Doing Business Case Studies

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Digitalization and the Use of Technology in the Electricity Sector

Introduction

Digitalization has been identified as one of the major global trends that is transforming the electricity sector.[1] A recent study investigating the level of digitalization at utilities in 50 economies around the world shows that almost half of them consider the digital grid as part of their strategic programs or as an area for investment.[2] The increasing use of online processes has been affecting the entire electricity system, from power generation to transmission and distribution.[3] One such area is the use of technology in the provision of a reliable supply. Utility companies in several economies have been investing in automated systems for monitoring interruptions and restoring service, helping them minimize outages.[4] Online tools such as website-based notifications are also commonly used to communicate planned interruptions and to report data on outages to the public.

Other types of information are frequently made available online, contributing to a better customer experience: utilities often inform the requirements for a new service request through their website, allowing customers to know in advance the steps of the connection process, as well as connection charges, documents required, and expected service delivery timeframes. In some cases, utilities go further in the adoption of technological solutions by offering a range of digital services and allowing customers to perform a variety of actions online. For instance, users often can view and pay their electricity bills online or even apply for a new electricity connection from their home, office, or anywhere.

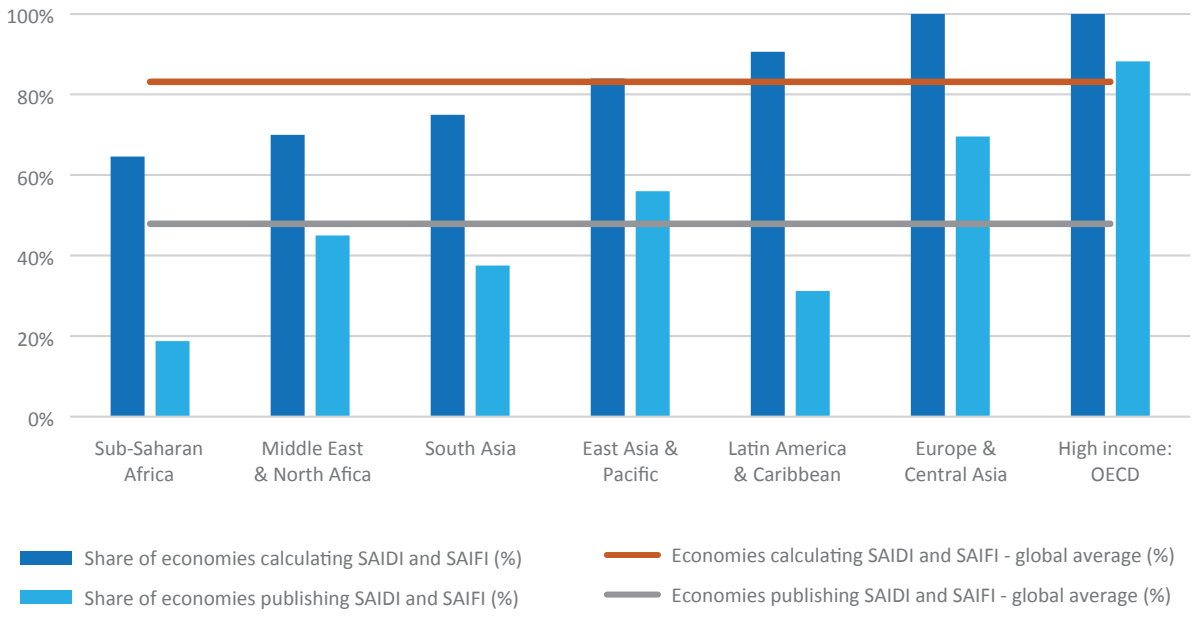
But how can the use of technology and online tools help utilities provide better services to their customers? This study aims at identifying what types of online information and actions are available in the electricity sector around the world, and how they translate to more efficiency in the connection process and to an improved reliability of electricity supply.

Publishing data on tariffs and power outages: the first step towards transparency and accountability of utility services

In most developing economies, electricity distribution is a service with monopolistic characteristics and is often under government control. As such, transparency and accountability in this sector can flourish if the government chooses to promote them. A first step towards transparency is allowing customers to know how reliable the service is. Both the government and the public benefit from having data on the quality of electricity supply. This is usually done by calculating the frequency and duration of power outages through the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI), and then making them available to the public.[5] Calculating SAIFI and SAIDI can help decision makers estimate the costs caused by power outages to the economy and to society as a whole and take informed actions to improve the reliability of supply. And for citizens to be empowered and able to hold electricity providers accountable, they need to have information on which to base their demands for a reliable service.

Evidence from *Doing Business* data shows that utilities in 158 economies calculate SAIDI and SAIFI, but less than half of utilities in the world publish this data (figure 1).[6] The highest percentage of utilities that share data on power outages is recorded in the OECD high income economies, where 88 percent of utilities share data with the public. On the other

Figure 1. Two thirds of economies that collect data on power outages in the world make this data available to the public



Source: Doing Business database. Out of a sample of 190 economies, this analysis showcases the economies that published or calculated SAIDI and SAIFI data for the main business city as of December 2018.

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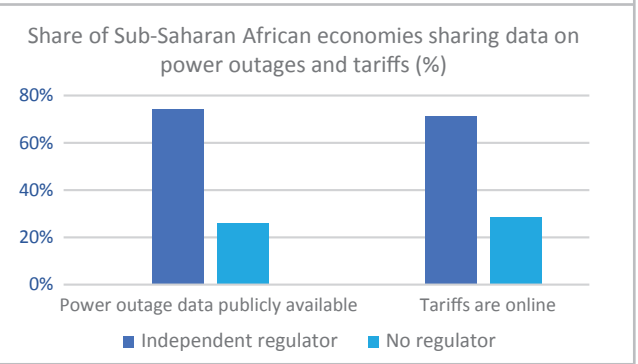
hand, Sub-Saharan Africa is the region with the lowest percentage of utilities sharing outage data with the public (19 percent).

Moreover, utilities can enhance the level of predictability of the electricity service by notifying the public of planned service disruptions. In any network, occasional outages are at times inevitable. Sometimes, works on the grid are needed, such as maintenance of equipment, network expansions for new connections, or other improvements; these often require service to be interrupted. Unfortunately, some utilities do not give customers any advance notice. Business owners may incur additional costs if they were not expecting outages, since they cannot prepare in advance; and without the relevant information, manufacturers are not able to suspend and reschedule their operations on the days affected by scheduled outages. To mitigate the impacts of power outages, utilities in several economies, such as Costa Rica and Côte d'Ivoire, have enacted measures to increase predictability and transparency of the electricity supply (box 1).

Another area of the electricity sector where transparency plays a major role is tariffs. Customers are affected not only by service reliability, but also by the cost of electricity consumption. Studies on the impact of electricity tariffs on businesses' behavior and performance suggest that their performance and productivity are sensitive to prices.

Figure 2. Electricity tariffs and data on power outages are most commonly available to the public in Sub-Saharan Africa when there is an independent regulator monitoring utility performance



Source: Doing Business database. This analysis verifies the presence of an independent regulator among the 9 Sub-Saharan African economies that publish data on power outages in the main business city; and among the 30 economies in this region that publish data on electricity tariffs, including announcements of tariff changes ahead of the billing cycle. Similar results are observed on a global level and for all regions. Globally, 89 percent of economies that publish data on outages, and 80 percent of those that publish tariffs, have a regulator. The percentage of economies that have a regulator varies from 60 percent of economies that publish data on tariffs in East Asia and the Pacific, to 100 percent of economies that publish data on power outages in South Asia, Europe and Central Asia, and the OECD high income group.

Research drawing on firm-level data from India provides evidence that electricity constraints, including higher electricity tariffs, limit growth by pushing businesses to activities with fewer productivity-enhancing opportunities. In response to an exogenous increase in electricity tariffs, SMEs switched to less electricity-intensive production processes.[10] When it comes to access to information, it has been suggested that price transparency leads to lower and more uniform tariffs.[11] By publishing tariffs online and communicating changes in tariffs in advance, electricity providers can make the costs of electricity consumption more predictable. However, this is not always done. *Doing Business* data show that in more than one fifth of economies around the world, nearly half of them in Sub-Saharan Africa, tariffs and tariff changes are not published online or announced in advance.

A common way for governments to promote accountability in the electricity sector is setting up a regulator with the task of monitoring electricity providers. During the 1990s, many developing economies created energy regulatory agencies, making this the most widely adopted power sector reform during that period.[12] Research shows that, even if in practice these agencies lack the independence and decision-making competence that are foreseen in the legislation, the presence of a regulator has a positive impact, especially among privatized utilities with good governance rules.[13] Most importantly, a sound regulatory framework should monitor and enforce both tariff-setting and the quality of service. An analysis based on *Doing Business* data demonstrates that the existence of regulatory utility supervision is highly correlated with the publication of data on both tariffs and power outages.[14] This relationship is evident at both the global and the regional levels. For instance, *Doing Business* data show that economies in Sub-Saharan Africa that have an independent regulator are nearly three times as likely to publish data on outages and tariffs (figure 2). The complexity and importance of the regulator's role is likely to increase in the future, in view of the technological disruptions that are taking place in the power sector, including the increased importance of digitalization, renewable energy, and decentralized power generation.[15]

An example of a country that established an energy regulator during this period is Uganda. In 1999 the Electricity Act created the Electricity Regulatory Authority (ERA) to monitor and regulate the performance of electricity suppliers, enforce adherence to the National Grid Code, and approve tariff structures.[16] Since then, the regulator's roles have been evolving, with the aims of increasing transparency and reliability. In 2014, ERA established a quarterly Automatic Tariff Adjustment plan based on a specific formula that adjusts tariffs fluctuations up to 10 percent, due to changes in

Box 1. Good practices in dealing with planned outages: the cases of Costa Rica and Côte d'Ivoire

The *Compagnie Ivoirienne d'Electricité* (CIE), the utility in Côte d'Ivoire, follows the practice of announcing planned outages in advance. The days of the scheduled power cuts, as well as their duration and areas affected, are announced in the utility's website. CIE also provides an explanation for the outages and the contact details for customers who need additional information.[7] Similarly, the *Compañía Nacional de Fuerza y Luz* (CNFL), the utility in Costa Rica, announces planned outages in advance. In this case, the utility provides the exact timeframe in hours during each day to be affected by service interruptions. It is even possible for customers to report any service irregularity or make a complaint about the reliability of supply.[8] Such practices can contribute to promoting accountability in the electricity sector and, within the constraints imposed by outages, empower businesses to make better informed choices about their activities.

Some utilities even take advantage of the popularity of social media to announce planned outages on platforms such as Facebook. The utilities in the Bahamas and Barbados both frequently use their Facebook pages to communicate scheduled outages to the public.[9] This type of announcement allows for direct interactions between the public and representatives from the utility, increasing its accountability.

Figure 3. Types of information commonly found online for new electricity connections

Source: Doing Business database. At least one of these types of information on how to obtain a new electricity connection is published online in 144 out of 190 economies covered by *Doing Business*.

costs, exchange rates, and oil prices.[17] Tariff changes are communicated to customers in advance, as well as the reasons for the change.[18] The monitoring of power outages has also been improving in the country. In 2018, UMEME, the utility serving Kampala, started to calculate data on power outages according to common international standards.[19]

Providing online information for a more transparent connection process

Through new technologies, power utilities are transforming their relationship with customers. Online interfaces allow new and existing clients to get access to information, personalized services and opportunities to minimize costs.[20] In the European Union, the Third Energy Package establishes that consumers are entitled to receive transparent information on applicable prices and tariffs, as well as in standard terms and conditions with regards to access to electricity services.[21] When it comes to getting information and receiving energy services, some entrepreneurs consider the internet as their preferred information channel (instead of contacting an electricity company in person or by phone).[22] Therefore, it is important that utilities provide information online about connection requirements, procedures, costs and timeframes for companies seeking a new connection.

According to the OECD, bringing together the full range of requirements, including the expected time to obtain a new connection, its costs and the necessary documents and procedures, into one single website helps reduce administrative burdens for entrepreneurs (figure 3).[23] Furthermore, the availability of online information enhances transparency and accountability of power companies and can reduce transaction costs and time for all parties involved.[24] Not surprisingly, utilities in nine of the top 10 economies ranked on the ease of getting electricity in *Doing Business 2020* publish information on connection requirements on their websites.[25]

Electricity suppliers benefit their customers by providing information in a short, easily understandable, prominent and accessible manner, to the point that this practice is mandatory in the EU.[26] This regulation is adopted at the national level, for instance by Portugal's energy regulator, which obliges suppliers to provide consumers with a standardized information chart for energy offers and contracts, or in France, where the distribution company Enedis provides an online descriptive notice for new connections, the *'Fiche descriptive de l'offre'*.[27] Another example of an economy that has implemented good practices related to availability of information through online platforms

is the United Kingdom. In its website, UK Power Networks clearly establishes what are the steps to get connected to the grid, how much it will cost and how long it will take for a new customer to obtain a connection.[28] Additionally, it offers a pre-application online service where entrepreneurs can find a 'Frequently Asked Questions' section, communicate with experts and request face-to-face meetings to learn more before they apply for a new electricity connection.

When distribution utilities share information on the access to electricity services, as well as on customer's rights and obligations, for both residential and business customers, they contribute to a more transparent connection process.[29] However, the availability of information on access to power services is not homogeneous around the world. The requirements to obtain a new commercial connection are not published online in almost one fourth of the world's economies. This figure varies greatly across regions, as this information is not published in nearly half of the economies in Sub-Saharan Africa, compared to only one economy in Europe and Central Asia.[30]

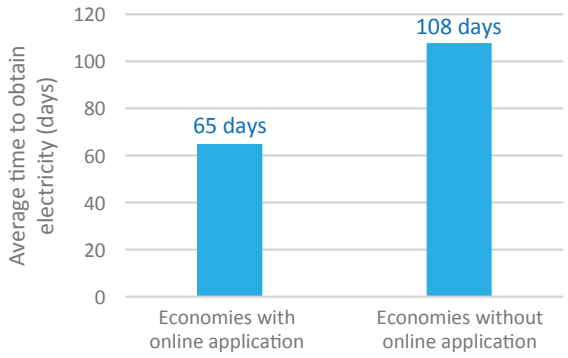
Doing Business data show that there is a strong correlation between economies that have online information on how to obtain a new commercial connection and their performance on getting electricity. Availability of online information about a new connection is most strongly correlated with performance when it includes information on cost; transparency and predictability of connection costs is associated with more affordable connection charges.[31] Overall, economies that publish information online for obtaining a new commercial connection have an average getting electricity score of 73.3, while those without online information have an average score of 57.2. Over the years, several examples of utilities that use technology to improve the efficiency of their connection services have been identified. For instance, in 2018 the utility in the Indonesian cities of Jakarta and Surabaya, Perusahaan Listrik Negara (PLN), invested on digitalization to reduce the time to obtain a new connection. Through efforts to comply with the procedural and time estimates published on its website, PLN managed to improve its efficiency and to have better accountability of its services.

Enhancing consumer experience through online applications, digital signatures, bill payments and other digital services

Online public services help reduce travel time required to comply with the requirements imposed by public administrations.[32] Similarly, electronic interfaces at the utility that allow customers to submit their applications online can lead to a decrease in the time required to obtain a new electrical connection. Currently, in over 40 percent of economies around the world, utilities have an electronic portal that allows customers to apply for a commercial connection online. Utilities in OECD high income economies lead the cohort, with almost 80 percent of them providing online application services. They are followed by their peers in the Europe and Central Asia and Middle East and North Africa regions, where online applications are available in almost 50 percent of cases.[33]

Online application platforms can help reduce the time required to process applications and issue technical conditions by utilities. This, in turn, affects the overall time of obtaining a new connection. Notably, economies with an online application for an electricity connection tend to have a more efficient connection process in general, compared to those where utilities are not equipped with online application platforms. Globally, obtaining a new electricity connection takes on average 68 days in economies with online applications, compared to an average of 92 days in economies without similar online application services. The evidence for low income and lower middle income economies is even more pronounced (figure 4).

Figure 4. Among low and lower middle economies it is faster to obtain a new connection when online application is available



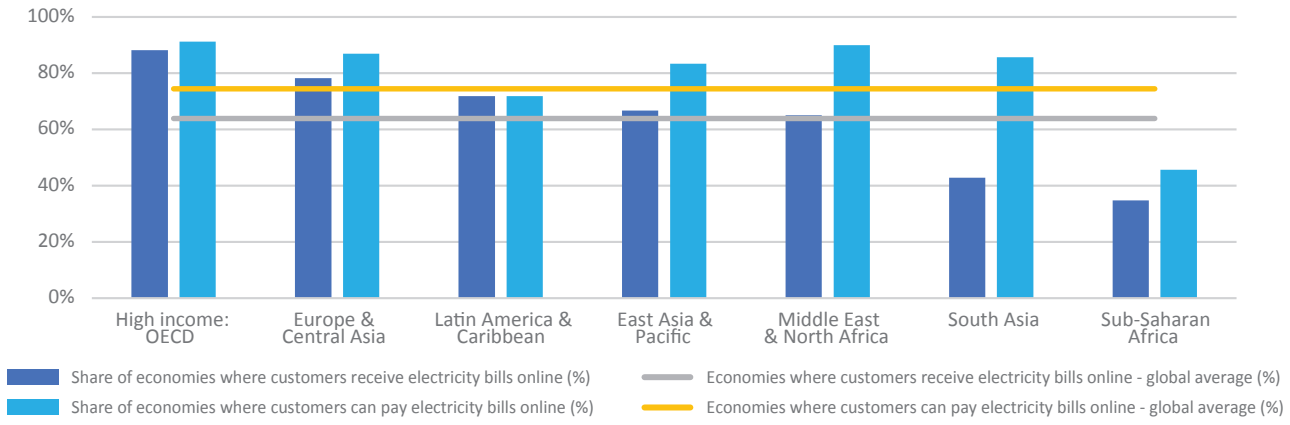
Source: Doing Business database.
Note: The relationship between the time to obtain a commercial electrical connection and the possibility to submit application online is statistically significant at the 1 percent level after controlling for the logarithm of GNI per capita in low and lower middle income economies. When pooling data for all income levels, the relationship is only significant at the 10 percent level.

For example, the Chinese utilities serving Shanghai and Beijing, the Shanghai Municipal Electric Power Company and the State Grid Beijing Electric Power Company, both launched new mobile applications in early 2017, allowing customers to pay their electricity consumption bills and receive notifications of power outages. Customers are also encouraged to use these apps to request a new connection to the grid. Towards the end of 2017, most applications were already submitted through the mobile apps, which significantly reduced the time required to obtain new commercial connections from over four months to around one month in both cities.

Furthermore, there is a wide range of auxiliary services that can improve the efficiency of the utility's operations and the process of issuing electricity connections. Besides offering online applications, several utilities around the globe offer services such as online payment of connection costs, a digital signature for signing contracts and documents, or a monitoring or tracking function. Integrating these functionalities into electronic portals can contribute to enhancing customer experience and lead to more transparency and accountability of utility services, as customers have more information on the status of their requests.[34] For instance, throughout 2011-12, the Dubai Electricity and Water Authority in the United Arab Emirates introduced an online application platform allowing customers to submit and track their applications online, which reduced the time for processing applications. In a similar vein, in the second half of 2017, the utilities in the Russian cities of Moscow and St. Petersburg upgraded their single windows for new connection applications, enabling customers to apply and pay for a new connection online, as well as sign connection and supply contracts using an electronic signature.

Digital infrastructure for the issuance and payment of electricity bills is another area that demonstrates the wide range of utility services that have potential for digitalization. Online services at the utilities may be provided through their own platform or by linking it with online banking or mobile payment services. *Doing Business* data show that in over 60

Figure 5. In most economies around the world, customers can receive and pay their electricity bills online



Source: Doing Business database. This analysis is based on a sample of 180 economies. Data are not available for Equatorial Guinea, Kiribati, Liberia, Maldives, Federated States of Micronesia, Mongolia, Samoa, Timor-Leste, Tonga, and Vanuatu.

percent of economies, customers receive their electricity bills online. Notably, in nearly 75 percent of economies customers can pay their bills using online services, although there is wide variation across regions (figure 5). This may be indicative of the different level of integration of online banking services into the electricity sector across the different regions. As online banking services are becoming widely available around the world, citizens and businesses eagerly make use of them. For instance, online bill viewing and payments are most common in the OECD high income group – and it is estimated that on average two thirds of internet users in the OECD economies used online banking services in 2018.[35]

Digital bill payments may be less common in Sub-Saharan Africa; however, this is also a growing trend in the region, in particular through mobile money. In Uganda, the share of electricity consumers paying their bills with mobile money skyrocketed within five years, jumping from 3 percent of total consumers in 2012 to 52 percent in 2017.[36] Similar developments are taking place across the region and beyond.[37] Digitalization of billing benefits both customers – by reducing travel time and allowing for more convenient payment options, and utilities – by increasing revenue collection and reducing the costs of maintaining service centers. At the same time, important risks, such as fraud, privacy and data security issues, should not be neglected.[38]

The successful application of digital technologies requires new governance frameworks and goes beyond the mere transfer of existing services to online options, as technology can be leveraged to re-engineer and transform the delivery of public services.[39] Implementing a fully-fledged digitalization of utility services overnight would be a challenging process. In this regard, gradual development and the introduction of digital services, through integration with existing online banking services, may pave the way for further digitalization of processes and services.

Box 2. Behind the scenes: back-office digitalization of utilities operations

Providing customers with an opportunity to apply online for new electrical connections is a good example of utility reorganization that benefits the user. However, having an online portal for electricity distribution services is only the first step in tackling the problem of administrative fragmentation. When it comes to the electricity connection process, citizens and businesses expect efficiency and coordination between the agencies involved. In this regard, back-office integrated reorganization of the administrative body can help eliminate unnecessary steps and improve efficiency. From the agency's point of view, an efficient reorganization marked by improved inter-agency coordination or integration, and supported by an enhanced digitalization of operational processes, can help improve cost effectiveness and the quality of services in the electricity sector.[40]

One example is the use of a geographic information system (GIS). The implementation of GIS allows data from different sources to be combined and linked to maps of specific areas.[41] By providing solutions for data integration and visualization through maps, combining spatial and non-spatial data, GIS is used as an information and analytical tool and as a decision support system.[42] In the electricity sector, GIS has proven to be successful in supporting decisions in grid management or expansion, and utilities around the world have been introducing GIS as a solution to enhance their back-end operations and streamline the process of issuance of electrical connections. In many cases, GIS eliminates the need to conduct a site visit in order to prepare technical conditions and estimate the connection costs, thereby enabling utility employees to determine the details of a new connection without visiting the customer's premises. This, in turn, allows customers to avoid an extra interaction with the utility representatives, which streamlines the process of obtaining new electricity connections.

An interesting case is that of Kenya Power and Lighting Co. Ltd. (KPLC), the utility in Nairobi, which introduced a GIS at the end of 2015. KPLC carried out a comprehensive national campaign obtaining a General Packet Radio Service (GPRS) to coordinate all equipment used in electricity transmission and distribution– mapping all substations, transformers and meters in the GIS, which was further linked with cadastral maps from the survey of Kenya and Google Maps. This allowed the utility to prepare the connection designs for customers in urban areas where there is an existing network directly from the utility's office. As a result, the site visit, a procedure that used to be necessary to provide a quotation of connection costs, was removed, making it easier and faster to obtain an electricity connection in Kenya. Over the recent years, utilities in many other economies, such as Armenia, Thailand and Mexico, implemented GIS, eliminating the need for a site inspection and streamlining the process of providing new electrical connections.

Conclusion

When it comes to electricity, customers need first and foremost a reliable, affordable and predictable electricity supply. They should be made aware of how reliable the service is, how much their consumption costs will be, and where and when planned outages will happen. They should know in advance what they must do to obtain a new connection, how much this will cost them and how long it will take. Ideally, the public could also benefit from digital services such as online applications for a new connection and online bill viewing and payments.

Digital transformation comes as a response to such needs. But it represents much more. It can improve operational efficiency, reduce transaction delays and costs, and positively impact firm productivity. In terms of the delivery of public services, digital transformation significantly improves the way citizens interact with their governments.[43] As shown in this study, across the different regions there is plenty of room for innovation in the electricity sector, through further digitalization and automation of an array of services, starting from online applications and payment of bills to the use of GIS and automated systems for outage monitoring and service restoration, as well as through the communication of information on outage schedules, tariffs, or requirements for a new connection.

NOTES

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1 EWorld Economic Forum 2017.
2 EY 2016.
3 McKinsey&Company 2018.
4 Over the past five years, fifteen economies introduced automated systems to monitor power outages and restore supply in the main business city, joining the group of 133 economies out of 190 that use automated outage monitoring systems: Albania, The Bahamas, Brunei Darussalam, Bulgaria, the Arab Republic of Egypt, El Salvador, Gabon, Georgia, Iraq, Kenya, Kosovo, Lao PDR, Montenegro, Paraguay, and Vietnam.
5 SAIDI measures the average total duration of outages experienced by a customer in a given period, and SAIFI measures the average frequency of outages experienced by a customer in a given period. To make sure that the data is comprehensive and representative of all interruptions, SAIDI and SAIFI estimates can include planned and unplanned outages, as well as load shedding. Another good practice is to record all interruptions lasting longer than a minimum duration.
6 SAIDI and SAIFI calculations were considered for economies that adopt a set of common standards measured by *Doing Business*, such as including all types of power cuts lasting 5 minutes or longer. For these economies, all planned and unplanned outages as well as load shedding are included in the estimates. For more information, please access https://www.doingbusiness.org/en/methodology/getting-electricity.
7 *Compagnie Ivoirienne d'Electricité*. http://www.cie.ci/communiques
8 Compañía Nacional de Fuerza y Luz. https://www.cnfl.go.cr/suspension-del-servicio-electrico
9 The Barbados Light & Power Company Limited, Facebook page: https://www.facebook.com/blpconline/ and Bahamas Power and Light, Facebook page: https://www.facebook.com/mybpl242/
10 Abeberese 2013. Akuru et al. (2014), using data from Nigerian businesses, reaches a similar conclusion.
11 Austin and Gravelle 2007.
12 Foster and Rana 2020.
13 Idem.
14 The relationships between regulatory monitoring and the publication of data on power outages, and between regulatory monitoring and the publication of data on tariffs (including announcements of tariff changes ahead of the billing cycle) are both statistically significant at the 1 percent level after controlling for logarithm of GNI per capita.
15 Foster and Rana 2020.
16 Mawejje 2013.
17 Godinho and Eberhard 2019.
18 The latest change took place when ERA reduced the electricity tariffs in the country in January 2019, announcing the new tariffs and the causes for the decrease (The Independent 2019).
19 Umeme, the distribution utility in Kampala, started to calculate SAIDI and SAIFI according to standards such as the inclusion of all service interruptions lasting up to five minutes or less.
20 Deloitte 2017.
21 European Parliament and Council 2009.
22 Idem.
23 OECD 2003.
24 World Bank 2012.
25 The top 10 economies ranked in the *Doing Business 2020* ease of getting electricity are: United Arab Emirates; the Republic of Korea; Hong Kong SAR, China; Malaysia; Germany; Thailand; Russian Federation; United Kingdom; Taiwan, China; and Sweden. Utilities in all economies except Germany make connection requirements, including timeframes, costs, documents and procedures, available to the general public through their websites. In Germany, the utility operating in Berlin offers a consultation service to potential customers, where the necessary information about connection requirements is provided.
26 European Consumer Organization 2018.
27 For Portugal, see Entidade Reguladora dos Servicos Energéticos 2015. https://dre.pt/application/conteudo/66490056. For France, see ENEDIS *Fiche descriptive de l'offre de forniture d'électricité*. https://particulier.edf.fr/content/dam/2-Actifs/Documents/Offres/fiche-descriptive-vert-electrique.pdf
28 UK Power Networks. https://www.ukpowernetworks.co.uk/electricity/new-connection/over70kva
29 Fumagalli and Lo Schiavo 2009; Pargal and Ghosh Banerjee 2014.
30 For the purposes of this analysis, economies are represented by the power company that provides services in the main business city.
31 Economies that have connection requirements online have an average 7 points higher score on the ease of getting electricity. The relationship is based on data published by *Doing Business 2020* and it is significant at the 1 percent level, controlling for income per capita.
32 ITU 2017.
33 Online application portals are available in 40 percent of economies in East Asia and Pacific; 31 percent of economies in Latin American and the Caribbean; 28 percent of South Asian economies; and 17 percent in Sub-Saharan Africa.
34 Westholm 2005.
35 OECD 2019.
36 Bungane 2018.
37 GSMA 2017.
38 Bungane 2018.
39 OECD 2015.
40 Idem.
41 Saha and Pande 1993.
42 Kaushik 2011.
43 ITU 2017.

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