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Breaking the cycle of corruption in Nigeria's electricity sector: Off-grid solutions for local enterprises

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ABSTRACT

Access to electricity is a major constraint to economic growth in Nigeria. Small and medium enterprises (SMEs) are arguably the segment of the Nigerian economy most disadvantaged by a lack of access to reliable power. Due to the failure of grid-based supply, over 80 % of SMEs rely on a generator to power operations. Inclusive, diversified growth in the country depends on growth of the SME sector. This paper examines how SME grid access can be improved given the technical inefficiencies and systemic corruption in the sector. In line with the political settlements framework we provide a macro-analysis of the sector which helps address and identify a solution for the main research problem of how to solve the power constraints Nigerian SMEs face. Our research, conducted between 2018 and 2019, but still valid currently, as the features we describe have not evolved substantially, identifies that the reasons for the failure of grid-based supply is a combination of interdependent factors. Technical inefficiency in the grid is high. Revenue shortfalls have also resulted in extensive government bailouts. These inefficiencies are compounded by 'legacy' and recent corruption that has led to poor maintenance of the transmission network during state-ownership and to the presence of politically-connected bidders in the recent privatisation efforts, leading to sub-optimal outcomes. Any solution for SMEs has to take this sectoral configuration into account. Our strategy is supported by focus groups discussions and interviews with over 30 clustered firms in the South Eastern SME hubs of Onitsha, Aba, and Nnewi.

1. Introduction

The power sector was privatised in Nigeria in 2013. The privatisation of Nigeria's power sector was one of the most ambitious market reforms attempted in Africa. Privatisation was intended to modernise the sector and allow it to meet the country's growing demand for electricity. However, a decade on, the desired outcomes have still not materialized and access to electricity remains a major constraint to economic growth in Nigeria. Economic losses from insufficient power are estimated to be 5 to 7 % of GDP annually [1]. Since privatisation, the electricity available on the national grid to light homes and power the economy has remained stagnant at around 4500 megawatts (MW). This level of generation is well below the 8400-megawatt target for 2018 and leaves 45 % of the country- or 90 million Nigerians- without connectivity to the power grid [2]. In addition to having limited capacity, the power sector has been operating in a significant fiscal deficit since privatisation. In 2019, the annual shortfall in the electricity sector was US$1.9 billion- an amount greater than the federal health budget [2].

The current crisis in Nigeria's power sector is a result of deep structural distortions. The sector is constrained by legacy corruption, technical inefficiency, the adverse selection of politically connected investors, and financial illiquidity. Due to these factors, privatisation has not been as successful as expected in modernizing Nigeria's power sector [3–5]. The performance characteristics of the sector haven't improved since the research was conducted, especially in terms of key commercial statistics like collections (staying the same at around 69–70 % from Q2 2019 to Q2 2022), the percentage remitted back by distribution companies to the market operator (73 % in Q1 2019 and 69 % in Q2 2022). Average generating capacity has improved somewhat from 3711 MW to 4712, but this has also been fluctuating [6,7]. The sector is therefore stuck in a low-level equilibrium where incentives to invest in and upgrade the grid are absent.

Arguably, the segment of the Nigerian economy most disadvantaged by the mismatch between supply and demand for power is the small and medium enterprise (SME) sector [8,9]. SMEs in Nigeria contribute about 50 % of national GDP and account for 77 % of employment [10]. Youth

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ownership was also very high in this segment in 2012 [11]. Therefore inclusive, diversified growth in the country depends on the growth of the SME sector. Due to the failure of grid-based supply, over 80 % of SMEs own or use a generator, or self-generate (power produced by the consumer on-site to make up for grid shortfall or reduce purchase from the grid) in Nigeria. There is a substantial black market for diesel which is diverted from official sources, smuggled into the country, or purchased from artisanal oil refineries in the Niger Delta that use stolen crude [12]. These black markets are driven by the fact that markets are imperfect and formally and informally administered, so that prices do not rise to the full extent necessary to clear the gap between demand and supply. The black market in diesel is consistent according to our KIIs and expands rapidly during periods of fuel scarcity.

Residential and commercial users also face power shortages but do not face the same problems of competitiveness as SMEs do. Residences with sufficient purchasing power can complement grid power with self-generation (using smaller generators and other means such as inverters). Poorer consumers do suffer more but also engage in accessing supplies illegally and often do not pay bills. Commercial consumers have specific policies in place that improve supplies to commercial areas. Most large industrial consumers have captive facilities. However, no significant policy exists for SMEs, nor do they have the scale that makes captive generation economically viable, making electricity access-related policy design vital for this segment.

Costly self-generation is both a cause and an effect of some types of corruption. There are many causes behind the failures of the main grid but these include the power and influence of key players whose informal interventions prevent critical reform and contribute to continuing diversion of resources into inefficient activities. The power cuts that this drives forces SMEs (and others) into high-cost self-generation. Off-grid generation in turn drives other types of corruption, including the search for parallel market diesel but it also justifies in the minds of many SME actors the theft of power from the grid and non-payment of bills, as we show later in the article.

A combination of interdependent issues—legacy corruption, transmission inefficiency, problematic contract design during privatisation, technical bankruptcy of distribution companies, and low billing collections by them—cascade losses back up the value chain. This amounts to an adverse configuration of organisational power for enforcement in the sector. As a result, the grid is not expected to function as required in the short-to-medium term, and this is one of the reasons why Nigeria has more capacity in self-generation (around 14GW) than utility or grid-based (around 13 GW) [13]. While the state-owned Nigerian power sector required extensive reform, the policies selected to drive privatisation were not appropriate for the prevailing institutional conditions [5,14]. A broader lesson from the privatisation of power in developing countries is that corruption may remain entrenched despite reforms introducing private ownership and a formal structure of competition [16,17]. This is because in high-risk markets like electricity or infrastructure in developing countries, politically unconnected investors may stay away because of contract enforcement risks, leaving politically connected players to get significantly preferential deals and engage in corruption even in the context of open tendering [18].

Nigeria is ranked 150 out of 180 countries in Transparency International's Corruption Perception Index. Corruption in Nigeria is perceived to be deep-rooted and entrenched [19]. However, despite these adverse circumstances, the evidence also suggests there are opportunities for pursuing anti-corruption in Nigeria in ways that are 'developmental' and feasible to implement.

Given the broader sectoral dynamics, this paper examines how to feasibly improve SME grid access. A long-term strategy for the power sector entails substantial financial and institutional restructuring of the sector to reduce risks so it can become a viable system [14]. This will allow actors to take a long-term view and undertake investments to improve gas supply, transmission and distribution infrastructure, and metering. At the time of conducting this research in 2018, there was little progress on these counts but some recent events like the stock market listing of a private power generator and partial restructuring of distribution companies have taken place. However, the scale of the challenge is still substantial and it will be difficult to enforce policies that will enable financing to flow through the grid more fluidly or to resolve the political corruption in the sector in the short-to-medium term.

We strongly believe that generation and transmission through the grid must remain a key policy target, but a national grid-based solution will not have a turnaround time short enough for SMEs. A policy redesign can help SMEs access power outside the main grid, as the latter is unlikely to be significantly reformed in the short to medium term. While broader constraints in the power sector have been discussed in the paper, these have been outlined to establish the necessity for an SME-focused policy.

The remainder of the paper is structured as follows. Section 2 presents the research question and methodological approach. Sections 3 and 4 summarize the challenges in the privatisation of the power sector and their impact on SMEs. Section 5 outlines the proposed short- and long-term strategies for delivering power to SMEs. Section 6 presents the evidence of support for the mini-grid strategy from FGDs and interviews, and the final section concludes.

2. Research question and methods

In this paper, we aim to identify conditions under which incentives in the sector can be restructured such that actors will no longer resort to corruption, in their self-interest, as a result of horizontal peer-to-peer checks and balances, and not because of attempts to externally enforce rules. The broader methodology in the paper derives from and uses the political settlements approach [20,21]. A political settlement refers to the distribution of power across actors (firms, agencies, individuals) in a sector, country or region. This distribution of power helps to explain how policies and institutions that determine the formal allocation of benefits across these actors emerge, and more importantly, how these are implemented. In developing countries, the distribution of benefits across actors is often brought into line with the distribution of power through corruption and informality of different kinds [22]. The political settlements framework thereby helps to identify and assess the feasibility of different types of strategies to control rent-seeking and corruption. To be implementable and achieve developmental and anti-corruption outcomes, a policy combination has to distribute benefits such that sufficiently powerful actors at the appropriate policy level are incentivized to work to monitor and enforce the policy and to assist formal enforcement efforts in their own interest. These are described as horizontal checks, and the political settlements approach says that most anti-corruption efforts fail because there are insufficient actors with the power, capabilities, or interests to engage in horizontal checks to enforce the relevant rules [23]. In this paper, we apply these insights to identify feasible reforms in power generation in Nigeria.

The political settlements lens suggests a number of risks and opportunities, and these are our starting points. First, the distribution of power, capabilities and interests across the actors in the main grid are such that directly targeting informal arrangements at that level is unlikely to be immediately effective. Many of the privatised firms involved in power generation and distribution are not only politically connected, their 'informal benefits' are known to be large. From a political settlements perspective, reform that threatens these interests is likely to be very difficult to implement given the power of the actors involved relative to potential reforming politicians and agencies. Alternative approaches that sequentially address important problems in power supply in more feasible ways are likely to be more appropriate for addressing immediate problems. Alternative methods of improving power supplies not only have to be economically viable, they also have to address problems of corruption particularly at the level of non-payment of bills and power theft. This is only likely if the actors

involved have strong interests in making the alternative solution work, and if the possibilities of informal violations and corruption can be limited by plausible horizontal checking by the actors themselves. The primary purpose of this paper is to demonstrate that such an alternative approach is economically feasible and that the anti-corruption effects based on the power and interests of the actors are plausible.

Anti-corruption strategies like privatisation reforms often fail in developing countries because they typically assume corrupt acts are deviations from a rule of law that are primarily driven by the discretion of government officials at the micro level [24]. If that were so, improvements in transparency and accountability would be successful and enforcement by lawmakers would work. In contrast, developing countries have high levels of informality and 'rule by law' - many institutions and laws are enforced, but often not on the powerful and that includes players in the private sector, like in the case of the Nigerian power sector as we will demonstrate later. Enforcement is therefore selective and most often not impartial [24].

Cross-country evidence has shown that some rents can lead to developmental social outcomes [25–28]. Equally, informal networks of patron-client politics can be very damaging to growth [29–31]. The challenge is to identify where a configuration of interests and capabilities in the Nigerian power sector exists, such that rent creation does not lead to adverse outcomes. Our research has identified a feasible, low-risk strategy for the provision of power to SMEs by creating mini grids for clusters of productive firms. The strategy is designed to leverage horizontal monitoring to create self-sustaining enforcement that is independent of external enforcement [23]. Given this self-interest of the players and the fact that the actors are in a small enough setting to be able to observe and check each other, it is likely that will this be an affordable source of power and reduce corruption by making it more difficult to not pay bills or not provide power as a result of free riding. We expect firms within mini grids to have credible interests to monitor their peers to lower corruption related to illegal access and non-payment for services. In this context, firms are also likely to have sufficient interests and collective power to monitor the performance (i.e. price, reliability, transparency of billing) of the mini-grid power supplier, both of which are not present in the current grid-based system. We show in a later section that SMEs demonstrate a willingness to pay for power at prices higher than those notionally available in the grid, as they already self-generate at considerably higher prices.

Our research was conducted between April 2018 and December 2019 and included focus group discussions (FGD) with SME owners, key informant interviews (KII) with key stakeholders and a survey of 30 SMEs in 3 clusters. The SMEs in the three clusters were engaged in plastics and polythene-making and metal fabrication (Onitsha), shoe-making and tailoring (Aba), and automotive part-making (Nnewi). We also conducted one FGD in The Federal Capital Territory of Abuja attended by ten participants where we had SMEs from the hospitality sector, poultry sector and retail, among others.

We were interested in already established SME clusters that are now in danger of becoming uncompetitive as these SMEs are more likely to have relevant information about the alternatives we wished to assess. We chose to work in the South Eastern zone of Nigeria for two reasons. First, this region was known for its clusters of successful small-scale manufacturing but was now facing significant constraints to continued growth [32]. Second, these clusters are located in regions that experienced significant organised protests and violence in the late 1990s. Many of the youth who were involved in those movements transitioned to being owners of productive SMEs, including some whom we interviewed. Their responses consistently underscored the need for inclusive and productive growth, and access to electricity was an important constraint they all identified.

Once we were able to establish constraints, cost structures, and a strategy, we conducted follow-up interviews with the SME owners to establish their willingness to pay for an off-grid solution. Our research also engaged with 11 anonymous, influential and key informants in the power sector, some of whom were approached more than once. The informants had close involvement or knowledge of the privatisation process and provided assessments of the sector's trajectory. Given how prominently the sector's performance appears in Nigerian media, we have also sought to supplement this evidence with policy documents and credible news items.

3. Privatisation and corruption in Nigeria's power sector

This section provides an analysis of the underperformance of the sector post-privatisation. This is important to highlight as Nigerian power consumers including SMEs are forced to rely heavily on self-generation. SMEs, therefore, have to resort to illegal methods to access power, for instance buying diesel from the black market or stealing electricity from distribution lines. The sector's institutional features as they currently exist are not yet fit-for-purpose where SMEs are assured of consistent grid-based power [3,4]. Yet given the SME sector's importance in the Nigerian economy a solution has to be designed keeping in mind the current constraints which we outline below.

Reform and privatisation of the power sector started with the formulation of the National Electric Power Policy in 2001 and the Electric Power Sector Reform Act in 2005. These reforms provided a legal framework for the commercialisation and liberalisation of the industry and were comprised of two main components- restructuring and privatisation. First, the sector was restructured into its constituent parts of power generation, distribution, and transmission. The existing public monopoly of the National Electric Power Authority was incorporated as the Power Holding Corporation of Nigeria (PHCN). Following the successful incorporation, the PHCN was unbundled into 6 generating companies (GENCOs), 11 distribution companies (DISCOs), and 1 transmission organisation. At the same time, the Nigeria Electricity Regulatory Commission (NERC) was established as an independent regulator. Second, bids for the generation and distribution companies were submitted in July 2012 with negotiation proceeding into the following year. The GENCOs and DISCOs were sold for $2.5 billion. The Nigerian government chose to maintain control over the transmission organisation and a 40 % stake in the DISCOs. In November 2013, the federal government formally handed over the operation of the 6 GENCOs and 11 DISCOs to private investors.

However, despite the privatisation of the DISCOs and GENCOs, service delivery did not improve. Fig. 1 shows that peak power generation remained relatively stagnant below 5000 MW from 2015 to 2022. Why did privatisation fail to achieve the desired outcomes? Based on extensive interviews with key informants in the sector, we contend that the current crisis is a result of structural distortions including 1) technical inefficiencies and underinvestment in the sector, 2) problematic contract design that led to the selection of politically-connected investors, and 3) the selection of reform strategy that was not suitable for the political settlement in the sector. These factors have contributed to significant operating deficits and financial illiquidity in the sector over the last decade [5,14,33,35].

3.1. Technical inefficiencies and underinvestment

One central reason why privatisation has failed to improve outcomes is that the sector is plagued with technical shortcomings in power generation, transmission, and distribution [33,36]. According to a key informant who was a senior member of NERC during privatisation, the country was not ready for privatisation due to technical inefficiencies and a significant lack of investment in infrastructure in the preceding decade.[1] This led to a build-up of significant financial liabilities in the sector which made it unattractive for politically unconnected investors

[1] Key Informant 8, Senior member of Nigerian Electricity Regulatory Commission during privatisation. London March 2018.

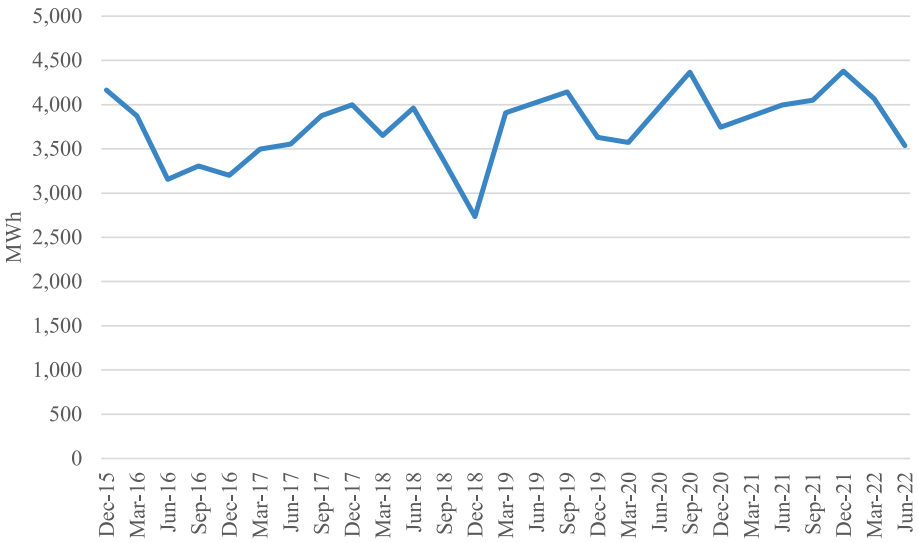

Fig. 1. Average hourly power generation in Nigeria post-privatisation from 2015 to 2022.
Source: CEIC; https://insights.ceicdata.com/.

to bid when the privatisation process began. Starting with the generation sector, there was not enough electricity to sell at the time of privatisation to make the sector financially viable. Transition documents recommended that electricity supply should be at least 18,000 MW before privatisation so that there would be a functioning market to sell in.[2] However, supply was much lower between 3000 and 4000 MW when the sector was privatised. Additionally, new generating plants that came online during this period had insufficient access to gas supplies, constraining peak power generation. To this day, insufficient gas supply remains a key constraint to the performance of GENCOs.

The transmission sector was also very inefficient due to years of underinvestment. In 2012, the transmission sector was not privatised alongside generation and distribution companies. Instead, the Transmission Company of Nigeria (TCN), the state-owned utility, is responsible for power transmission. A Canadian company Manitoba was chosen through a bidding process to manage the grid for TCN, but its contract expired in 2016 and wasn't renewed leading to questions as to why this was allowed to happen [4]. According to official statements, the transmission network is able to transmit no more than 7000 MW if Nigerian power stations were operating at full capacity due to its ailing infrastructure. However, most industry analysts, including some of our industry key informants, state that actual transmission capacity is much lower.[3] One central reason for this underinvestment in the transmission sector has been high levels of political corruption within the TCN [14].

Additionally, distribution companies face significant challenges including insufficient power from GENCOs, technical loss in the transmission and distribution network, collection loss from unpaid power bills by customers, and commercial loss due to consumers tapping illegally into distribution lines. Technical transmission and distribution losses due to poor infrastructure alone accounted for 16 % of Nigeria's total electricity output in 2014 [37]. In addition to technical losses, distribution companies have struggled to collect power bills from consumers. In 2012, NERC found that DISCO records of registered consumers represented only 19 % of the total Nigerian households and that 55 % of these registered customers were not metered [38]. Due to the scarcity of meters, NERC allowed an 'estimated billing' policy that remains deeply contested. Under the policy, estimated bills are based on average load calculations for unmetered areas and allow DISCOs to pass commercial losses from illegal tapping onto customers [33]. Post-privatisation, there were reports of distribution companies misusing this policy to over-charge. Equally, there were reports that customers who received the correct estimate refused to pay as there was no proof of their usage. In other cases, users 'settled' with officials from distribution companies at a rate much less than billed. NERC has repeatedly implemented new policies to incentivize DISCOs to increase metering, but these efforts have largely failed [39]. In 2021, over 60 % of registered customers were on estimated billing [40].

Altogether, aggregate technical, commercial, and collection losses in the sector are estimated to be as high as 50 % of total power generated [41]. Because DISCOs are responsible for payments up the value chain, their underperformance in bill collection and onward payments have affected the financial viability of actors across the grid. At the time of privatisation, DISCOs were settling close to 40 % of the amount invoiced to them. Some improvements in collection were made between 2013 and 2015, but collections soon declined [42]. As a result of the significant debt, assets in the distribution sector are now in danger of being termed 'stranded' – that is, their investment costs cannot be recovered.

3.2. *Adverse selection of investors*

A second major problem with the privatisation process was that the companies finally involved in the process had strong political connections, sometimes at the expense of possessing strong technical qualities [43]. The privatisation process was not attractive for technically competent international investors. The process did not give permission for bidding companies to conduct sufficient due diligence and lacked sovereign guarantees to mitigate political risks for unconnected investors. Instead, large politically connected firms in Nigeria were able to distort privatisation policies using their connections. For instance, the initial guidelines for privatisation stated that local entities could bid without having a technical background as long as they had international partners who were technically competent. In many cases, local entities with no background in the sector bid in partnership with technically competent international companies, but the latter's equity participation remained too low to be decisive in operations [44]. These politically connected bidders secured financing from Nigerian banks, which have ended up assuming much of the systemic risk in the sector.

The result of privatisation was the acquisition of the 6 generation plants and the 11 distribution companies by politically connected actors. In at least a few cases, the GENCOs and DISCOs were owned by the same politically connected investor. For instance, Integrated Energy, which

[2] KI 8, London March 2018.
[3] Key Informant 9, Ex-Senior power sector policy advisor to President Goodluck Jonathan's government. Abuja, July 2019.

acquired the Ibadan and Yola DISCOs, was promoted by General Abdulsalami Abubakar, a former military head of state. Additionally, Colonel Sani Bello, who is the chairman of Mainstream Energy that acquired the Kainji and Jebba power plants, is a former military administrator of Kano state. Lastly, Yusuf Hamisu Abubakar, the managing director of Sahelian Power that bought Kano Electricity Distribution Company, was a commissioner at the Nigerian government agency regulating the telecom sector.

3.3. Inappropriate reform model for the Nigerian context

A third key reason why privatisation failed in Nigeria is that the reform framework was not compatible with the political settlement in the power sector. While the sector required extensive reform, the outcome of privatisation suggests the set of implemented policies was not appropriate for the prevailing institutional conditions. Privatisation was modelled on Indian examples, which had very different configurations of organisational power [4,45,46]. That India was an initial model of choice, but a wrong one was also confirmed by two of our key informants.[4] In India, privatisation was spurred by the fact that the State Electricity Boards (SEBs) – the agencies charged with coordinating generation, transmission, and distribution– were in deep financial crisis due to mismanagement and rent-seeking, which motivated the central government to bring in private investment [47].

The major public-sector generator in India was the National Thermal Power Corporation (NTPC), a near monopoly, which is still the single largest producer of India's electricity and contributes about 25 % of power generated with an installed capacity of 57,356 MW. The NTPC was a profitable generator and was not privatised due to political opposition. The emerging private sector in power generation, therefore, operated next to a large and profitable public sector that set the yardstick for performance. The presence of the NTPC also constrained private companies from negotiating informal deals that would let them get away with inefficient performance.

Subsequently, the horizontal enforcement of policy in the sector was more feasible in India than in Nigeria. Due to historical reasons, the manufacturing sector in India was more developed than in Nigeria, with powerful interests demanding electricity at reasonable prices. In India, most firms set up their own captive power plants (CPP) programme after privatisation, which allowed industry consumers to set up and manage generation facilitates for their own consumption [48]. CPP clusters put pressure on public-sector generators and distributors in terms of pricing, particularly if they attempted to expropriate too much from business interests. In the industrially advanced state of Gujarat, clusters of SMEs also contested the state electricity board which was passing on suspiciously high prices to them [23,49]. Such horizontal checks and balances across different types of organisations were only possible because there was a broader and diversified base of productive capabilities in both the private and public sectors. Horizontal monitoring by competitors with the interest and capability to create real pressure is often effective in reducing collusion and corruption even where formal rule enforcement is weak [23]. Finally, the private-sector firms that went into generation were politically connected in India but also had sufficient technical capabilities to be able to generate electricity efficiently when under pressure to do so.

In contrast, the configuration of organisational power in Nigeria's electricity sector included powerful and less technically capable private-sector organisations. In Nigeria, privatisation gave these organisations significant new rents that increased their already high relative power. On the other side, there were relatively weak and fragmented regulatory institutions as well as a weak manufacturing sector and retail consumer base. Additionally, the politically connected nature of the private actors made the government reluctant to take any tough decisions with regard to reform in the sector. The reform strategy should have considered whether, in the specific conditions of Nigeria, countervailing forces existed to check these attempts at informal rent capture [50]. If not, a more gradual privatisation strategy should have been followed, that only privatises parts of the chain where productive capabilities, competition, or pressures from other constituencies could limit informal rent capture.

3.3.1. Networked corruption and the need for a 'disconnected' solution

Our research has identified distortions across all sections of the national grid from gas supply to the end customer. We define this as 'networked corruption' where relevant organisations in the sector are all benefiting from corruption. Creating policies in this context is difficult because actors do not have incentives to break this network. This is significant for the design of anti-corruption policies. Addressing the distortions in any one component is unlikely to help the electricity sector as bottlenecks and corrupt practices will remain elsewhere in the value chain as presented in Fig. 2. Addressing the problems across the entire grid requires a level of political coordination that is unlikely to be present. The high levels of political connectedness in the sector also means political transaction costs will be considerable in any reform efforts.

4. Impact of electricity shortages on SMEs

Small and medium enterprises account for 96 % of all businesses in Nigeria [51] and contributed over 55 % of the manufacturing sector's input to GDP in 2013 [52]. Access to power is one of the three main constraints to growth identified by SMEs with close to a majority of them receiving between 1 and 5 h a day of electricity [52]. Electricity supply constraints have been found to have a significant negative effect on SME productivity in both Nigeria [53] and a wider sample of developing countries [54]. A sizeable literature on SMEs has also concluded that lack of power is a key reason for high operating costs among such firms [53–58]. Due to a lack of grid-based electricity, most SMEs also utilise alternative sources such as generators or battery packs. In Nigeria, 85 % of firms own or use a generator [54]. The availability of diesel diverted from official sources in the country means there is a consistent black market for fuel [4]. Evidence for this is hard to come by given the sensitive nature of this information. Four key informants told us that despite the dismantling of the subsidy for diesel a parallel market still exists in the fuel given the high demand for use as feedstock for a majority of generators.[5] The supply for this market is diverted from the official one. As one informant reported[6]:

- "*There are known spots on the highways where tanker drivers stop and sell to merchants who then sell on the stocks to their regular customers.*"

Evidence was also provided by three of our SME respondents about their own use of stolen or 'bunkered' diesel.

- "*We get from bunkerers about 20 litres at 3500 naira weekly. Bunkerers prefer to sell in bulk of at least 20 litres. We buy from them about once or twice monthly.*" **-SME interview conducted 13th May 2018 in Aba**
- "*We use diesel from oil bunkerers once in a while e.g. when filing stations have closed.*" SME interview conducted on 6th May 2018 in Aba
- "*Electricity tariff has gone extremely high and so has the cost of maintenance of generators/plants. This is not to mention the fact that*

[4] Key Informant 1, closely associated with the privatisation process in 2013. London, January 2019. Key Informant 2, a senior executive in one of the privatised companies. Abuja, September 2018.

[5] Key Informant 3, working in the extractives sector. Abuja, July 2019. Key informant 4, consultant in the power sector. Ibadan, February 2018. Key Informant 5 online conversation, works in the local extractive sector in the Niger Delta, Port Harcourt, July 2018.

[6] Key Informant 6, involved in transportation, Abuja, October 2019.

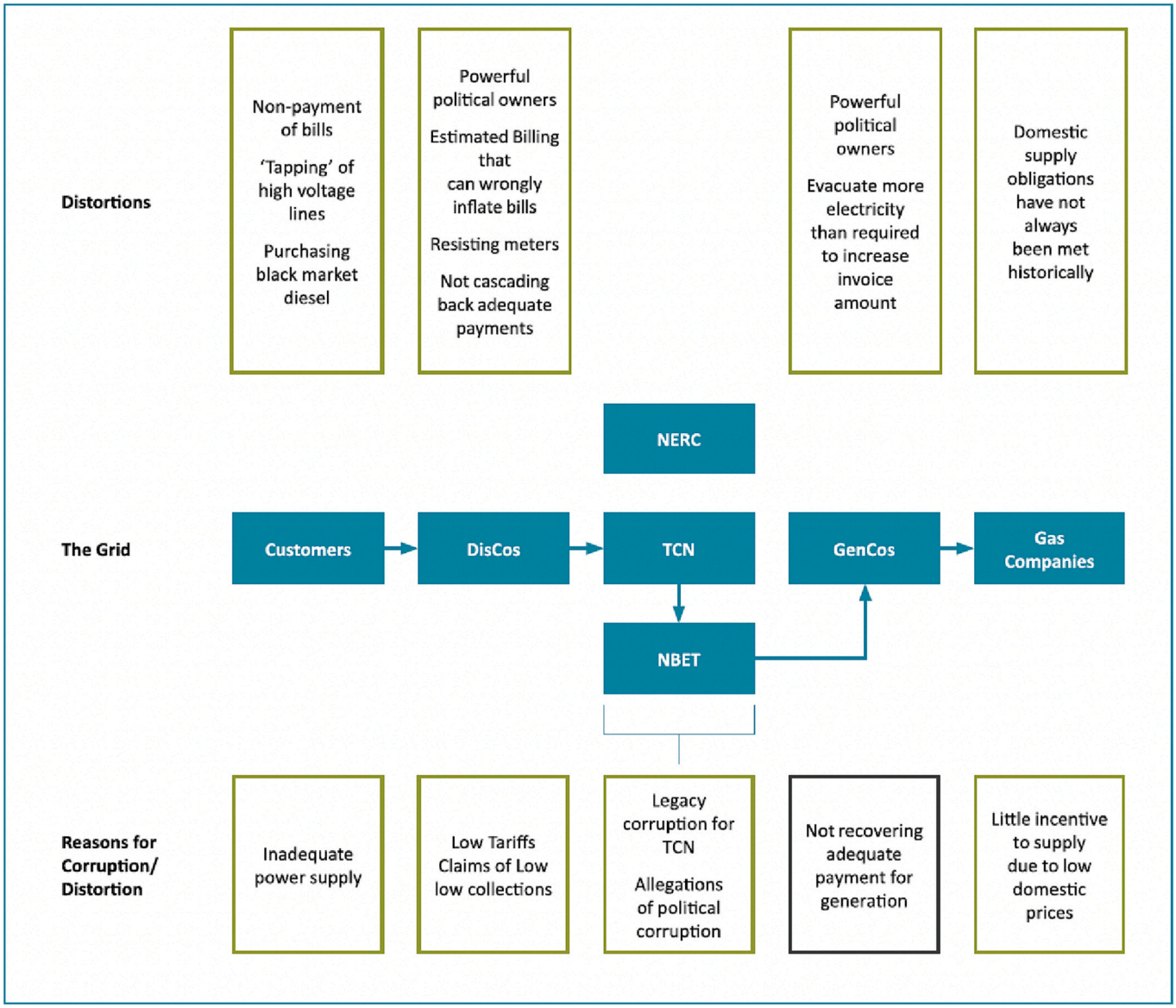

Fig. 2. Sectoral map of distortions.
Note: The blue arrow denotes payments made up the chain. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

sometimes petrol and diesel could be unavailable or only procured via black markets at high prices. What are we paying for?" -**SME interview conducted on 3rd June in Onitsha**

Other participants also informed us that this was a common feature of SME operations in their clusters, though understandably did not admit to doing so themselves. However, such sources are inadequate to meet the demand of SMEs in the manufacturing sector, where firms require consistent motive power for machinery. In sectors where demand is high and supply is severely constrained, there are also strong perverse incentives for firms to resort to stealing electricity from distribution lines through 'tapping', or through non-payment of bills.[7]

The justification that SMEs provided us in FGDs is that if they have to pay such high costs for off-grid power, they will not pay for grid power if they could get away with it. These are a selection of quotes highlighting their dissatisfaction with grid connectivity.

- "*The bill I pay does not in any way reflect the light I rarely see. A customer does not know how much power he consumes yet he has to pay the bill given to him.*" -**SME owner in Aba that participated in a FGD between 6th May and 3rd June 2018**
- "*Where I have my business in Onitsha where there are clusters of ice cream and cold room dealers, the transformer was purchased by the businessmen/women and they paid a whooping sum of N250, 000* (*two hundred and fifty thousand naira*) *to EEDC to install the transformer. And to perfect the corrupt deal, they were coerced to sign a form at EEDC indicating that EEDC installed the transformer at no cost to the manufacturers. The alternative was to wait for whenever EEDC Onitsha would get approval from Enugu to come and install it. And to businessmen, time is of the essence thus they had to play along.*" -**SME owner of a cold room in Onitsha that participated in a FGD between 6th May and 3rd June 2018**
- "*Electricity tariff has gone extremely high and so has the cost of maintenance of generators/plants. This is not to mention the fact that*

[7] Key Informant 7, works as a consultant in the power sector. Abuja, October 2019.

sometimes petrol and diesel could be unavailable or only procured via black markets at high prices. What are we paying for?" -**Interview conducted in Aba May 2018**

While this may be a convenient justification for theft, the fact that many respondents shared this perception in our KIIs and FGDs and did not see the non-payment of bills by their neighbours as affecting them, horizontal checks across SMEs were non-existent. This clearly encourages additional corruption by SMEs. An important condition for reducing this type of corruption would be the perception by these actors that their neighbour who does not pay affects them. This is necessary to trigger horizontal checks that may involve not just reporting, but also assisting bill collectors, and putting social pressure on non-payers, none of which are in play if all SMEs face high costs as a result of failures in the grid that they (rightly) perceive to be at least partly the result of higher-level corruption.

Power constraints in the SME sector have implications for economy-wide productivity and employment growth. Countywide, firms reported that electrical outages cost them 16 % of annual sales [59]. A lack of consistent power has also hampered industrialisation with the manufacturing sector's contribution to GDP remaining (currently 13 %) well below the levels achieved in the 1990s (around 21 %) [60]. Additionally, the power constraints have implications for labour force participation and inclusive growth. Manufacturing businesses in the SME sector employed 28 % of the entire workforce, the highest share of any sub-sector [52]. In terms of ownership, female entrepreneurs accounted for 24 % of SMEs and 43 % of micro-enterprises [52].

5. Strategies for expanding electricity to SMEs

Given the level of technical inefficiency and political corruption in the electricity value chain, what are feasible strategies to effectively increase supply to SMEs? A long-term strategy for the power sector entails substantial financial restructuring of the national grid to reduce risks so it can become a viable system. The sector requires significant capital infusion to overhaul the efficiency parameters of the grid from gas supply to distribution as well as debt restructuring to improve the liquidity situation in the sector and attract investors. In the short term, a strategy is needed to identify solutions outside the national grid via investors who are willing to explore off-grid solutions. Our search for an anti-corruption strategy is a bottom-up approach to identify feasible and implementable solutions that work within the constraints of the sector's distribution of power [23]. Our policy solution is to provide disaggregated, independent-but-embedded power-generating networks, often referred to as mini grids, for existing clusters of SMEs. Mini grids are electric power generation and distribution systems that can be isolated from the main grid and designed to provide high-quality, reliable electricity [61]. In South East Nigeria, we propose that mini grids for SME clusters use natural gas as a feedstock due to its availability, lower price (to end users), and for being relatively less polluting compared to diesel.

The Nigerian Government, donors, and the private sector are actively working to create enabling conditions for successful mini-grid development in Nigeria [62]. However, no significant policy exists for established SME clusters. In 2012, NERC announced policies that made it possible to create independent distribution networks [63]. A more recent policy announcement was made in 2017 for 'eligible customers' that has further helped in devising mini-grid solutions [64]. This policy allows consumers who have an average consumption level of at least 2 MWh/h in a month to source electricity directly from an independent generator rather than through a DISCO [65]. These customers need to be connected to the same distribution network. Importantly, the policy also allows end-users to aggregate their consumption to meet the consumption criteria, and the clusters of firms in our study meet these criteria. Technology to address this level of scale is also now available with natural gas used as a feedstock. Natural gas is available in Anambra and the recent linking of Aba to the gas transmission network (most of the gas available is in the country's Niger delta in the southern coastal region) is also an opportunity. Our suggested policy is agnostic across energy sources, and therefore our argument for CNG could be replicated with other comparably priced or cheaper renewables, especially solar. However, the recently implemented Petroleum Industry Act provides incentives and a clear road map for Nigeria's abundant gas resources to be used as a transition fuel. Therefore, in the short term, compressed natural gas could work as a partial solution for SMEs, together with renewables wherever feasible.

Almost all interviewed respondents reported they had cut down on production due to power shortages and reported sourcing power through informal methods like self-generation or pay-as-you-go electricity. In these situations, pay-as-you-go electricity is provided by entrepreneurs who invest in large generators to supply electricity to SME units located in a close radius. While the mechanism of pay-as-you-go power is obviously inadequate, it does provide evidence that there is support for a collectivised solution for power supply among a broadly powerful community that can be mobilised in their self-interest to support alternative policies. The business owners in our sample, who can be considered representative of the larger population of firms in the region, have an average of 13.4 years of experience running their operations-this means that they have significant stakes in keeping their businesses running productively and they are also powerful enough as a collective.

6. Evidence of strategy

To ascertain the levels of support for a mini-grid generation strategy that would supply power to clusters of SMEs, we conducted primary research using a series of FGDs and interviews. The FGDs generated three major findings. First, there was a general consensus among participants that there has not been any positive or visible change in terms of improvement in power supply since privatisation in 2013. The dominant view was that the privatisation of PHCN and the Enugu Electricity Distribution Company (EEDC) has been in name only. The only notable change that participants felt strongly about is a continuous increase in electricity tariffs. Electricity tariffs have increased since privatisation and the recent hikes in April 2022 raised tariffs for all five bands, including those in the category of poorer households [66]. Second, all the firms reported dependency on high and stable electricity consumption for their operations. The firms reported that power supply is the single most expensive item in the production process. Third, the businesses demonstrated enthusiasm for an off-grid power supply. However, participants were clear that they wouldn't pay more than what they currently pay (to the EEDC and for diesel-generated power) even if it meant consistent supply.

Our initial findings are encouraging in that all of our respondents reported they would support a mini-grid system. We decided to extend our research to compare current costs for SMEs with ideal costs from grid-based electricity, as well as extrapolating costs by combining various scenarios of electricity usage (i.e., grid-based, self-generation using diesel generators, and illegal tapping). For the second round of research, we set up interviews with 32 SME owners in October 2019. During this round, we were interested in learning not just the costs of electricity, but also how the entrepreneurs sourced electricity (which typically also included informal means). Almost all of the respondents provided answers to the three key financial questions for our exercise: 1) monthly expenditure on their electricity bill from the power company, 2) monthly expenditure on diesel for their generator, and 3) the amount spent every month on maintaining their generator.

As was expected, we did not get any responses when we asked participants about accessing electricity by illegally tapping distribution lines. However, our only aim in this line of questioning was to gain information on total usage by source. The aim was certainly not to 'name and shame', because we understand the constraints many of these SME owners face in keeping their production lines working. In fact, this is an

excellent example of why enforcement-related policies that involve naming and shaming in communities like these are unlikely to work as they will be viewed as adversarial to their interests. Indeed, nor will a 'whistle-blower' policy work as most SME owners are likely to have accessed electricity informally to keep operating their machines. This is especially true when a solution- a consistent supply of power- is not being provided. However, a solution is much more likely to work if power can be supplied through formal means at competitive tariffs, given that the incentives to tap or to source diesel on the black market will be weaker.

Table 1 presents selected characteristics of the SMEs in our sample including the nature of business, number of employees, number of years each firm has been in operation, weekly sales, capacity of generators, and weekly hours of operation. The employment of the SMEs ranges from one-person businesses to factories with 20 employees. The average reported weekly revenue was 328,731 Nigerian naira (N) with a range of N30,000–2,100,000. The capacity of generators used by the factories significantly varies by nature of the business between 1 and 60 kilovolt-amperes (kVA), and the weekly generator operating hours range from 45 h to 144 h. Our aim here is not to create a model to track differential uses of off-grid power and diesel. There are different levels of diesel consumption across firms and this has to do with different lengths of power outages (between six to 12 h a day) across clusters, the fact that some SMEs have no access to the grid because getting grid connections can be difficult and sometimes involves corruption. Despite these differences, our investigation shows that all SMEs have significant off-grid power use.

Fig. 3 presents the breakdown of firms' total monthly electricity outlay by expenditure on grid electricity, diesel, and generator maintenance. The figure demonstrates the shortcomings of the EEDC power grid and firms' dependence on diesel generators to power their operations. On average, firms in our sample source only 9.8 % of their monthly electricity outlay from the grid and 80.3 % from diesel generators. In our sample, spending on alternative electricity costs is high not only because of diesel costs but also because of poor-quality generators, which require high expenditures on maintenance. On average, generator maintenance constitutes 9.9 % of firms' total electricity outlay.

The next figure, Fig. 4 adjusts for differences in firm revenues in our sample of SMEs by looking at the off-grid expenditure on power as a share of firm revenue. This is presented on the vertical axis and shows very little variation across firms, regardless of size and the intensity of electricity use. The horizontal axis shows on-grid relative to off-grid power expenditures. This shows more variation as declared on-grid expenditure depends on many factors, including the access of firms to the grid, which depends on the ability of the firm to get and maintain its grid connection and the degree to which the firm is actually paying its bills to the grid. As we would expect, firms that declare a greater share of power expenditures on the grid have a slightly lower spend on off-grid power adjusted for revenue. But the interesting point is that the negative slope is weak. We interpret this on the basis of our KIIs and FGDs as showing variations in the theft of power from the grid, while the off-grid power expenditure per revenue is relatively stable across different types and sizes of SMEs. Nevertheless, there are also variations in the off-grid expenditures across firms due to differential diesel use, though the point of significantly high off-grid use remains.

Relative to the power supplied from the grid, diesel-based self-generation is expensive and inefficient. The EEDC tariff that these firms pay is N31.51 per kilowatt-hour (kWh) [67]. In contrast, typical costs for formal, large private sector firms are estimated to be much higher between N75–80 per kWh, as they utilise a mix of grid-based and self-generated power [68]. If we consider this pricing information alongside the breakdown of electricity expenditures for SMEs provided in our sample, we can conclude that decreasing a firm's reliance on self-generated power will result in lower total expenditures on electricity. However, grid-supplied electricity is currently insufficient to meet the power demands of SMEs, creating the need for off-grid solutions.

Due to the cost difference between grid-supplied electricity and self-generation, there is a wide range of tariffs at which mini grids could offer power that we can classify as 'developmental'- that is, at a price that has the potential to lower corruption risks as well as costs for firms. Our FGD respondents support an off-grid generation and supply mechanism if the costs were lower than what they currently face. A common response across our FGDs was:

- "*The fact is that we would be glad to pay anything that would be cheaper than our current costs of power* (*EEDC plus Diesel/petrol*)." **-FGD conducted in Aba between 6th May and 3rd June 2018.**
- "*Although cost of power is a major factor in production, my concern is also to do with availability and effectiveness of any alternative to EEDC and lister plants or generators. Hence a solution suggested here that provides good quality power will always be preferable. And EEDC can't provide that.*" **-FGD conducted in Aba between 6th May and 3rd June 2018.**
- "*I am positive that we would make even more profits than we are currently if buying the embedded power systems would mean signing for regular and sustainable power supply. Given regular power supply, demand for our goods/services would increase exponentially and that would translate to higher profits all things being equal.*" **-FGD conducted in Nnewi between 6th May and 3rd June 2018**

These responses demonstrate demand within the community for formal power supply at prices lower than are currently being effectively paid. Our findings are also consistent with research showing that Nigerian households who self-generate are also more likely to have a higher willingness to pay for reliable power. One study found that households who self-generate, irrespective of their incomes, are willing to pay up to 86 % above current tariffs for better service on the grid.

Embedded generation for SME clusters is at an early stage at the time of writing and pricing data are only indicative at this stage. Nevertheless, the available data validate the plausibility of our hypothesis. In an analysis of 'renewable embedded generation' (REG) that uses a mix of solar photovoltaic, battery storage, and thermal generation, the authors

Table 1
Characteristics of the sampled SMEs by firm type.

Firm type	# of firms	Average years in business	Average # of employees	Average weekly sales (N)	Average generator capacity (kVA)	Average weekly work hours
Tailoring	9	9	5	115,611	10	72
Shoemaking	7	19	7	596,428	7	78
Computer/IT services	4	11	12	700,000	23	72
Metal fabrication	4	14	3	126,666	7	56
Cold room	3	12	3	52,500	43	82
Canopy fabrication	2	6	5	325,000	25	69
Personal services	1	25	2	22,700	Undisclosed	75
Oil processing	1	15	1	360,000	20	72
Military outfitter	1	30	3	Undisclosed	10	66
All firms	32	13	6	328,731	16	72

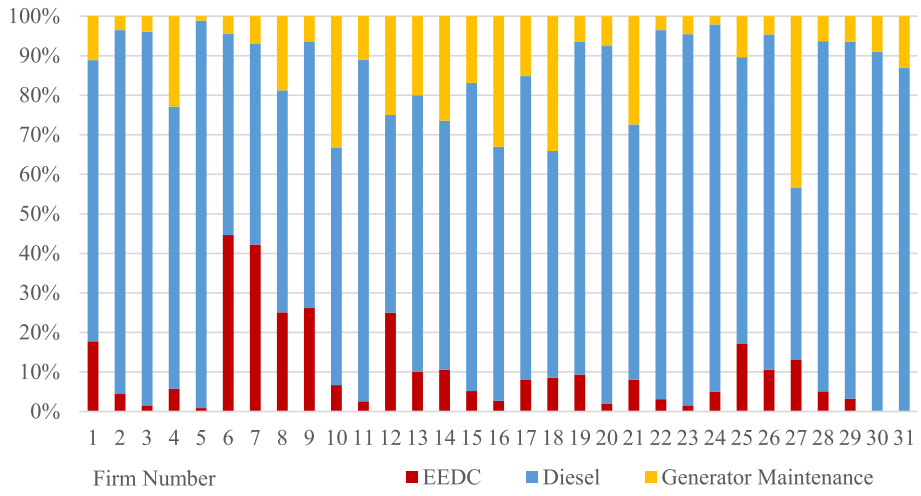

Fig. 3. Breakdown of monthly expenditures on grid electricity, diesel, and generator maintenance.

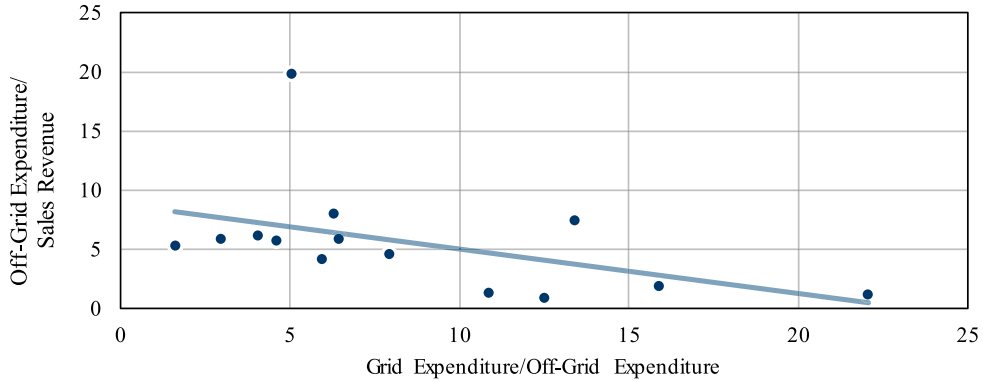

Fig. 4. Grid and off-grid power expenditures in firms with different revenues.

estimate significant price reductions. While there are differences between our two approaches, the rough order of cost-savings identified in that model demonstrates the viability of cluster-based generation. Potential customers were divided into premium or large commercial, industrial, high-income residential, and non-premium, who are small commercial and residential customers. Costs for premium customers with REG declines by 40–50 % as it completely replaces self-generation, and for non-premium customers costs go down by 20–30 % because of a reduction in self-generation [69]. These figures are plausible because the scale economies achieved, even in a local grid serving multiple SMEs, provide cost savings over inefficient plant-based generators using poor technologies that are cheap enough for an SME to purchase. Our SME respondents validate how similar savings might be arrived at.

Here we present two examples from SME respondents who shared their total monthly costs on electricity as well as their total monthly consumption. We utilise this information to calculate the range of tariffs necessary to attract these specific SMEs as consumers. The acceptable range is the range between what the distribution company currently charges and what the SME owners currently spend on electricity, including self-generation and maintenance. If the price of electricity offered does not fall into the average developmental range of firms within the cluster, firms will continue to access electricity informally.

The first example is a firm in the IT education sector in Aba South that is not currently supplied by the grid. The firm's monthly electricity costs, including diesel and an engineer for their generator, is N1,205,000. The firm's monthly electricity consumption is 19,712 kWh. The realised unit cost of power for the firm is N61.13 per kWh. The average unit cost of power obtained from the EEDC (if the firm had been connected) is N31.51 per kWh [67]. Therefore, this firm would be interested in power from a local off-grid distribution mechanism if the power was priced between N31.51 and N61.13 per kWh. Of course, if a provider could supply power below the EEDC tariff rate that would also be accepted.

The second example is from a polythene manufacturer in the Onitsha cluster. The firm's total monthly electricity costs, including payments to the distribution company, diesel for the generator, and generator maintenance, is N500,000. The firm's total monthly consumption is 11,200 kWh. The overall unit cost of power for the firm is N44.64 per kWh. Again, the average unit cost of power obtained from the EEDC is N31.51 kWh. Therefore, this firm would accept power from a local mini grid if it was priced between N31.51 and N44.64.

The immediate challenge is to increase generation and supply in critical areas such as the SME sector, without immediately stepping on powerful political interests that may block reform. Our research suggests a possible solution based on an alignment of incentives among SME entrepreneurs and power suppliers who are not linked to the grid. This can potentially achieve a number of interdependent requirements for a solution to work. First, it does not directly target the interests of major incumbents in the power sector and therefore has a reasonable chance of not being actively blocked at the outset. SME clusters in Nigeria have low productivity and profitability and are not seen as prime targets for rent-seekers. Second, our research verifies a plausible hypothesis, that the own generation of power is so costly that there is a sufficient willingness to pay for formal power if supplies could be assured.

This is not only plausible, but our results for SME consumers are also aligned with other studies on residential consumers. Thirdly, our KIIs

and FGDs revealed that SMEs were quite open in declaring that they did not want to pay bills to the grid suppliers given that their inadequate supplies forced them into expensive alternatives. Any power they could steal from the grid was therefore 'justified' and did not attract any criticism from their peers. This ecosystem of corruption is only likely to change if the local grid power supplier could provide reliable power at a price that made business viable. Not paying for power would be more difficult to justify in public, and if the viability of the local power supplier depended on bill collections within the cluster, there is likely to be a development of the horizontal checks that implicitly operate in rule of law contexts. Violators are unlikely to be protected or defended by their peers once detected. The last point is plausible and supported by our KIIs and some level of horizontal checking would be important to make local grids sustainable over time. But a precondition for testing this governance arrangement would be to identify a feasible and reliable alternative power supply that was not already heavily distorted by informal arrangements and corruption.

Based on our qualitative evidence from firms in South East Nigeria, we believe that mini grids provide a feasible short-term solution to fulfilling the power requirements of SMEs met through self-generation. There are currently growing numbers of applications in Nigeria for similar, smaller mini-grid projects for hospitals, schools, and markets. These solutions should be scaled and targeted to existing clusters of SMEs. However, as experts have pointed out, the widespread use of mini grids could be harmful to DISCOs. Therefore, it is important to also see that their interests are balanced via compensation like the competition transaction charge being considered by NERC or through wheeling charges if generated electricity from mini grids passes through their network from the licensed independent generator to eligible customers.

7. Conclusion

The privatisation experience in the Nigerian electricity sector did not go as planned due to legacy corruption, technical inefficiencies, the selection of politically connected investors, and a privatisation strategy that failed to curtail sectoral corruption. As a result, the power sector has been operating in a significant deficit since privatisation resulting in a low-level equilibrium where incentives to invest in and upgrade the grid are absent. Solving the liquidity crisis in the sector requires a long-term horizon and strategy. Capital infusion is needed to overhaul the efficiency of the grid from gas supply through to distribution. Additionally, debt restructuring is needed to improve liquidity and enable a long-term investment view. Small sums of money will not have a meaningful impact on overhauling the sector. Nor will draconian measures like banning the importation of generators, as was suggested by a Nigerian lawmaker, solve the crisis on the grid. If anything, strict measures would exacerbate the crisis in the sector.

To deliver effective off-grid solutions, local power structures need to be carefully considered. The region has a complex and contested history. Suspicion of the formal establishment exists alongside the demand for better formal infrastructure, like electricity supply. The firms in our study depend almost solely on their local networks. Therefore, there are significant local informal institutional arrangements that exist and any localised policy, as supplying to clusters will be, needs to be cognizant of these. There is also a clear need for context-specific policy that can help win back some trust with electricity providers. Local unions and trade associations are important players for investors to engage with in this context. Our research suggests mistrust between customers and electricity suppliers is high in some potentially productive areas like in the ones we surveyed. This points towards deploying a more consultative process than one which is technocratic and purely top-down.

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Declaration of competing interest

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Data availability

Data will be made available on request.

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Appendix A. Appendix on interview protocols, FGD and KII participants

Summary Interview Protocols

- The interview protocols were guided by SOAS University of London's code of practice for researchers.
- In case of both the focus group discussions (FGDs) and key informant interviews (KII) we began by collecting informed consent verbally (as most participants were uncomfortable signing a form).
- We disclosed all funding information and research aims at the start of the process. We also informed all participants that if required we could request follow up questions with some of them
- We used an open ended, semi-structured instrument for both, though we added supplementary probing questions in the case of the KIIs
- The instruments were designed based on a prior literature review and informal conversations with stakeholders
- In the case of the FGDs we were especially mindful of explaining the time requirements beforehand so the SME owners would come with some time to spare despite their responsibilities and schedules. We also conducted the FGDs on Sundays for their convenience
- We recorded the interviews by hand and did not electronically record them given the sensitive nature of the research. In the case of the FGDs we had two note takers and two sets of transcripts that were compared in order to ensure all the data was adequately captured

Anonymised details of focus group discussion participants.

All Aba FGDs		Nnewi FGDs	
Name	Business	Name	Business
IS	Printing company	OJ	Alumaco technician
IG	Graphic designer	DS	Recoiling, grinding
OO	Shoemaker	AS	Laundry
AI	ICT	OE	Ice cream & coldroom
CE	ICT	TO	Polythene productions
OO	ICT	IT	Fabricator
OM	Tailoring	OJ	Shoemaker
EC	Welding	NO	Welding
EE	Tailoring		
AA	Plastic manufacturing		
EG	Welding		
TE	Tailoring		

Anonymised details of key informants.

Key informant (KI)	Designation	Place	Date
KI 1	Senior private sector executive closely associated with the privatisation process in 2013	London	January 2019
KI 2	A senior executive in one of the privatised distribution companies	Abuja	September 2018
KI 3	Senior executive working in the extractives sector	Abuja	July 2019
KI 4	Consultant for the power sector	Ibadan	February 2018
KI 5	Researches the local extractive sector in the Niger Delta from Port Harcourt	Online conversation	July 2018
KI 6	Involved in transportation and logistics including for fuel	Abuja	October 2019
KI 7	Works as a senior consultant in the power sector	Abuja	October 2019
KI 8	Senior member of the Nigerian Electricity Regulatory Commission during privatisation	London	March 2018
KI 9	Ex-Senior power sector policy advisor to President Goodluck Jonathan's government	Abuja	July 2019
KI 10	Senior economist in a private sector bank	Lagos	February 2019
KI 11	Senior financial executive on a privatised generation company	Abuja	February 2020

References

[1] World Bank, Resilience through Reforms: Nigeria Development Update, World Bank, Washington DC, 2021. https://openknowledge.worldbank.org/handle/10986/35786.

[2] IEA, IRENA, UNSD, World Bank, WHO, Tracking SDG 7: The Energy Progress Report 2021, Washington DC, 2021.

[3] SERAP (Socio-Economic Rights and Accountability Project), 'From Darkness to Darkness': How Nigerians Are Paying the Price for Corruption in the Electricity Sector, SERAP, Lagos, 2017.

[4] Stakeholder''s Democracy Network (SDN), 'Nigerian Power Sector Review 2018' London and Port Harcourt, SDN, Nigeria, 2018. https://www.stakeholderdemocracy.org/wp-content/uploads/2018/08/POWER-SECTOR-11.06.18-TB.pdf.

[5] Okechukwu Marcellus Ikeanyibe, Managing post-privatisation challenges: a review of Nigeria's electricity sector, J. Contemp. Afr. Stud. 39 (1) (2021) 70–87, https://doi.org/10.1080/02589001.2020.1825647.

[6] NERC (Nigeria Electricity Regulation Commission), Quarterly Report: Second Quarter 2019, NERC, Abuja, 2019.

[7] NERC (Nigeria Electricity Regulation Commission), Quarterly Report: Second Quarter 2022, NERC, Abuja, 2022.

[8] O. Olawoyin, Power outage: how Nigeria's electricity problem cripples small businesses, July 28, https://www.premiumtimesng.com/news/headlines/405288-power-outage-how-nigerias-electricity-problem-cripples-small-businesses.html, 2020. (Accessed 6 February 2022).

[9] S.A. Anaba, O.E. Olubusoye, Determinants of use of solar energy as an alternative means of energy by small and medium enterprises in Lagos State, Nigeria, Discov. Sustain. 2 (2021) 29, https://doi.org/10.1007/s43621-021-00038-7.

[10] PricewaterhouseCoopers, MSME Survey 2020 Building to Last. https://www.pwc.com/ng/en/publications/pwc-msme-survey-2020.html, 2020.

[11] NBS, Micro, Small, and Medium (MSME) National Survey 2017 Report, National Bureau of Statistics Nigeria, 2017.

[12] Roy, P., Sewell, A., & Dumnamene, F. "Mitigation and Transformation Solutions to Networked Corruption in Artisanal Refining in the Niger Delta: Retooling Anti-corruption Analysis for Effective Policy." Working Paper 044. SOAS ACE: University of London.

[13] M.O. Oseni, Impact of Self-Generation on Willingness to Pay, Nigerian Electricity Regulatory Commission, 2020. https://www.energyforgrowth.org/wp-content/uploads/2020/02/Impact-of-Self-Generation-on-Willingness-to-pay.pdf.

[14] E.K. Ogunleye, Political Economy of Nigerian Power Sector Reform, WIDER, Helsinki, 2016. https://doi.org/10.35188/UNU-WIDER/2016/052-2.

[16] N. Van de Walle, Tipping games: when do opposition parties coalesce? in: A. Schedler (Ed.), Electoral Authoritarianism: The Dynamics of Unfree Competition Lynne Rienner, Boulder, CO, 2006.

[17] V. Fritz, A.R. Menocal, Developmental states in the new millennium: concepts and challenges for a new aid agenda, Develop. Policy Rev. 25 (5) (2007) 531–552.

[18] M. Khan, M. Watkins, I. Zahan, De-risking private power in Bangladesh: how financing design can stop collusive contracting, Energy Policy 168 (2022), 113146, https://doi.org/10.1016/j.enpol.2022.113146.

[19] K. Sanni, Again, Nigeria drops in latest corruption ranking, January 25, https://www.premiumtimesng.com/news/top-news/507715-again-nigeria-drops-in-tis-latest-corruption-ranking.html?tztc=1, 2022.

[20] M. Khan, Governance during social transformations: challenges for Africa, New Polit. Econ. 17 (5) (2012) 667–675, https://doi.org/10.1080/13563467.2012.732276.

[21] Z. Usman, The successes and failures of economic reform in Nigeria's post-military political settlement, Afr. Aff. 119 (474) (2020) 1–38, https://doi.org/10.1093/afraf/adz026.

[22] M. Khan, Political settlements and the analysis of institutions, Afr. Aff. 117 (469) (2018) 636–655, https://doi.org/10.1093/afraf/adx044.

[23] M. Khan, P. Roy, Making anti-corruption real: using a 'Power Capabilities and Interest Approach' to stop wasting money and start making progress, in: SOAS ACE Consortium Synergy Paper, 2022.

[24] M. Khan, Determinants of corruption in developing countries: the limits of conventional economic analysis, in: S. Rose-Ackerman (Ed.), International Handbook on the Economics of Corruption, Edward Elgar, Cheltenham, 2006, pp. 216–240. https://eprints.soas.ac.uk/id/eprint/9850.

[25] D. Booth, Development as a collective action problem, in: Africa Power and Politics Programme Policy Brief 9, 2012.

[26] M. Khan, Governance, Growth and Poverty Reduction, United Nations Department of Economic and Social Affairs, 2009. https://www.un.org/esa/desa/papers/2009/wp75_2009.pdf.

[27] N. Meisel, J.O. Aoudia, Is Good Governance a Good Development Strategy? Direction Général du Trésor et de l'Économie Politique, Paris, 2006. https://www.afd.fr/en/ressources/good-governance-good-development-strategy/.

[28] D.C. North, J.J. Wallis, B.R. Weingast, Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History, Cambridge University Press, 2009.

[29] T. Hodges, The role of resource management in building sustainable peace, Accord 15 (2004).

[30] M. Khan, Political Settlements and the Governance of Growth-enhancing Institutions. https://eprints.soas.ac.uk/9968/1/Political_Settlements_internet.pdf, 2010.

[31] A.R. Menocal, Less political and more pro-poor? The evolution of social welfare spending in Mexico in a context of democratization and decentralization, NORD 3 (4) (2005) 346–359. https://cdn.odi.org/media/documents/1918.pdf.

[32] K. Meagher, Social capital, social liabilities, and political capital: social networks and informal manufacturing in Nigeria, Afr. Aff. 105 (421) (2006) 553–582, https://doi.org/10.1093/afraf/adi123.
[33] F. Adeniyi, Overcoming the market constraints to on-grid renewable energy investments in Nigeria, in: OIES Paper: EL 37, Oxford Institute for Energy Studies, Oxford, 2019, https://doi.org/10.26889/9781784671495.
[35] O. Olatunji, S. Akinlabi, A. Oluseyi, A. Abioye, F. Ishola, M. Peter, N. Madushele, Electric power crisis in Nigeria: A strategic call for change of focus to renewable sources, in: IOP Conference Series: Materials Science and Engineering vol. 413, IOP Publishing, 2018, September, p. 012053. No. 1.
[36] S.S. Idowu, J. Ibietan, et al., Privatization of power sector in Nigeria: an evaluation of Ibadan and Ikeja electricity distribution companies performance (2005–2018), Int. J. Public Adm. 43 (16) (2020) 1413–1420, https://doi.org/10.1080/01900692.2019.1672183.
[37] IEA Statistics, Electric Power Transmission and Distribution Losses, OECD/IEA, 2018. https://www.iea.org/stats.
[38] NERC, Final Report for Metering Committee: Nigeria Electricity Regulatory Commission, Abuja, Nigeria, 2012.
[39] NERC, Concept Paper on Capping Estimation of Energy Consumption Developed by the Nigerian Electricity Regulatory Commission, Abuja, Nigeria, 2015.
[40] K. Jeremiah, DisCos Justify Estimated Billing of Consumers, Revenue Targets, The Guardian Nigeria, 2022. January 3, https://guardian.ng/news/discos-justify-estimated-billing-of-consumers-revenue-targets/.
[41] W. Arowolo, Y. Yannick Perez, Market reform in the Nigeria power sector: a review of the issues and potential solutions, Energy Policy 144 (2020), https://doi.org/10.1016/j.enpol.2020.111580.
[42] Unpublished data provided by the Nigerian Association of Power Generation Companies in 2019.
[43] Nextier Power, The New Owners of Nigeria's Privatized Power Assets, September 6, https://www.nigeriaelectricityhub.com/2020/09/06/the-new-owners-of-nigerias-privatized-power-assets/, 2020.
[44] D. Games, Rocky Road for Nigeria's Power Sector, Dec 9th, https://www.gga.org/a-real-conundrum/, 2020.
[45] Business Day, The Indian electricity supply industry a model for Nigeria, July 31, https://businessday.ng/news/legal-business/article/the-indian-electricity-supply-industry-a-model-for-nigeria/, 2014.
[46] PricewaterhouseCoopers, Privatisation in the Power Sector: Navigating the Transition, PwC, Lagos, 2012.
[47] S. Kale, Current reforms: the politics of policy change in India's electricity sector, Pac. Aff. 77 (3) (2004) 467–491. https://www.jstor.org/stable/i40001260.
[48] R. Tongia, The Political Economy of Indian Power Sector Reforms, Center for Environmental Science and Policy, Stanford Institute for International Studies, Stanford, CA, 2003, https://doi.org/10.1017/CBO9780511493287.005.
[49] C.J. Hansen, J. Bower, An Economic Evaluation of Small-scale Distributed Electricity Generation Technologies, Oxford Institute for Energy Studies, 2003. https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2010/11/EL05-AnEconomicEvaluationofSmallScaleDistributedTechnologies-ChristopherHansen-2003.pdf.:.
[50] R. Roy, Anti-corruption in Nigeria: A Political Settlements Analysis, SOAS ACE Working Paper No. 2, SOAS University of London, London, 2017.
[51] PricewaterhouseCoopers, MSMEs: Using Technology to Drive Business, PwC Nigeria, Abuja, 2021.
[52] National Bureau of Statistics, SMEDAN and National Bureau of Statistics Collaborative Survey: Selected Findings 2013, SME Development Agency of Nigeria and National Bureau of Statistics, Abuja, 2013.
[53] A. Adenikinju, Analysis of the Cost of Infrastructure Failures in a Developing Economy: The Case of the Electricity Sector in Nigeria, African Economic Research Consortium, Nairobi, 2005.
[54] A. Scott, E. Darko, A. Lemma, J.P. Rud, How does electricity insecurity affect businesses in low and middle income countries, in: Shaping Policy for Development, 2014, pp. 1–80. https://assets.publishing.service.gov.uk/media/57a089f5ed915d3cfd0004ee/61270-Electricity-insecurity-impact-SMEs-010914.pdf.
[55] J.M. Arnold, A. Mattoo, G. Narciso, Services inputs and firm productivity in Sub-Saharan Africa: evidence from firm-level data, J. Afr. Econ. 17 (4) (2008) 578–599.
[56] R. Bloch, N. Makarem, M.B. Yunusa, N. Papachristodoulou, M. Crighton, Economic development in urban Nigeria, in: Urbanisation Research Nigeria (URN) Research Report, ICF International, 2015. https://www.gov.uk/research-for-development-outputs/economic-development-in-urban-nigeria-urbanisation-research-nigeria-urn-research-report.
[57] A. Escribano, J.L. Guasch, J. Pena, Assessing the Impact of Infrastructure Constraints on Firm Productivity in Africa, World Bank, Washington DC, 2009. http://hdl.handle.net/10986/19901.
[58] B. Moyo, Do power cuts affect productivity? A case study of Nigerian manufacturing firms, Int. Bus. Econ. Res. J. 11 (2012) 10, https://doi.org/10.19030/iber.v11i10.7262.
[59] World Bank, Enterprise Survey: Nigeria, World Bank, Washington DC, 2016. https://www.enterprisesurveys.org/en/data/exploreeconomies/2014/nigeria#infrastructure.
[60] World Bank, World Development Indicators Database, World Bank, Washington DC, 2020.
[61] World Bank Energy Sector Management Assistance Program, Mini Grids in Nigeria: A Case Study of a Promising Market, World Bank, Washington DC, 2017. http://hdl.handle.net/10986/29016.
[62] Rural Electrification Agency, Nigeria Mini-grid Investment Brief, REA, Abuja, 2017. https://rea.gov.ng/Nigeria_MinigridInvestmentBrief_171202-V2.pdf.
[63] NERC, Regulations for Independent Electricity Distribution Networks, NERC, Abuja, 2012.
[64] NERC, Eligible Customer Regulation, NERC, Abuja, 2017. https://nerc.gov.ng/index.php/library/documents/Regulations/NERC-Eligible-Customer-Regulation-2017/.
[65] J. Barba, Eligibility Customers regime: the implementation of an "open access" electricity market in Nigeria?, in: The Energy Platform Blog, 2018, 2 January, https://www.lexology.com/library/detail.aspx?g=529c2d0e-de5b-48b3-8361-244d234dbc91.
[66] K. Jeremiah, Nigerians Pay More for 'Darkness' as Government Hikes Electricity Tariff, May 6, https://guardian.ng/news/nigerians-pay-more-for-darkness-as-government-hikes-electricity-tariff/, 2022.
[67] O. Gershon, A. Ezurum, Energy Sector Governance and Cost-reflective Pricing in West Africa, Presentation at UNECA-AfDB-UNDP 12th African Economic Conference, 4–6 December, Addis Ababa, Ethiopia, 2017, http://eprints.covenantuniversity.edu.ng/id/eprint/10097.
[68] R. Abati, Nigeria's Electricity Problem: FG vs DISCOs, This Day Live, 2020, 25 February, https://www.thisdaylive.com/index.php/2020/02/25/nigerias-electricity-problem-fg-vs-DISCOs/, 25 February.
[69] O. Imoukhuede, W. Omonuwa, O. Okeowo, S. Shah, O. Edun, I. Oyofo, Unlocking Renewable Embedded Generation in Nigeria, RMI, 2022. https://rmi.org/insight/unlocking-renewable-embedded-generation-in-nigeria/.