outages in three *favelas* in the South Zone of Rio, which do not appear in the nomenclature as sectors in their own right (but as part of sectors including other neighborhoods) show that the division between *favelas* and other districts persists when it comes to service quality.

The table below shows the DEC and FEC values for these three *favelas* (Chapéu Mangueira, Babilônia, and Santa Marta) and the difference between these figures and the average values for the Light concession area as a whole.

Table 3. DEC and FEC values observed in three *favelas* in the South Zone of Rio (2008)

Area	DEC	FEC
Chapéu Mangueira	43.56	13.32
Babilônia	73.00	23.09
Santa Marta	11.31	2.71
Light (network average)	11.06	6.74

Source: Light (internal document), 2008.

The ongoing processes of "sociopolitical fragmentation of the city" (Lopes de Souza 2005), produced through the presence and territorial control by gangs in the *favelas*, appear as a dynamic that sustains and feeds the uneven quality of the electricity service recorded in the *favelas*. In fact, their presence has multiple effects on the way services are managed in the *favelas* and can result in a policy of minimal intervention in terms of network improvements, which has serious consequences on service quality. In this context, while their presence does not appear to have played a role in redefining the boundaries of electricity sectors, it has become a key issue in legitimizing the differentiated management of electricity services in the eyes of the regulator. This dynamic invites us to consider the quality of electricity provision not only as a technical and economic issue, but also as something embedded in and produced through heterogeneous governance structures.

[8] In 2002, the electricity sectors covering *favelas* were as follows: Catumbi, Complexo da Maré, Complexo da Penha, Jacarezinho, Mangueira, Morros de Copacabana, Rio das Pedras, Rocinha–Vidigal, and Vila Vintem Favelas. From 2003, Vila Vintem Favelas no longer appeared in the official nomenclature.

[9] For example, according to figures from IBGE (Instituto Brasileiro de Geografia e Estatística), the Brazilian national statistics office, Rocinha has a population of 70,000, a number which is contested by residents who claim the real population is twice this figure, at around 140,000. The complex of *favelas* that form the Maré district is also home to some 140,000 residents.

Towards integration through service quality requirements?

In 2009, Light considerably exceeded the maximum permitted power-outage values laid down by the regulator in all sectors corresponding to *favelas*.[10] However, since 2010, following a redefinition of the electricity sectors, these *favelas* no longer appear in the official nomenclature as sectors in their own right. Their disappearance could suggest that the *favelas* in question have been incorporated into the sectors corresponding to the wider neighborhoods they belong to, and therefore, more generally, that they benefit from a better level of service. In reality, the new electricity sectors established in 2010 exhibit forms of internal differentiation by geographical area and by network type (overhead or underground), and differences in service quality requirements continue to exist. The maximum permitted outage durations and frequencies for areas supplied by underground cables are generally much lower than for those served by overhead wires. In the South Zone and central Rio, electricity is supplied to the *favelas* that border affluent districts primarily by overhead wires, whereas their wealthy neighbors are supplied by underground cable. So, for example, in the São Conrado electricity sector, the annual duration of power cuts in the overhead network—including the *favelas* of Rocinha and Vidigal—stood at 32 hours in 2011, while those parts of the sector served by underground cables only experienced 6 hours of outages.

Analyzing the quality of electricity supply in the city only partially reveals the processes of urban fragmentation that exist as a result of the way different infrastructures are managed. It does, however, help to explain how, in a context where physical access to the network is considered universal, less visible forms of differentiation—that go far beyond the dichotomy of "connected or not" (Jaglin 2004)—produce spatial inequalities. Although this article has focused on Rio's *favelas*, finer analyses of these indicators across the city could be produced. As electricity supply issues are far from limited to the *favelas* alone, examining them can bring to light other processes of fragmentation in the city, beyond the division between *favelas* and other neighborhoods.

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[10] The most extreme example is to be found in the Morros de Copacabana sector, in 2009, where the maximum permitted DEC value was 20 hours and the annual duration of outages actually recorded was 51 hours.

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