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Energy, the city and everyday life: Living with power outages in post-war Lebanon

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ABSTRACT

Years of civil war in Lebanon (1975–1990) resulted in considerable destruction in its towns and cities, with significant impacts on buildings and infrastructure. Notably, the electricity sector continues to suffer from power outages long after the war ended, and the country's citizens have adopted various strategies for maintaining desired electricity services in their homes. This has given rise to informal infrastructures, such as diesel-powered generators run by commercial actors or co-owned by urban residents.

This paper uses a qualitative approach to explore the multi-faceted experience of power outages in urban areas of Lebanon, the nature and practices of the resulting informal electricity services that have filled that gap, and their impact on everyday life. It argues that the different practical solutions that households have adopted in order to augment electricity provision to their homes create a differentiated experience of infrastructural services in the city, its neighbourhoods and buildings. It explores these impacts through three junctions: the network of informal electricity providers, new routines and practices of households and the objects and artefacts that constitute the energy landscape in the city. This research contributes to an understanding of relationships produced by these 'new' and informal infrastructures.

1. Introduction

Despite the fact that the civil war that blighted Lebanon in the 70s and 80s ended in 1991, the urban landscape of the country's capital and neighbouring towns and villages still bear the marks of this long-lived conflict. In the last two decades, the noted efforts in reconstruction [1–4] – mainly in the capital Beirut – may have succeeded in regenerating some of its urban spaces; rebuilding destroyed neighbourhoods and reviving different economic sectors [5]. However, what belie the country's new growth and development are failing infrastructure services that have long been tolerated and managed by its inhabitants. Significantly, the country's inadequate electricity services have resulted in endemic power outages, which have become part of the normal everyday life of its citizens, suggesting an adaptation through several means.

Electricity in Lebanon is provided and managed by Électricité du Liban (EDL), the nationalized utility company. EDL are responsible for providing electricity to homes and businesses, maintaining the transmission and distribution network, metering, and redeeming payments from customers [6]. In addition, resources and investment in electricity infrastructure, such as the building of power plants and fuel imports, are controlled by the government's Ministry of Water and Energy. Yet, an electricity crisis remains, with electrical output significantly less

than demand [7–9], leading, over the years, to the country's residents and businesses having to rely on self-generation, amounting to almost 40% of the total electricity generated in the country [10]. EDL are also blighted by financial problems, with the company's inability to balance its books and its increasing reliance on loans from the government [7]. Arguably, a political inertia hinders the needed price rises for tariffs to match costs, and these are compounded by the prevalence of theft on the grid and inefficiencies in payment collection [11]. These “non-technical” deficiencies or political barriers [12] are often cited as causes for the longstanding electricity crisis, but very few studies have unpacked the nature and extent of these challenges insofar as the ramifications of the crisis have affected the provision of electricity in Lebanon's cities and towns (c.f. [13,14]). This paper explores in more detail the multifaceted yet mundane impacts of the electricity crisis by tracing the socio-material entanglements that result people's need to augment electricity services for homes, and how eventually these constitute electricity and energy in the city of Beirut.

Since the end of the civil war, considerable investment in infrastructure has taken place, yet for electricity, these have proven to be insufficient [8,10] and as a result, the current electricity network is incapable of providing the 24 hours of electricity customers need. Instead, a schedule of rolling power outages is implemented; the capital rotates 3 hours of power cuts a day across its different neighbourhoods,

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whereas the districts outside metropolitan Beirut can have the power to their homes cut to up to 8 hours a day. The length and frequency of power outages can vary depending on circumstances, some of which are outside the control of the electricity network managers. These include excessive electricity demand for cooling during summertime, which often coincides with a temporary increase in the size of the population due to returning migrants visiting in the time of year, as noted by a leading electrical engineer interviewed for this study. Other factors that lie outside the control of network management include acts of war targeting infrastructure which have slowed down progress over the years since the end of the civil war in 1991 [16].

What can be observed across towns, neighbourhoods, streets and homes (as well in extensive media coverage) is how the unreliability of electricity-related services became inherent in the Lebanese everyday life, resulting in the normalization of “coping strategies” adopted by citizens in order to maintain required levels of electricity services for their comfort and convenience. Equally, businesses and smaller industry have also had to invest to ensure reliable power supply; though this paper will only draw on homes in the city and its suburbs. Over the years, the different strategies for coping with electricity cuts included the purchase of a diesel generator for a single home, the collective purchase of a larger generator which is shared by residents in an apartment block, or individual households subscribing to neighbourhood-level informal electricity providers (IEPs), who sell them a restricted amount of electricity during the power outages for a monthly fee.

2. Beirut's electricity interruptions

Electricity services interruptions, and the resulting need for diesel generators mean considerable costs are added to the monthly expenses of many Lebanese households [10]. The costs vary depending on the area of residence and the average length of power outages. Whilst residents in metropolitan Beirut can pay between 30–50 USD a month for 5 amperes or 10 amperes, people living in the suburbs and across the country face connection costs of 50 USD/month, rising to 120 USD/month for 5 or 10 amperes respectively. These prices are not subsidised, are not fixed and are subject to fluctuations owing to the price of diesel [10]. Furthermore, the limited amperage for a household mean that for the duration of the power outage, only basic household appliances can be used, such as lighting, a medium sized refrigerator/freezer, and a television set. The use of more energy intensive appliances such as water heaters, washing machines, or the charging of computing equipment, which require more amperage, would have to be postponed or shifted until the electricity is reconnected. Whilst in metropolitan Beirut such shifting can be managed or tolerated, in other areas, longer power outages coupled with higher IEP fees can have crippling impacts on people's ability to manage their everyday life and partake in the typical daily routines. Another impact is health related, whereby the generators (whether co-owned by residents or belonging to IEPs) tend to be located in the backyards or basements of apartments blocks. The co-location of generators and housing in the densely populated residential areas of Beirut and its suburbs posits a significant environmental health risk to residents, with the discharged particulates linked to increasing levels of cancer and respiratory illnesses among the population [17].

It is important to note that both the health and economic impacts are endured in such a way that penalizes poorer households [14], creating uneven energy geographies not only in terms of access to electricity services, but also in how the informal network for electricity supply impacts on residents. To clarify, the reliance on IEPs – which are more expensive than co-owning and running a private generator – is more common in poorer suburbs where households lack the economic or social capital to invest in co-owned generators for their apartment blocks. Likewise, the proliferation of large polluting generators for IEPs in the poorer suburbs suggests that levels of exposure to diesel

particulates can be higher than other more affluent neighbourhoods. As such, the experience of power outages in urban areas of Lebanon is not only multi-faceted, but also differentiated by geography and income. What becomes evident when attempting to understand the impacts and experiences of power outages in Beirut is the difficulty in separating these lives from the geography of energy in the city. In other words, in eliciting the lived experiences of power outages in Greater Beirut – the geography of the user [18], we begin to trace the associations the co-constitute energy in the city – the geography of production and supply which are themselves fragmented and uneven [14,19]. Faced with the requirement of bringing in all these disparate yet connected elements, the concept of assemblage or network [20], broadly conceived, is useful in explaining the nature and experience of power outages, which are always in flux, always changing, and contingent. As such, it is the view in this paper that approaching the case of power outages in Beirut informed by concepts from assemblage contributes to better understanding the spatial dimensions of the energy landscape affecting the city's inhabitants. The purpose is to suggest a shift towards a broader and a more spatial view of the opportunities and limitations of energy access in Beirut that are now entrenched as a result of system failures, the rising informal networks of provision and the emerging practices of energy consumption. Taking the case of Lebanon, this can be helpful in pointing to new directions for engaging with the challenges of energy as they manifest in the cities of the global south, whether these are problems of access or the quality of energy services available, but more importantly the multiplicity of factors that can instigate change to fairer and better access to electricity.

3. Conceptualizing power outages in everyday life

Positioning the experience of power outages within the socio-materiality of everyday life emphasises their heterogeneity, and the rich and multi-faceted accounts they provide. It is this relational account of our encounter with energy and its various modes of consumption that forms the basis of the study of power outages in people's everyday life. Understanding space as constituted through social and material relations [21], an assemblage approach enables an unpacking of the challenges of energy access in Lebanon that goes beyond techno-economic assessments [7,8] or reform and growth plans for the country's energy capabilities [22], but which ignore spatial determinants that can hinder a transition towards a fairer, safe and more equitable access to electricity services. As Verdeil [14] argues, flows of electricity and power in the city of Beirut constitute the urban geography that structures life for its residents in the everyday. This is therefore an invitation to proceed with two objectives: the first is to explore and better understand the everyday experiences of using electricity in the city, and secondly to do so by focusing on the power outages, these disruptions in electricity services that, due to their emerging and contingent attributes, are better at unpacking the processual nature of energy infrastructure [23,24].

This paper presents several vignettes of experiences with power outages, the aim of which is to show examples of how the flows of electricity and their disruption entangle the everyday lives of the people in Greater Beirut. The traces of these flows on people's routines, their homes and appliances, as well as on their sense of safety and comfort in the city, shows how living with disruptions becomes normalised and embedded in the urban infrastructure. This approach and analysis benefits from a relational turn in geography [25,26]. By thinking with assemblage, we are able to focus our attention to networks and the relations that form or break down, but that both produce a landscape of electricity services in Lebanon. From this perspective, relations can be traced from the formal electricity grid to the informal network of IEPs and includes the city of Beirut's built environment that permits or summons the various wires and connections. This produces a networked flow: two ‘grids’ that function in the same space, and a myriad of everyday practices that enable and sustain the relationships and associations necessary for electricity services in homes.

As such, this analysis not only empirically builds on the work by Verdeil which has drawn attention to the case of Beirut, but is conceptually informed by work in geography that has adopted the assemblage approach to develop thinking on cities [27,28], states and territory [29], and materials, technology and infrastructure (cf. [30–32]). Assemblage thinking draws attention to the heterogeneous nature of these formal and informal networks and how they come to be [18], both as a phenomenon and as a process [33]. As material interpretations of power, resources and capital, an assemblage approach is valuable in the study of energy infrastructure as it helps in unpacking why orders or associations emerge in particular ways, why and how they become fixed and how they fall apart [20]. This approach is therefore useful in questioning how social and cultural practices become normalized in these contexts, drawing on the agency of non-human objects and the co-constitution between humans and non-humans [34].

For the purpose of this study, this paper will not delve into the differences between assemblage approaches, originating from the work of Deleuze and Guattari [35] on the one hand, and actor-network theory, an approach from science and technology studies pioneered by Callon [36], Latour [37], and Latour and Law [38] on the other hand. Whilst acknowledging the differences between the two approaches as outlined by Muller [20], this study agrees with McFarlane [39] with regard to the focus of assemblage on the processual and the emerging – attributes that befit the exploration of the spatiality of energy infrastructure in urban Lebanon.

Furthermore, the advantage of an assemblage perspective is in avoiding implicit distinctions that sometimes appear to be made between techno-economic systems of provision and infrastructure on the one hand, and patterns of consumption on the other hand [40–43]. Whilst these studies provide much needed insight for understanding consumption and changes in consumption practices, such framing risks solidifying our view of these practices in time and space, whereas the reality of the situation is that what constitutes these practices is contingent on heterogeneous associations. In those instances, a social account of the dynamics of these practices, whether at the level of the everyday or in our understanding of infrastructure, is insufficient to bring to the fore underlying relations of power that shape energy in the city. From the point of view of assemblage, the lived experience of power outages can be understood as a condition that emerges from the ways the political, economic, legal (and illegal), technological, practical and cultural configure to form electricity provision in Lebanon today.

Electricity networks are ideal sites for assemblage thinking. Bennet [23] describes them as clusters of “charged parts that have indeed affiliated, remaining in sufficient proximity and coordination to function as a (flowing) system”, highlighting the importance of the “powerful non-humans” (p. 446) and their agency, and arguing for a distributive agency along the lines and flows of the network and electricity. This suggests in the case of Lebanon that in order to get to grips with the challenges at hand, it is no longer sufficient to revert to engineering assessments of generation and transmission, nor would an over-emphasis on political will and corruption [44] suffice. Such accounts risk ignoring the emerging power structures resulting from the long-endured shortages in electricity, the work of IEPs and their undue influence on service provision in the city’s streets and neighbourhoods. Furthermore, the opportunity presented in the focus on power outages is precisely because these failures and breakdowns reveal the assemblage of electricity in the city, which tends to become visible upon breakdown. In the case of long-term failure and reduced quality of access, the elements of infrastructure are visible and foreground the lives of those affected by it [15]. The foregrounding can also trigger fascination in the breakdowns [46] such as with the blackout of New York in 2003, whilst for Bennet [23] the blackout sheds light on the distributed agency of infrastructure. Whilst useful in helping us identify the socio-technical nature of cities and revealing underlying power structures, disruptions and failures in infrastructure services are also a reminder that they are not stable [47], pointing out their continuous

flux through which urban space is produced and performed.

4. Reorganizing electricity in the city: the case of Beirut

Across Beirut’s landscape, diesel generators hum in between or beneath its buildings and apartment blocks. It is very common that apartment blocks within central and greater Beirut are equipped with medium to large diesel generators to provide homes with uninterrupted but metered (for amperage) electricity. Generators co-owned by the building’s residents would have been purchased collectively by the owners/residents either during the civil war or soon after it ended, and managed through regular payments for maintenance and fuelling. The generator would be located in the vicinity of the apartment block and maintained by the building manager or concierge. Newly built apartment blocks pre-empt the need for the generator, which is usually purchased by the developer, its location designed into the building’s plans and wired into individual flats using separate metering systems. The existence of the diesel generator service will be proudly advertised in the development’s marketing brochures and the amount of amperage available to each unit clearly indicated.

In addition to the private generators are the IEPs who run neighbourhood-based subscription services. These enterprises are based on larger diesel generators and involve a significant investment in infrastructure including wiring, metering, electricity boxes and switches for apartment blocks or subscribing households. These IEPs are officially illegal, given that by law, only EDL is allowed to provide and charge for electricity to paying customers. However, the long-endured shortages of electricity supply to the city over the years has created the demand for these services, whilst at the same time the legality of their status has never been effectively challenged due to the lack of legal institutions in the wake of the civil war that are capable of enforcing the rule of law effectively [48]. After decades of their existing services being relied upon in the different districts and neighbourhoods of the city, they have become a *fait accompli*, which subsequent governments have had to manage and organize either directly through municipal rules and regulations [13], or indirectly through established lines of the clientelist state that function in the country [48,44]. The illegal IEPs are arguably legitimised through practices that aim at their organisation [13], including the enforcement, through local authorities, of quarterly tariffs published by the Ministry of Water and Energy.

Verdeil [14] notes the reorganisation of electricity services across Beirut, that embeds “new infrastructural, social and political dynamics in the city” (p. 155). Whilst these have sometimes led to political mobilization of the populace in areas of the city where power outages had severe impacts, the long-standing normality [27] of the electricity interruptions (which sit alongside the intermittency and unreliability of other infrastructure services) produces an often-problematic urban politics [19]. Hence, the backdrop of people’s everyday lives with electricity in the city is one that is fraught with distinct socio-political and material inequalities, owing to Lebanon’s divisive sectarian politics and its neo-liberal economic structures. Entwined within the re-organized electricity grid is a sectarian discourse that not only obfuscates the techno-economic causes of the failures of electricity provision in the country [14], but also succeeds in quelling popular or grassroots mobilisation by delegitimising their demands for an efficient and equitable access to this much-needed resource. For example, theft from the grid is associated with certain religious sects or is seen as confined to particular suburbs dominated by one political party [49,14]. The implication is that any local mobilisation to demand rights for infrastructural services in the city is perceived as motivated by sectarian politics, thus inhibiting its ability to instigate broader resistance to the current situation.

5. Exploring power outages in Beirut

A qualitative research strategy was used to explore how households

Table 1
Summary description of research participants' households.

| Research participant | Location | Family size | Area type | House type | Power cut/day (approx.) |
|----------------------|----------------|-------------|-----------------|------------|-------------------------|
| 1 | Greater Beirut | 4 | Suburban dense | Flat | 6–8 h |
| 2 | Greater Beirut | 3 | Peri-urban | House | 8–12 h |
| 3 | Greater Beirut | 5 | Peri-urban | House | 8–12 h |
| 4 | Greater Beirut | 3 | Suburban dense | Flat | 6–8 h |
| 5 | Greater Beirut | 4 | Suburban dense | Flat | 6–8 h |
| 6 | Central Beirut | 2 | Urban dense | Flat | 3–6 h |
| 7 | Satellite town | 3 | Semi-rural | House | 8–12 h |
| 8 | Greater Beirut | 3 | Suburban medium | Flat | 8–12 h |
| 9 | Greater Beirut | 4 | Suburban dense | Flat | 6–8 h |
| 10 | Central Beirut | 5 | Urban dense | Flat | 3–6 h |

lived with and made sense of the long-term power outages that affected them. The work consisted of ten semi-structured interviews with households in areas of Greater Beirut, as part of the initial study into the impacts of power outages in Lebanon. The households were recruited through formal invitations distributed during area visits (two households), whereas the remaining eight households were recruited using snowballing and word of mouth invitations. Fieldwork proceeded until we reached saturation in the themes that emerged from the data. Whilst the total number of interviews is limited to ten households, the small sample size is justified given the exploratory nature of the study and the interest in the drawing out vignettes of everyday living with electricity, revealing through the normalized yet hybrid nature of the infrastructure, the flows of energy in the city.

Of the ten households, two were in peri-urban or moderately populated residential suburbs and one was located in a semi-rural area on the outskirts of the capital. Seven of the participating households were flats in apartment blocks at least seven-storeys high, located in highly populated and urbanized areas of metropolitan Beirut or in densely populated suburban areas of Greater Beirut. The following table (Table 1) presents a summary of the interview participants for this study.

The fieldwork was conducted in October 2014 by the author and a research assistant. The qualitative approach used provided a rich account of the everyday household-level practices that were common amongst residents of Beirut and its suburbs in relation to power outages and routine household activities. The interviews focused on how participants provided electricity to their homes, how they used it in their day-to-day, the disruptions that they experienced (at the time of the interview) and the impacts this had on them. The interviews show that disruptions were often managed using a combination of different objects or technological artefacts, as well as modifications to patterns of electricity use. Households also relied on different sources of alternative power such as subscriptions to IEPs, the purchasing of individual sources of electricity generation, as well as installing various 'fixes' to separate appliances to render them useful for convenient and safe use. The interviews where opportunities to converse at length regarding the combination of the various 'solutions' the households adopted currently and historically during the civil war, or in more peaceful times.

Interviews were analysed with a view of electricity consumption and provision as a precarious socio-material assemblage, which required constant 'work' to flow into the sockets and electrical appliances of homes. Although what was elicited may not be as thorough or immersive as using ethnographic methods, the interview method used made possible the collection of these everyday vignettes that present elements of the mundane in relation to power outages. The focus of the research on power outages *per se*, as opposed to a broader concern with other infrastructural failures in the country, made this method advantageous, particularly as it permitted focused discussions on power outages on the one hand, and made it feasible to gather varying points of view from as wide a pool of households as possible during the limited fieldwork schedule.

6. Living with power outages in Beirut and its suburbs

This paper outlines three interrelated junctions where the experiences of power outages are most salient. These junctions are heterogeneous and magnify different yet interconnected elements of the electricity assemblage. The first pertains to the embedding of the informal diesel generator-based IEPs into homes, apartment blocks and neighbourhoods in the city, exploring the different ways people come to be connected to them. In the second junction that we observe are the 'stuff' of power outages, the myriad objects and artefacts of electricity provision that pepper the domestic landscape of homes in Beirut, as households go about their ordinary lives, but also strive to achieve their everyday comfort and convenience. These objects vary in complexity and cost, and are either new innovations that have shifted trends in the country or can be re-appropriations of existing technologies. Finally, the routines that come to be as a result of the power outages form the third junction of everyday life in Greater Beirut, indicating a new normal in relation to the rhythms and patterns of urban life.

6.1. Embedding informal power generation in the city

Whilst it is important to consider the incremental growth of the IEPs in Lebanon in the years following the end of the civil war [14,19], this research is concerned with how households became subscribers to generator services: what prompted the decision to connect initially, whether other options were considered and how did they choose their provider, if they had a choice. One interviewee explained how she and her husband only recently purchased their flat, and the connections (wiring, metering and switch) for the generator service was already built into the apartment block. She explains:

"When we bought the flat, there was a designated provider. His cables and connections were already in place and for every flat in the building; there was a placeholder for the ampere meter and the switch. It was up to us whether we wanted to activate that connection when we moved in, but he's the only provider for this neighbourhood. It is his neighbourhood. He won't let anyone else do business on his turf" (RP-8).

What is observed in this case is IEPs securing a new apartment block before it is completed to ensure that the new residents are enrolled as customers. The lack of choice gives the IEP in this case complete monopoly and control over the monthly fee, especially since imposed tariffs are not uniformly applied. The situation leaves many with no option but to connect to generator services, or not have any source of electricity for the duration of a power cut.

In older neighbourhoods or buildings, new residents have had limited choice when deciding to connect to available IEPs in their area. The resident in a central district of Beirut below explains how she came to have a subscription with the 'grocery store owner' at the end of her street.

"The residents who lived her prior to us had the connection already

installed with the generator owner who also owns the shop downstairs. When we moved in, we asked them not to disconnect and we started paying for the subscription for 5 amperes every month” (RP-6).

In the situation above, the interviewee was familiar with the power outages in the city, as she had experienced them in her previous residence and found the readymade connection convenient and reasonably priced when she first moved in. Although it has since increased to 50 USD per month, she kept up with the connection given how far more comfortable it is for her to live with electricity services at all times. The relationships with the IEPs are not just informal, but sometimes built on friendship, neighbourliness and familiarity. When the IEP entrepreneur is “from this place”, the subscription service is held through these social ties. The interviewee below explained why they have remained with the same provider for over thirty years:

“We’ve been with this provider for as long as he’s been here, as soon as he got a generator. We’ve never switched. I don’t like to switch. Some people here have switched to an ‘outsider’, I mean why? If a person born and bred in your neighbourhood is providing this service, why would we switch to an outsider? I don’t like it. I am very principled” (RP-2).

The distinction between the “outsider” character of an IEP *vis à vis* the neighbourhood business is symptomatic of the social and sectarian divisions, these “collective intimacies” [49] that are constantly being reinforced, particularly when the functions of the state are contested such as the case is of electricity [50]. Observed here are familial or neighbourly connections [51] that are entangled into the wires that connect the various homes to an informal but much needed electricity service, and so translating themselves into a new energy landscape in the city and its suburbs. One can argue that the resulting urban landscape is an extension of the sectarian and communal divisions sown and since carefully managed across the districts and neighbourhoods of Beirut [52]. The informal electricity network and the infrastructure assemblage is itself enrolled into a wider network of spatial politics that transcends the safety and comfort of homes to produce in its wake turfs, boundaries and intimacies that mimic and reproduce communal fragmentation in the city. Thus, the flow of electricity is observed to both drive and be expropriated by sectarian divisions.

6.2. Ordinary lives and routines

Electricity services and everyday lives have been extensively researched [53,18], exploring not only their impact on consumption habits and practices [40,43] but also the embeddedness of routines in daily patterns of work and leisure that come to constitute expectations of comfort, convenience and cleanliness [41,42]. Furthermore, changes in the types of services provided [54] or the sources of energy used for electricity [55,56] manifest in daily life. Both the regular and frequent disconnections as well as the precarity of informal or *ad hoc* connections (regardless of source) produce varying practices that constitute these differentials. For example, one interviewee explained how she had to constantly remind her visitors from abroad about the things they could not do during the power cut, even though that was for only 3 hours per day as she lived in central Beirut.

“I have to teach my family when they are staying over – I need to remind them of the routine and a lot of times they can’t manage the consumption of different appliances. You just need to explain to them” (RP-6).

This participant was referring to pulling the plug off other larger appliances in her home such as the refrigerator in order to keep the water heater on for washing. This was common especially in summer when the hot weather required showering everyday. The contrast of the knowledge and actions taken by this interviewee to the ‘taken-for-

grantedness of the electricity services that her visitors have, highlights how invisible and embedded infrastructure can be, and how the regular and long-endured rolling power cuts – and the resulting precarity of the infrastructure – renders it visible to the city’s inhabitants [45]. The informal electricity service is nonetheless embedded, with related conventions and practices that fix it in place. The result is that the informal system begins to resemble an infrastructure and align itself to the socio-material constituents of electricity in Beirut. Another example from an interviewee below expresses how these practices have congealed in time and space. She explains her preparedness in the face of the regular outages below:

“I organise myself, for everything. I prepare the laundry, for example in the evening I know the electricity is going to be available, I put it on and go to sleep. You organise yourself, I don’t know, we got used to it. Doing the laundry is the hardest in terms of getting it done when a power cut can happen. The ironing I can manage, in the afternoons or when I need a piece of clothing I iron it. The ironing is not a problem” (RP-7).

Other infrastructure failures, such as lack of regular water services blights the well-being of many families in Beirut and its suburbs. In many instances, households have to procure water from informal sellers to fill their water tanks, which then requires electricity to be able to pump the water up to the flats. Water pumps are a significant source of electricity consumption, and having to manage the demand for water pumps to what is already an elaborate routine designed around power cuts, adds another layer of complexity to the everyday life of many families in the country. As the interviewee explains, to her the challenges of power outages are dwarfed by the lack of water in her home.

“The problem is not just electricity, it is the water. Regardless of whether I am tired or not, I need to see how I’m going to get the water up. Water is available every 48 h and when it comes ...I don’t have an automatic pump, I have to turn things off, the fridge or lights...I plug the pump in for 30 min to fill the water tank. Then I can do the washing...”

The quote above shows not only the challenges and intricate organisation of households’ activities that needs to happen so that different chores can be completed, but also how these typically ordinary everyday routines are entangled in different infrastructure services, both of which fail and impact the life of the interviewee above. What should also be noted is the enrolment of feelings, fears and anticipation that magnify these practices.

What the examples above indicate is how normal everyday routines are deeply impacted by infrastructure failures. When power outages are managed at the household level, the complexity and dependence of different services such as water, heating and lighting cascade the disruptions across the different aspect of peoples’ everyday lives in the city. Normal everyday household activities, bodily needs and mental well-being are intricately managed using different sources of electricity, formal and informal services, as well as combinations of technologies and artefacts to enable the ordinariness of the everyday. In the section below, the knowledge and use of all these different objects is discussed, with an exploration of their appropriation as part of the power outage solutions used by the participating households.

6.3. The ‘stuff’ of power outages

Myriad objects of power outages make up the domestic landscape in relation to electricity. It is not uncommon to find battery-powered torches, rechargeable LED lights in several homes that were interviewed for this study, or candles for temporarily lighting up the rooms when the lights go off, all of which feature in homes that experience typical power outages [57]. However, the long-term nature of the power outages coupled with the intermittency of the electrical current led to the proliferation of additional technological artefacts that are

enrolled into the network of electricity management in people's homes. For example, Uninterrupted Power Supply (UPS) systems are not unusual as auxiliary to desktop computers. However, larger three-phase UPS systems are now common to power small to medium size appliances in the house such as the refrigerator or freezer. One respondent explains the reasons behind investing in the UPS system even though the household could not rely on it for all the appliances running together, compared to when they had a subscription service.

"I was unhappy paying monthly for the service, so I paid \$700 for the APS and the batteries and I was done, I'm tranquil. The batteries ran for two years and then we bought new ones. Inevitably it will break down ...but it's better than to pay \$150 or \$100 every month" (RP-7).

In addition to relying on other sources of energy for household management and work, households are sometimes purchasing complementary equipment to protect appliances from the inconsistent voltage that results from having multiple sources of electricity coming into their homes. When washing machines and refrigerators are disconnected from the formal power network and come back on when the IEP source is connected, some interviewees have experienced the breakdown of their household appliances at a faster rate. To avoid that, it became necessary for several homes to purchase stabilizers (RP-2, RP-4 and RP-10) for their refrigerators, as one respondent explains:

"We have a UPS because the electricity is not stable. We have a voltage regulator, because the voltage comes too strong. Last year, at my brother's house, the television, washing machine and dishwasher were all 'burnt', their motor broke because the voltage came on too strong. From both the IEP and the national grid, we have a voltage control device for both" (RP-2).

Similarly, another interviewee perceives the problem to be an unstable electricity source and the constant switching off and on of the larger appliances at home. She explains:

"The fridge takes up three minutes to start up, on the stabiliser. We have stabilisers on fridges in this house and the other house where we spend our summers. We had them installed from the moment we bought the fridges because the electricity is on and off and it's not stable, either too strong or too weak in power, so there's a hazard of the refrigerator motor burning out" (RP-4).

Alongside power stabilisers and UPSs, IEP switches hang on walls in hallways or utility rooms, whilst water heaters are connected to separate fuse boxes to prevent them switching on when the IEP power supply is connected to a household. These small yet significant solutions 'hack' into the hybrid form of electrical supply to homes in Beirut, simulating smoothness in supply and circumventing undesirable disruptions. By disconnecting larger appliances from the IEP electricity supply, residents avoid shorting the supply and having to call out the IEP servicemen, or having to interrupt the flow of their day by switching it back on (often having to leave their homes and children temporarily). Many cite the need to mind children and therefore are unable to leave the house, the difficulty of reaching the switches which are sometimes in the basement of a building (and then having to walk up stairs) or simply not wanting to go into where switches are located, such as dark or unsafe rooms in apartment blocks.

The totality of devices, switches, wiring and smaller power supplies further complicate the network of objects and appliances in households in the country. Whilst rational reasoning can be attributed to some of those purchases – often advice from specialists, we find that these connections are also determined by emotional and practical needs, the desire for comfort or the quest for tranquillity by avoiding subscribing with IEPs and the precarity of supply that produces. What these socio-technical landscapes at the scale of the home illustrate is the delicate work of stability of supply and quality control that inhabitants of the city have to engage with and the end result, which is often a workable

level of electricity supply, is very much conveyed through that constant 'work': the balancing of voltages, the control of amperages and the connections and disconnections of different appliances from the informal and formal networks of supply.

7. Conclusion

This paper has explored the impact of living with power outages in Greater Beirut, Lebanon, across three junctions: the normalization of the informal generator-based suppliers within the energy landscape of the country, the objects and artefacts that embed themselves into peoples' homes, changing and impacting on the domestic electricity supply and use, and the new routines and practices produced as a result of the power outages. These three junctions are important insofar as they reflect some of the characteristics of infrastructures in relation to the informal network of electricity provision, in accordance with the description of Leigh Star [45]. As such, the informal infrastructure of energy supply positions itself at the fore of the energy challenge facing Lebanon. Importantly, the situation of Lebanon is not unique, as an exploration of the literature on variations in energy supply and sources show shades of informality and hybridity in the supply of electricity (c.f. [58]) that is more prevalent in cities of the global south. However, in the case of Greater Beirut, the embeddedness of the informal infrastructure that is controlled by the IEPs, and their entrenchment through the connections built over the years offers a needed spatial account of what might hinder a transition towards a sustainable and more equitable energy infrastructure.

What can also be observed is how the fragmentation and differentiation of electrical services to people in the city weakens the structure and reliance often expected with formal infrastructure services. Whilst not unusual in the developing world, the *de facto* structure and legal nature of IEPs coupled with their ubiquitous presence in neighbourhoods and buildings of the city [14] results in a differentiation of electricity provision that, as shown here, percolates into the routines and the shaping of everyday life for the average household in Lebanon, and in doing so producing their own technological structure and space within the home. These point towards serious justice implications in terms of access to energy services, which are often overlooked in the techno-economic literature on the energy crisis in Lebanon – accounts which have concerned themselves mostly with national level indicators that whilst important to consider, can obfuscate the underlying inequalities and divisions which have festered around and through the informal provision services.

And so, amidst the generators that furnish the city and its suburbs, the everyday experiences and practices of urban inhabitants manifest themselves not only in the 'stories' of power outages that can be held but can also be traced in the physical form of the city, from the wires that criss-cross the skyline of Beirut to the practices that are congealed in routines and in the artefacts and objects that furnish people's homes. These impacts intersect with other dimensions of everyday life in Lebanon – as pointed out by Verdeil [14] on political mobilisation and divisions of the city [52]. However, in this paper, an initial exploration of these three junctions is presented in an effort to contextualize further the impacts of power outages as felt and lived on the micro-scale. This more focused view is one way to build towards a better understanding of the political economy of energy provision by starting at the level of households and neighbourhoods, with the expectation of following those lines of enquiry into the broader economic interests and financial incentives that keep countries such as Lebanon in this delicate balance of electricity supply and use.

The purpose of this research was to contribute to an understanding of the relationships and practices that constitute informal structures of electricity provision and how power outages materialise in the everyday rhythms of the city. It draws attention to the myriad elements of the socio-materiality of electricity, its technologies, failures and resulting disruptions. The exploration begins to show elements of what

can be understood as a sociotechnical system that continues to develop to accommodate the society's desire for comfort and convenience in a way that corresponds to the expectations of those living in urban Lebanon. In some instances, it mimics existing political or sectarian divisions, whilst in other cases it drives changes in the social and material entanglements that have the potential to shape the lived experience of the urban. Exploring further the relationships between the different elements of this 'new' energy landscape is needed to better understand the shaping of the urban through infrastructure in the city.

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