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Infrastructural Heterogeneity: Energy Transition, Power Relations and Solidarity in Kingston, Jamaica

Francesca Pilo' 

Department of Human Geography and Planning, Utrecht University, Utrecht, the Netherlands

ABSTRACT



In cities of the Global South, socio-technical heterogeneity in electricity provision is a reality that has partially shifted debates to the diversity of arrangements beyond the grid. Building on the case of Kingston in Jamaica, this article focuses on the relationship between the grid and such heterogeneous configurations and considers how heterogeneity transforms existing power relations. By analyzing the different strategies that actors (the government, the electricity provider, different types of consumers) have developed to address different challenges (energy transition, non-technical losses, affordability, etc.), the article shows how this heterogeneity entails a political process that reshapes possibilities and constraints for governing, and being governed by, the electricity grid. This analysis suggests taking solidarity as a central dimension when considering how to govern heterogeneous configurations, including the relationships between consumers, types of socio-technical systems and neighborhoods.

KEYWORDS

electricity infrastructure; heterogeneity; power relations; energy transition; solidarity

Introduction

Cities of the Global South have historically been studied through the lens of their (often uncompleted) networked infrastructure (e.g. electricity, water, etc.) in order to contribute to debates on urban fragmentation, spatial inequalities, and citizenship (Graham and Marvin, 2001; Lemanski, 2018; McFarlane and Rutherford, 2008). During the past few years, the focus has partially shifted from the network to the diversity that characterizes urban services provision in these cities (Jaglin, 2014; Koepke et al., 2021; Lawhon et al., 2018; Munro, 2019; Rateau and Jaglin, 2022). The notion of “heterogeneity” particularly dominates this emerging debate, which examines the presence of these systems and their implications for access, energy transition, and service co-production. “Heterogeneity” seems to be able to capture the pragmatic response of these cities in which the infrastructural ideal fails to provide a uniform service, while also offering “an analytical lens through which to compare different configurations” (Lawhon et al., 2018: 720). Whereas urban infrastructure studies have a strong tradition of deeply analyzing

CONTACT Francesca Pilo'  f.pilo@uu.nl  Department of Human Geography and Planning, Utrecht University, Utrecht, the Netherlands.

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single infrastructures and objects (e.g., pre-paid meters, smart meters, solar panels, etc.), the material, spatial, and socio-political aspect of the diversification of these socio-technical arrangements is still poorly understood (Koepke et al., 2021; Rateau and Jaglin, 2022). Despite heterogeneity being increasingly considered “an integral part of the material fabric of southern cities” (Jaglin, 2014: 435), empirical understanding is still limited, particularly outside the African context.

This article contributes to these emerging discussions on “heterogeneity” through an analysis of the diverse socio-technical arrangements that characterize electricity provision in Jamaica, with a specific focus on the city of Kingston. Kingston offers an interesting perspective from which to explore heterogeneous socio-technical configurations because it has relatively different infrastructural conditions to many African urban contexts, which mainly inform debates on heterogeneity. Whereas in African cities heterogeneous electricity configurations primarily emerge as a response to poor electricity supply and an uncompleted electricity grid, in Kingston the grid is universalized, but the provider-consumer relationship that is developed through the grid is transformed by multiple socio-technical configurations. Thus, heterogeneity is not a direct response to the absence, incompleteness, or incapacity of the grid to respond to users’ demand. It actually develops as part of a close relationship with the grid itself, and under the pressure of other important issues, such as energy security, imperatives for energy transition, affordability, and non-technical losses (electricity theft), etc.

In this article, I analyze these configurations from the perspective of different actors and users (electricity provider and different types of consumers) in order to examine how heterogeneity transforms the existing power relations developed through the conventional electricity grid. In particular, I focus on the relationship between the electricity grid and the diverse socio-technical arrangements that emerge as alternatives to or in connection with the grid itself and which has not yet received much attention: different socio-technical configurations present both *in* and *beyond* the grid, including pre-paid and post-paid smart meters, solar panels, ready-boards, as well as hybrid solutions that enable consumers to switch on and off from the grid in accordance with their needs (e.g., LNG, generators, etc.). Through this analysis, I respond to recent calls to consider the possibility that heterogeneous infrastructural configurations “might involve many different kinds of technologies, relations, capacities, and operations, entailing different risks and power relationships” (Lawhon et al., 2018: 720). By analyzing the different socio-technical arrangements, strategies, and adaptations that the various actors and types of consumer have developed to address such challenges, the article advances the idea that heterogeneity is not only the expression of differentiated capacities for navigating constraints (high electricity costs, electricity losses, energy transition, etc.). It also actively reshapes the way in which the electricity grid governs by prompting a shift in the power relations between different actors. Thus, I argue that technical heterogeneity in electricity provision challenges conventional ways of thinking about the state-society-infrastructure relationship, and consequently how infrastructure governs. It entails political processes that change possibilities and constraints for governing and being governed by the electricity grid. As such, this article develops the idea that, when the electricity grid is universally present, heterogeneous configurations are the expression of a differentiated capacity to negotiate the relationship with the grid, and such socio-technical negotiations develop in a highly relational way, influencing each other.

In particular, I have identified three types of trends that exemplify different relationships with the grid: “leaving the grid,” decreasing dependence on the grid, and “onboarding” to the grid. Each of these conveys a specific power relation with the grid.

My premise is based on four months of research conducted in Kingston in 2018 and 2019, during which I conducted 15 semi-structured interviews with key electricity sector stakeholders, including the current and former minister of energy and technology, a USAID officer in charge of renewable energy developments, various agents from the electricity company JPSCO, and one “large consumer” who had decided to increase their independence from the electricity grid. In addition, I conducted a more in-depth study of the existing socio-technical configurations in low-income neighborhoods located in downtown Kingston, which included conducting interviews with different actors involved in the ongoing electricity regularization project in these areas (electricity company, community stakeholders, etc.). The information collected from these semi-structured interviews was supplemented by technical documentation, media articles, and “neighborhood visits” (upper-middle-class neighborhoods equipped with solar panels).

Through this analysis, the article contributes to academic debates on urban electricity infrastructure in the Global South (e.g., Castán Broto et al., 2014; Luque-Ayala and Silver, 2016) and, more specifically, to emerging discussions on infrastructural heterogeneity (Jaglin, 2014; Koepke et al., 2021; Lawhon et al., 2018; Munro, 2019; Rateau and Jaglin, 2022). The article’s specific contributions are threefold. First, it empirically contributes to understanding electricity heterogeneity within an urban geographical setting that remains unexplored from an infrastructural perspective, despite the fact that the island of Jamaica as a whole is garnering increasing attention for its profound energy transformations (Harrison and Popke, 2018a). Second, it reveals the political aspects of infrastructural heterogeneity by highlighting the importance of considering the link between different configurations and devices as being mediators of relationships between actors, consumers, and places. Third, the case of Kingston can help expand our understanding of the dynamics of Caribbean energy transition that have already been characterized as deeply political and embedded in socio-material power relations (see Cederlöf and Kingsbury, 2019; Harrison and Popke, 2018b).

Below, I start by presenting the theoretical framework that combines recent debates on infrastructural heterogeneity with how these configurations are reshaping political ideas linked to the “modern infrastructural ideal” (Graham and Marvin, 2001). The Jamaican energy context is then described, including the main sector challenges (energy security, affordability, reliability, and electricity losses) and the actors’ responses to these issues (government energy policies, and the electricity provider’s response). I then focus specifically on the city of Kingston as a space where different actors adopt different electricity provision strategies. I particularly examine the relationship between the electricity provider, large consumers, and middle-income and low-income consumers. The conclusion reflects on these configurations and suggests that infrastructural heterogeneity is the expression of a differentiated negotiating power in the relationship with the electricity grid, and consequently among customers, and that it reflects inequalities. This implies the need to consider solidarity as a central dimension when considering how to govern heterogeneous configurations, including the relationships between consumers, types of socio-technical systems, and neighborhoods.

Infrastructural Heterogeneity and its Relationship with the “Modern Infrastructural Ideal”: A Matter of Power

In the past few years, scholars have been paying increasing attention to the heterogeneity of the socio-technical systems that facilitate access to utilities (water, electricity, etc.), providing a (welcome) shift away from focusing on the (failures of) networked infrastructures (e.g., Lawhon et al., 2018; Koepke et al., 2021; Munro, 2019; Rateau and Jaglin, 2022). In these contexts, the “modern infrastructural ideal” (Graham and Marvin, 2001) is confronted by urban fragmentation and substantial socioeconomic inequalities that influence the ways in which networked infrastructures are distributed in space. De facto, there is tension between the persistent aspiration to develop a modern infrastructural ideal based on networked, uniform and centrally-organized infrastructures (Monstadt and Schramm, 2017) and more hybrid and decentralized systems; and this tension is reflected in recent debates (Furlong, 2014). In recent research focusing on electricity infrastructures, heterogeneity first emerges as a pragmatic response to inadequate grid coverage, and the network model and hybrid delivery configurations often co-exist (Jaglin, 2015).

Rateau and Jaglin (2022), for example, have analyzed the spatial dimension of socio-technical *dispositifs* (solar panels, generators, conventional network, batteries, etc.) in Cotonou and Ibadan, and have revealed how this diversity is the result of co-production arrangements. In Gulu Town, Munro (2019) sees electricity heterogeneity as the expression of the adaptive practices adopted by the poor to satisfy their energy needs. In Dar es Salaam, Koepke et al. (2021) propose a spatial typology of electricity constellations and show how socio-technical heterogeneity is deeply embedded in the diversity of the urban space, and highlight the importance of this dynamic for energy transition in Southern cities. While heterogeneity seems to produce both positive and negative externalities, various issues remain unresolved, in particular how this heterogeneity is governed (Jaglin, 2014). In this article, I argue that it is also important to question how heterogeneity changes the way in which infrastructures govern society. In fact, heterogeneity—through its multiple socio-technical mediations—make the relationship between consumers/users/citizens, the market, and the state more complex than the one established via the electricity grid. More empirical attention needs to be paid to the relationship between these heterogeneous configurations, how they influence each other, and which differentiated agencies and power relations these (sometimes chosen, sometimes imposed) configurations reveal. This question is particularly relevant as a focus on heterogeneous infrastructure “might involve many different kinds of technologies, relations, capacities, and operations, entailing different risks and power relationships” (Lawhon et al., 2018: 720), and it should also enable us to “better understand both specific artefacts as well as their relations to particular socio-political urban geographies” (Lawhon et al., 2018: 722). The relational aspect, including conflicts and complementarities between different infrastructural configurations, provides a productive window through which to view and examine power relations within socio-technical mediations.

An important relational dimension is to be found in the term itself. In fact, “heterogeneity” describes the diversity of infrastructure and is intended to explicitly contrast with the uniformity of the “modern infrastructure ideal” (Lawhon et al., 2018). In a certain sense, the idea of heterogeneity challenges the hegemony of the “modern

infrastructural ideal” (Graham and Marvin, 2001) and that of a universally “networked city” (Tarr and Dupuy, 1988). Heterogeneity enables us not only to see “beyond the networked city” (Coutard and Rutherford, 2016), but also to shape the politics embedded in the networked ideal. In fact, networked and centralized infrastructures are historically powerful systems through which citizens are connected (or disconnected) from the state, a material symbol of state power and sovereignty (Lemanski, 2018). Networked infrastructure can be an instrument both to govern the fabric of the city (McFarlane and Rutherford, 2008), and to define the identity of the “modern citizen” (Kooy and Bakker, 2008), and of the “deserving citizen” (Pilo, 2020). Heterogeneous infrastructures embody ideas of more decentralized power relations, in which different actors—not only the state—define “proper” norms and behaviors (Lawhon et al., 2018). In a context where it is recognized that these configurations are functionally interdependent (Rateau and Jaglin, 2022), who is connected to the grid, who leaves it, the kind of socio-technical mediations used to access the service, and which relationships they involve are all issues that appear important for understanding how heterogeneity operates on a political level through differentiated powers. Below, I provide an analysis of these dynamics, with a particular focus on the interaction between heterogeneous configurations (off-grid solutions) and devices (including solar panels, but also different types of meters) and the network, and the ways in which these influence each other.

The Jamaican Context: Energy Transition for Energy Security, Affordability, and Reliability

As other Caribbean islands,¹ Jamaica has a very high electrification rate (around 98 percent (Ministry of Energy and Mining, 2010)). However, there are other major operational challenges that affect electricity provision and thus its related policies. These challenges include the dependence on energy importation, high electricity prices, and significant electricity losses. In fact, Jamaica is highly dependent on imported fossil fuels—more than 80 percent of the electricity consumed in the island is produced from petroleum-based fuels²—which also makes the island highly vulnerable to fluctuating oil prices, which have a direct impact on electricity costs. Energy security and affordability are consequently seen as interlinked. Moreover, electricity losses are relatively high, a situation that results in a relatively inefficient system and affects the electricity provider’s finances and electricity costs. In 2018, electricity losses amounted to 26 percent of the electricity produced, including both technical (9 percent) and non-technical losses (17 percent). To address these challenges, over the past ten years, the government has actively developed an ambitious policy for energy transition and for improving the efficiency of the sector in general within a broader regional context in which international organizations and developers have worked to make the Caribbean “a laboratory for renewable energy strategies, policies and projects aimed at reshaping the region’s legal and regulatory environments and re-engineering its energy landscapes and infrastructures” (Harrison and Popke, 2018a: 165).

In 2009, the Jamaican government published the “National Energy Policy 2009–2030,” which sets out the vision, objectives, and strategies for an efficient and modern energy sector (Ministry of Energy and Mining, 2009). Within the larger development plan, based on the motto of “Jamaica, the place of choice to live, work, raise families and do

business” (Planning Institute of Jamaica, 2009), the electricity sector is seen as an important driver for the development of the country. This document highlights that ensuring sustainable development through an efficient, affordable and environmentally friendly energy sector³ is a key aspect of the *Vision 2030 Jamaica National Development Plan* (Planning Institute of Jamaica, 2009), particularly linked to the Outcome #10 on “Energy Security and Efficiency.” This strategic framework particularly stresses the importance of developing a decarbonization plan, which includes ambitious goals, such as no less than 20 percent of renewable energy in the energy mix by 2030 (Ministry of Energy and Mining, 2009). This objective was confirmed in the *National Renewable Energy Policy* published a year later (Ministry of Energy and Mining, 2010), before being increased to 30 percent in 2012 (Ministry of Science, Energy and Technology, 2016), and to 50 percent in 2018. Oil dependency decreased from 95 percent in 2010 to 71 percent in 2017,⁴ and the proportion of electricity generated from renewable energy increased from 0.9 to 12.01 from 2017 to 2018 (Chen et al., 2020). There have been a number of different instruments, strategies, and incentives developed since then with the aim of achieving this objective.

Large-scale electricity generation plays a central role in this. The Jamaica Public Service Company Limited (JPSco) is the sole electric distribution utility on the island; however, generation has been liberalized since 2004. Thus, independent power producers (IPPs) can supply electricity to the national grid. This structure, in which IPPs are able to generate and sell electricity on the national grid system, has helped Jamaica become “one of the fastest growing renewable energy hubs in the region” in a short space of time (Shirley and Kammen, 2013: 247). In 2018, 69.7 percent of the generated capacity was supplied by JPSco, whereas the remaining 30 percent was generated by IPPs (Chen et al., 2020). On the customer side, a pilot “Net-Billing Program” has been developed since 2012 in order to encourage customers to install renewable energy systems (mainly solar panels), and sell the excess generating capacity to the grid. Three types of interconnection are possible for residential, commercial, and industrial customers who wish to become self-producers: Net Bill (to sell their excess generation to the grid), Power Wheel (to generate their supply in one location and use all or part of it in another location) or connect for Auxiliary purposes (generating electricity for personal use and not exporting any to the electric grid) (Ministry of Science, Energy and Technology, 2016). The system capacity for each of these connections must not exceed the defined thresholds. For example, to apply for a net billing connection, the system capacity should not exceed 10 kW for residential and 100 kW for commercial customers. In this system, JPSco buys excess power from its customers at a tariff that is equivalent to the (monthly) short-term avoided cost of fuel.⁵

These initiatives embrace the idea of a profound change in the electricity system, characterized by heterogeneity in electricity production and distribution. Figure 1—presented by the Ministry of Energy and Mining’s former director of energy and economics in 2010—illustrates this heterogeneity in the future electricity network. The main concept involves developing a hybrid electricity network in which various sources of energy, and socio-technical delivery systems, are combined to develop a stable energy supply network. Quite obviously, this new system is supported by digital technologies. Most of these infrastructural changes are already underway.

Concept of Jamaica's New Electric Power Network

Stable Energy Supply Network, combining various New Energies controlled by means of IT, Network Control System

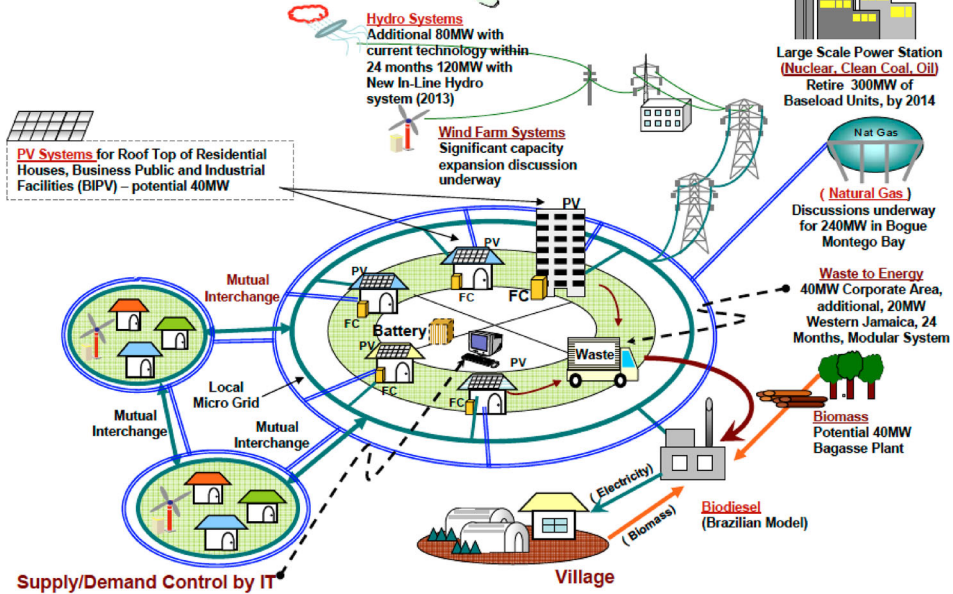


Figure 1. Concept of Jamaica's New Electric Power Network: Source: Stennett (2010)

In the rest of the article, I analyze how this energy and infrastructural transition trend affects the relationship between various actors who develop different strategies to address these different challenges. These strategies produce a heterogeneous socio-technical panorama of electricity infrastructure in which more sustainable and interconnected systems, characterized by mutual exchanges, co-exist with disconnections and new reconnections. I argue that these strategies are not only the expression of actors' differentiated capacities for navigating such constraints, but they also actively reshape the politics of governing or being governed by the electricity grid. I exemplify this idea by embedding such heterogeneity in the urban reality of Kingston, presented in the next section, where most of these changes are taking place. As Harrison and Popke (2018a) state in relation to the broader context of energy transition in the Caribbean, "energy transitions more generally are shaped by their spatial and material context" (165). The city of Kingston offers a specific perspective on this, since here heterogeneity meets urban fragmentation, and the diversity of consumers corresponds to different governance challenges.

Kingston: Urban Divisions and Infrastructural Change

With a population of around 600,000, Kingston is Jamaica's largest city. Located on the southern coast of the island, and surrounded by the hills of St. Andrew, the city was founded in 1692 after a large earthquake destroyed the then naval and commercial city of Port Royal (Jaffe, 2016). The development of the "Creole Colonial City" was planned by

the white elite and was molded by colonialism, the sugar plantation and slavery, being based on an urban geometrical structure influenced by the plantation's disciplinary social order (Clarke, 2006). Whereas spatial segregation was initially not very rigid, after the large-scale (voluntary and forced) migration movements that saw the population increase from 35,000 in 1828 to 237,000 in 1943 (Clarke, 2006), “a more definite relationship between income and spatial inequalities developed” (Jaffe, 2016: 29).

This division is still very strong today and, as a result, the city consists of two main contrasting parts: uptown, where the wealthiest residents live, and downtown, the historic city center located on the waterfront and where low-income residents live in what are often called “inner-city communities” (e.g., Tivoli Gardens, Trench Town, etc.) (see Figure 2). Despite there being some squatter settlements uptown that partially modifies the uptown/downtown division, the disparity remains analytically relevant. Uptown is a constellation of upper- and middle-class mainly residential neighborhoods, and also includes the business and commercial center of New Kingston and Half-Way Tree, with the latter considered as marking the uptown/downtown division. Uptown is also where the majority of government agencies and business headquarters are located. This is despite some businesses having moved their offices downtown over the past few years as part of a broader strategy of “redeveloping” the area, based on real-estate potential, crime reduction, and commercial redevelopment, which has lately been facilitated by a continuous police presence (Jaffe, 2019). Despite these attempts, this spatial division remains tangible and deeply embedded in Kingstonians' mobility practices,

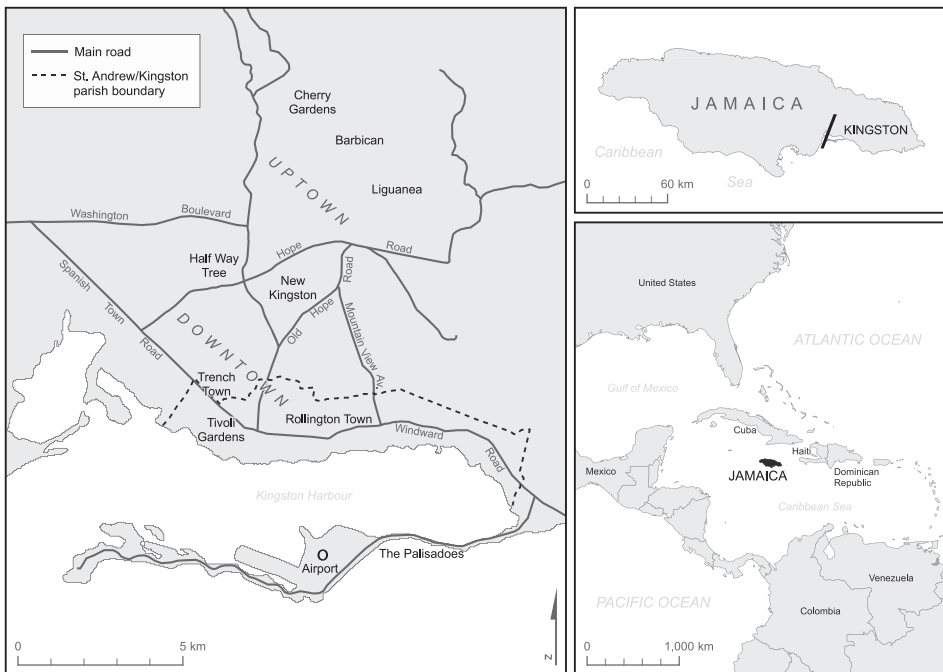


Figure 2. Kingston Metropolitan Area, including the uptown-downtown divide. Source: Map created by Rowan Arundel, based on the map from Jaffe (2012).

which mostly adhere to the invisible separation line of Half-Way Tree. Moreover, Kingston is considered a fragmented city not only along socioeconomic lines and race divisions, but also politically (e.g. Kroubo Dagnini, 2018). Since the 1960s, a form of “political tribalism” in which the two main political parties—the Jamaica Labour Party (JLP) and the People’s National Party (PNP)—compete for the electoral control of these communities, has formed the basis for a political culture known as “garrison politics” that combines forms of patronage and criminal governance arrangements and in which politicians and gangs leaders—called “dons”—co-govern these areas (Campbell, 2020; Harriott, 2008). These patronage practices have led to access to services and infrastructure and the redistribution of jobs and other resources, thereby largely legitimizing the perpetuation of this system, which includes tolerating illegal connections to networked infrastructures, which are widespread in these communities. Various industrial activities are also located between downtown and Spanish Town (on the Spanish Town road), creating a patchwork of industrial areas and low-income communities.

From the perspective of electricity infrastructure, these divisions are barely perceptible if we look at electricity coverage only. The city is considered universally electrified and national electricity coverage is reported to be 98.93 percent.⁶ This is not surprising as electricity came to Jamaica as early as 1892, when the Jamaica Electric Light Company started to supply electricity from a small coal-burning steam generating plant in Kingston.⁷ Despite this high electricity grid coverage, heterogeneous configurations have developed to meet the different challenges different actors face within the current electricity provision system—the conventional grid—and to adapt to the specific features of consumers and areas. As described in detail below, whereas “large consumers” attempt to reduce their operating costs by adopting alternatives to the grid, low-income consumers are “on-boarded” onto the grid, which means regularizing the high number of illegal connections, and middle-class consumers are encouraged by the provider to “remain” on the grid through technical measures that seek to reduce their bill. All these dynamics reveal forms of negotiation with the grid that affect the relationships between different consumers and their forms of contribution, especially with regards to the solidarity aspects, but they also reflect these complex spatial divisions in the city.

Large Consumers With Hybrid Electricity Systems: Grid Defection or Negotiating Their Stay?

The high cost of electricity, combined with the promotion of alternative sources of energy, has encouraged large customers to opt for alternative or hybrid solutions that have direct implications for the grid, as explained in detail below. Despite the high electrification rate, off-grid self-generation is commonly used by large hotels and businesses. Whereas it is difficult to exhaustively map the adoption of these alternatives, some have received much media attention and have been presented as an example of how public and private sectors are contributing to sustainable energy transition. Yet for companies, investment in cheaper energy is primarily a matter of driving down the cost of production and improving their competitiveness. This is why many business owners are eager to adopt alternative energy sources (Baker, 2014).

For large customers, LNG plants have become one of the most popular options for reducing costs and decreasing dependency on the grid. As an example, one of JPS's largest customers, the local beer company Red Stripe, has decided to dramatically change its electricity system, and to use JPS as a back-up system only. In 2014, the company decided to install a Combined Heat and Power (CHP) system that converts natural gas to electricity and thermal energy in the form of steam, hot water and/or chilled water.⁸ There are two generators of 1.5 megawatts each which give three megawatts total power output (See [Figure 3](#)). The new installation is considered more reliable than the electricity grid, cheaper, and more responsive to the brewery's energy needs. In fact, the system produces both electricity and thermal energy. The thermal oil from the plant is used to generate hot water (88 degrees) that comes from the engine creating a thermal balance. Hot water is produced, free of charge, by the CHP plant, which means high energy savings. Moreover, the plant produces steam. The engine has two waste heat boilers which produce about 1,600 kg of steam per hour and this is integrated into the steam supply. In short, through this system, the company gets four outputs: hot water, steam, chilled water at 7 degrees and electricity. The grid does not enable the same variety of outputs as the new hybrid system:

We wouldn't get all these benefits like the combination of the plant from JPSCO. The only thing you get from JPSCO is electricity, but with the combined plant you get other outputs, which we integrate into our system, and this reduces our overall consumption in terms of thermal. (Personal Interview, 2020)

With this system, the company is still connected to the national grid but use it for only 5 percent of their electricity requirements.



Figure 3. Part of the Red Stripe energy system (LNG). Source: Pilo' (2019).

We have to pay them (JPSCO.) for the standby mode. For our plant, now, in terms of total load, we use about 3.7 megawatts. That's our peak demand but, in terms of the capacity of the plant itself, we have two engines designed for 1.5 megawatts each, which gives us a total of three megawatts of output. So, the 700Kw we take from JPS is just for peak purposes. We run in parallel mode. (Personal Interview, 2020)

Red Stripe is the first company to be almost entirely powered by LNG, but other companies are following suit. The company Seprod Limited has invested almost a billion dollars in constructing two gas-powered energy plants that will generate three megawatts of electricity for their operations (Jackson, 2018). Similarly, the University of West Indies (UWI) has an LNG system on its Mona campus in Kingston, and recently argued that investments in LNG will ensure that the cost to students will be much more affordable (Virtue, 2017).

Other companies and institutions have opted for different renewable energy solutions that should also reduce costs. Another example is the law firm Myers, Fletcher, and Gordon (MFG) who decided to install a wind and solar hybrid renewable energy system in its offices in Kingston in 2014, in what was considered at the time to be the world's largest project of this type. Developed by WindStream Technologies, the firm installed 50 WindStream SolarMill units, which produce over 106,000 kWh of renewable energy annually, leading to expected energy cost savings of \$2 million.⁹ Similarly, the phone company Digicel decided to install a hybrid system using solar power, wind power, and geothermal cooling systems in its central headquarters situated on the waterfront in downtown Kingston (see Figure 4). Presented as one of the most environmentally friendly major office buildings in the Caribbean, this initiative has also been praised for contributing to the downtown redevelopment plan.¹⁰

The adoption of these alternative solutions is generally welcomed and lauded by both the government and the media as being a positive environmental improvement on fossil-based provisions and as helping to make Kingston a sustainable capital. However, according to JPS, they also raise important questions for the sustainability of the electricity grid, especially if large power customers opt for these solutions. LNG, in particular, is starting to be seen as a "threat" to the grid because it makes it possible to switch to quasi-autonomous energy systems. A recent newspaper article titled "'JPS will have to adapt'—LNG gives local entities power to leave grid" (Virtue, 2017), particularly questions what

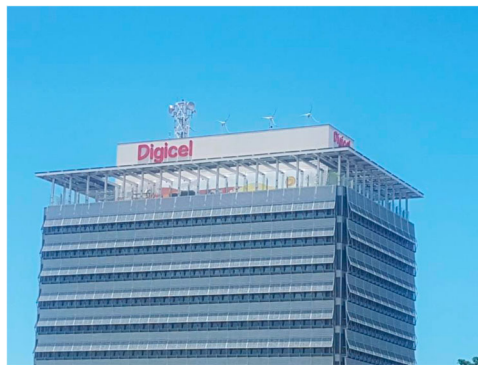


Figure 4. The hybrid energy system in the Digicel building (Kingston). Source: Pilo' (2019).

this shift could mean for all the other customers who remain within the grid, as well as for the company that now has to reposition itself within a changing market. In this context, the company recently indicated that “the smaller this group becomes, the higher billing would be for residential customers, as the large commercial sector of fewer than 3,000 companies subsidized rates for all” (Hewitt, 2021, online). Approximately 89 percent (587,606) of the 658,052 customers on the entire island are residential consumers, who account for approximately 33 percent of billed energy sales (JPS, 2019). Large industrial and commercial consumers make up less than 1 percent of the customer base, but they contribute to approximately 44 percent of JPS revenues (Hewitt, 2021), and consume 46 percent of total billed energy (JPS, 2019). While it seems evident that these customers are important for safeguarding the sustainability of the grid, it is difficult to quantify this trend in grid defection. Electricity sales have fluctuated over the past ten years. After a period when there was a drop in sales (2010–2014), sales rose by 2.9 percent between 2016 and 2019 (JPS, 2020) before falling again in 2020 due to the pandemic.¹¹ Between 2016 and 2019, the growth in sales in the (large and small) commercial and industrial category was even greater (in MWH): 10 percent for the large commercial and industrial customers, and 3 percent for the small. In 2020, there was a significant drop in sales to both large and small commercial and industrial customers (–7.7 percent and –17.7 percent respectively) due to the effects of COVID-19. While it is difficult to explain why numbers do not particularly reflect the de facto decreasing participation of some large customers, the fear that this could potentially affect sustainability of the grid and increase costs for other customers is garnering widespread media attention, resulting in emerging negotiations and strategies to prevent these risks. For example, in November 2021, as one of its strategies to keep its large customers, JPS submitted a proposal to the national regulator (Office of Utilities Regulation, OUR) whereby they would offer some large customers a wholesale improved rate (Hewitt, 2021). This proposal was rejected as “the OUR was not convinced that with this arrangement, JPS could guarantee that customers retained in the RT40/RT50 group (i.e., those with demand below 1MVA) would not seek alternative off-grid solutions to the higher tariff they would face” (Hewitt, 2021). Although this request was not approved, this attempt shows that these new socio-technical alternatives are prompting shifts in the strategies and positions taken by the provider and large customers for negotiating measures to safeguard the stability and sustainability of the electricity grid and the company’s revenues.

The Electricity Provider: “Keeping (Middle-Class) Customers on the Grid”

The increase in renewables and the fact that customers now have the option of adopting alternative (or complementary) energy systems is considered to have significant implications for the sustainability of the grid and for the utility company’s financial situation, to the point that certain media outlets are suggesting that there is a conflict between the grid and distributed energy, which is framed as “solar disconnect” (Jones, 2017). This view is contested by the provider who emphasizes that the challenge now is to find a way to optimize the synergy between the grid and the distributed electricity production (Personal Interview, 2019a). This obviously implies installing new technologies to minimize the potential risk of renewable intermittency and the related risks to the stability of the grid,¹² and will also require a new relationship to be created with potential

“prosumers.” More broadly, these transformations have prompted the electricity provider to strategically rethink their traditional business model, which was based on an electricity distribution monopoly and on remuneration drawn exclusively from the sale of electricity (Lee, 2018).

In this context, JPSCO has started to diversify its revenue streams not only by investing in renewable energy plants, but also by expanding the services offered to its customers. These two strategies seek to offer solutions at the delivery point, while reducing electricity generation by fossil fuels and integrating renewable energy generation at the grid level. In order to offer new services, JPSCO created a specific “Energy Solutions” unit in 2013 to “bring solutions” to commercial, industrial, and residential customers to help them reduce their electricity costs through renewable energy and energy efficiency measures. When “Energy Solutions” was created, it was considered a standalone business unit set up to resolve the issue of very high electricity costs caused by fluctuating oil prices (Personal Interview, 2019b). Its relevance also stemmed from the belief that there was a need to replace the traditional—old—model with “a new model of integrated renewables or energy efficiency and change the business to one that offers different services to customers to diversify the revenue stream” (Personal Interview, 2019b). Services include the sale of energy efficiency devices, such as solar mills, bulbs, timers, protection devices, etc., as well as the sale and installation of solar PV, like other EPC contractors. The unit also particularly targeted “load defection” customers. These are customers who are not specifically looking for off-grid solutions but want to reduce their consumption in order to dramatically reduce their bill. For these customers, the first step is energy conservation, followed by the installation of solar PV. These are mostly small businesses and upper-middle-class residential customers, and the use of solar panels is now increasingly visible in some of these neighborhoods (see Figures 5 and 6).

According to the company, “Energy Solutions” also helps them get closer to customers, and consequently better understand if a customer is dissatisfied and looking for alternative provision systems to become less dependent on the grid (Personal Interview, 2019c). In fact, this is the most difficult dynamic to anticipate because there is no direct signal to indicate that a customer wants to adopt an alternative. It is only after a customer has decided to install solar panels and is connected to the grid through the net billing



Figure 5. Solar panel installations in the wealthy neighborhood of Beverly Hills, Kingston. Source: Pilo' (2019).



Figure 6. Solar panel installations in the wealthy neighborhood of Beverly Hills, Kingston. Source: Pilo' (2019).

system that the company is aware that an alternative source has been installed. But when off-grid solutions such as generators or solar panels with batteries are adopted then these can be difficult to track. Thus, a system like the net billing system is considered useful because it allows the company to have more control over these customers' consumption (and production) behaviors. However, up to 2020, only 757 customers had opted for this solution. Hence, in a context where very large consumers can potentially “jeopardize” the grid by “leaving,” and where it is more difficult to keep them on the grid due to the competitive prices of LNG, smaller businesses and upper- middle-class customers have now become the target of energy efficiency and solar installation initiatives. In a context where large customers now have the option of decreasing their use of the grid, and upper-middle class and commercial customers have the resources to reduce their energy consumption and costs, and consequently gain the most benefit from these hybrid solutions, the question of who is supporting the grid—in terms of responsibility and solidarity—becomes crucial. In low-income areas, mainly located downtown, the trend is to be formally connected to a grid that risks being increasingly weakened by the rise in hybrid and off-grid solutions.

“On-Boarding” Poor Consumers: Pre-Paid, Post-Paid Meters and Ready-Boards

At the other extreme of the customer pyramid are the low-income consumers, the majority of whom are not formally registered as customers but still rely on the electricity grid for their electricity needs. In these low-income neighborhoods, the extension of the modern infrastructural ideal converges with cost-recovery imperatives (reduction of non-technical losses), which are considered crucial for improving the efficiency of the distribution system (Shakuntal et al., 2013). There are an estimated 180,000 unauthorized residential consumers across the entire island (USAID, 2017). Although “electricity theft” is not exclusive to low-income communities, regularization is more complex in these neighborhoods due to issues such as low affordability and to local governance structures. That means political support is required in order to implement electricity regularization measures (Personal Interview, 2018). Within this context, JPS's strategy over the past ten

years has been to “on-board” these consumers to the grid (Personal Interview, 2018), which means registering as new customers those people previously (illegally) tapping into the grid. Since 2010, electricity regularization actions have formed part of a specific framework, the Community Renewal Program, under which the electricity provider works with other governmental actors to implement what is defined as a holistic approach to electricity regularization. This includes both technical and social components. With regard to the technical component, the “on-boarding” of these consumers is done through heterogeneous socio-technical devices that seek to meet the specific challenges that, from the provider’s perspective, these communities pose for the grid. Three types of devices have been used to achieve regularization: ready-boards, pre-paid, and post-paid smart meters.

In cooperation with USAID, the company launched a pilot project in a community in downtown Kingston called Majesty Gardens. This was the ready-board project (2015–17) that targeted consumers whose housing infrastructure did not meet the legal wiring requirements of the Jamaican Electric Code (5 percent to 10 percent of the low-income population) (USAID, 2017). A ready-board essentially brings together different basic electricity connection elements, such as a circuit breaker, a LED lightbulb, a switch, and two power outlets. All of the around 400 ready-boards installed in this community are equipped with pre-paid meters. However, these are not installed on the customers’ premises, where only a Customer Information Unit is fitted that enables customers to charge the meter with credits. Pre-paid meters are known as travelling technology used to better manage low-income customers and to make them more accountable for finding the balance between consumption and payment capacity. While consumers’ reactions to the installation of these units can vary from rejection to being warmly accepted (see Baptista, 2015), these devices embed a specific intentionality by aligning consumption behaviors, economic affordability, and market rationale. There is also another technology that reinforces this aspect. Pre-paid and post-paid meters are supported by the Residential Advanced Metering Infrastructure (RAMI), which involves integrated digital meters, data management systems, and two-way communication networks. This system enables important changes to be made in JPS’s customer relationship management. For post-paid customers, this technology makes it possible to disconnect and reconnect users, and to remotely calculate electricity consumption. Moreover, post-paid meters are not installed on the customers’ premises but in protected boxes located on poles, which add an extra layer of protection against fraud. Thus, from the perspective of the grid, the RAMI should improve loss management by protecting the system¹³ and remotely checking for fraudulent behavior, and pre-paid meters should remove the risk of non-paid bills (Pilo’, 2021a). These three socio-technical devices—ready-boards, pre-paid, and post-paid meters—work together in different but complementary ways to onboard customers and keep low-income consumers (legally) on the grid. However, electricity costs are high (US\$0.30 per Kwh in 2020), and these are also affected by the dynamics described in the previous sections of this article. As mentioned by the Deputy Director General of the Office of Utilities Regulation (OUR):

The energy sector is changing. So that said, we are always concerned that as the large users leave the grid, the poor customers, who cannot afford it in the first place, will have to pay for all the fixed costs (Deputy Director General of the OUR. (Virtue, 2017)

While these low-income consumers are now legally connected to the grid, these new customers have neither the choice nor the power to negotiate more affordable access as they are unable to afford to switch to other types of electricity provision or adopt hybrid solutions that reduce their consumption from the grid. This trend calls for a review of the interdependency between different types of consumers and their choices, as these are central to developing cohesion between these heterogeneous systems in order to keep both a societal and urban form of solidarity.

Conclusion: The Need to Govern Infrastructural Heterogeneity to Reassess Solidarity

Heterogeneous electricity configurations in Kingston develop in accordance with three interdependent trends that involve different relationships with the electricity grid: “leaving” the grid, reducing dependence on the grid and “onboarding” to the grid. These different degrees of participation are the result of the differentiated power and resources that these actors have at their disposal: large customers can minimize their dependence on the grid through independent or hybrid systems; upper-middle-class and low-income consumers are “kept” on or “onboarded” to the grid but using very different strategies. Whereas upper-middle-class consumers have a choice and can benefit from solar energy technologies to reduce their energy bills, low-income consumers’ access to the grid is regularized through different devices that seek to minimize the business risk associated with their socioeconomic conditions. However, electricity costs remain high.

More broadly, we can see these three arrangements as being direct and indirect forms of negotiation that produce concrete relationships between the provider, large consumers, upper-middle class residential consumers, and low-income consumers that change in an interconnected way. The current and potential use of off-grid alternatives by large customers can be considered a unilateral decision that is nonetheless leading to new negotiations between the electricity provider and national regulator to provide these customers with more competitive tariffs to keep them on the grid. Energy efficiency measures and solar panels are the materialization of a negotiation between the provider and its middle-class and small commercial customers that seeks to stabilize their participation and acceptance of electricity costs by reducing them. Finally, pre-paid, post-paid meters and ready-boards are clear socio-technical devices for connecting low-income customers to the grid and demonstrate the provider’s resolve to regularize the relationship these consumers have with the grid; however, these customers have little power to negotiate their participation due to their poor capacity-to-pay. Thus, heterogeneous configurations and devices emerge not only as a pragmatic response to different needs and challenges (e.g., energy transition, high electricity costs, and losses), which reveal the differentiated capacities and resources required to navigate such constraints, but also as an expression of power as certain customers are able to determine the form of the relationship they have with the grid. It can be said that heterogeneity actively reshapes the centrality of the grid for governing different challenges, as well as for keeping a certain level of solidarity among different consumers, and for enabling these consumers to “be governed” by the grid.

In fact, as the JPSCO's senior vice president for business development clearly summarized: "whereas technically we are considered a monopoly, that's not quite the case, customers do have options now" (Personal Interview, 2019c). The idea of customers "having options" is not equally distributed, however; instead, it is market driven, which can reinforce inequalities. Revisiting the types of solidarity this heterogeneity entails is consequently central for identifying the long-term implications of these systems. As Jaglin has interestingly pointed out, whereas socio-political solidarity issues in conventional utilities have already been addressed and are regulated, alternative delivery configurations "cannot become an efficient and equitable solution for the majority of citizens without appropriate policies, the full challenge of which rests on the ability to "govern" diversity, that is not only to regulate the competition between the different *dispositifs* but to create synergies and rules they can share" (Jaglin, 2014: 445). We know that networked infrastructures are not a panacea for resolving inequalities (Pilo', 2021b), and the idea that these systems embed "solidarity" has also been questioned (Cesafsky, 2017). However, without a specific focus on the more socially inclusive potential of heterogeneous infrastructures, including their connection and relationality, these systems may also have an adverse effect on solidarity, especially in contexts where the grid is universalized and likely to remain crucial for electricity provision. If this issue is properly recognized and addressed, heterogeneity can potentially open up avenues for developing new solidarities between heterogeneous infrastructures and neighborhoods. Following this line of thought, "governing heterogeneity" can mean minimizing the risk of allowing these dynamics to be shaped by the economic power of consumers, and defining the political interaction between these multiple configurations (*in* and *beyond* the grid) and devices. In the context of Kingston, this is central as the grid remains the main electricity delivery system. However, it can also help inform such interactions in other cities of the Global South where urban fragmentation and inequalities are entrenched in the production of infrastructural heterogeneity.

Notes

1. With the exception of Haiti.
2. <https://www.mset.gov.jm/electricity-investments/>
3. "Goal 2: Jamaica has a modernized and expanded energy infrastructure that enhances energy generation capacity and ensures that energy supplies are safely, reliably, and affordably transported to homes, communities, and the productive sectors on a sustainable basis. Goal 3: Jamaica realizes its energy resource potential through the development of renewable energy sources and enhances its international competitiveness, energy security whilst reducing its carbon footprint" (Ministry of Energy and Mining, 2010).
4. <https://www.worldbank.org/en/results/2019/04/26/improving-energy-efficiency-and-security-in-jamaica>
5. Meanwhile, Net Metering customers can sell the excess power at the same rate at which it retails to customers.
6. <https://trackingsdg7.esmap.org/country/jamaica>
7. <https://www.jpSCO.com/our-history>
8. The description of the system is based on an interview I conducted with an employee of Red Stripe on December 5, 2020.
9. <https://www.myersfletcher.com/resources/item/windstream-technologies-unveils-the-world-s-largest-wind-solar-hybrid-installation-to-save-over-2-million-in-energy-costs.html>

10. <https://www.digicelgroup.com/jm/en/mobile/explore/other-stuff/news—community/2012/11/30/digicel-breaks-ground-on-downtown-kingston-global-headquarters.html>
11. All the data in this paragraph are calculations made by the author based on the data provided in the JPS 2020 Annual Report (JPS, 2020).
12. In order to accommodate more renewable energy, the company constructed a new hybrid storage facility that should provide spinning reserve power to the grid, the first of this kind in the Caribbean (Hutchins, 2018).
13. In fact, the RAMI system is mostly used in these low-income communities, which are also classified as “red zone” areas as, according to the provider’s criteria, these are communities in which high losses combine with high levels of violence.

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Note on Contributor

Francesca Pilo, is an assistant professor in spatial planning in the Department of Human Geography and Planning, Utrecht University, Utrecht, the Netherlands.

ORCID

Francesca Pilo  <http://orcid.org/0000-0002-2626-8748>

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