

## ENERGY ACCESS

# Addressing unreliable electricity in Sub-Saharan Africa

**Energy investment plans in the developing world often focus on increasing access to electricity. However, in many Sub-Saharan African countries the problem is low system reliability, reports Simon Trace.**



Engineers discuss blueprints at a power plant in Cape Town, South Africa  
Photo: EEG

For utilities operating in developing countries, it can be difficult to improve reliability. They face many challenges, including limited financial resources for infrastructure upgrades – due to low revenue collection rates and tariffs being set below cost-recovery levels – and a lack of data to help them understand reliability issues.

Of the 840mn people across the world who do not have access to electricity, close to 600mn of them live in Sub-Saharan Africa. Several countries in the region have made progress in expanding electricity access in recent years – but increasing electrification is only part of the picture. In parts of Sub-Saharan Africa that are already connected to the grid – such as urban areas, where access rates can be over 75% – the quality of the service is often low and unreliable.

In fact, fewer than half (43%) of Africans enjoy a reliable supply of electricity. Homes and businesses suffer unplanned, unpredictable power outages, as well as scheduled and controlled electricity shutdowns (load shedding), where power is deliberately rationed to relieve pressure on the system and prevent complete collapse.

These problems can last for hours, sometimes days, and can be

frequent. It has, for example, been shown that about 60% of urban households in Ethiopia and 77% in Rwanda experience four to 14 power outages per week. And, according to 2018 World Bank Enterprise Surveys data, in a typical month, firms in Sub-Saharan Africa experienced nine power outages.

Load shedding is very much a reality for many Sub-Saharan African households and businesses, especially those in South Africa, Zimbabwe and Zambia. In recent times, load shedding has been a daily occurrence for South Africans.

## The impact of unreliable electricity

A lack of access to reliable electricity affects health, education and wellbeing, but also has an impact on people's livelihoods and countries' economic growth. In fact, economic losses due to power interruptions are estimated to cost between 1% and 5% of the GDP of countries across Sub-Saharan Africa.

Frequent or long-lasting power outages and voltage fluctuations can suppress investment in income-generating electrical appliances – such as refrigerators, sewing machines and production machinery – and can lower output from existing ones. This reduces productivity and profitability while

also hindering entrepreneurship and job creation. World Bank Enterprise Surveys for Ethiopia (2015) and Sierra Leone (2017) each found that a third of firms saw electricity reliability as a major constraint.

For some businesses, spending money on backup generators, an expensive alternative to grid electricity, becomes a necessity. Unreliable power can also affect employment opportunities. The impact of living in a Sub-Saharan African community with an unreliable electricity supply is estimated to reduce the probability of employment by 35% or more. It also inhibits the participation of women and youth in the workforce by making domestic chores more labour-intensive.

The relationship between reliable electricity and economic wellbeing has been further highlighted during the COVID-19 pandemic. Countries with reliable electricity supplies have, at least to some extent, been able to maintain key supply chains and communication and IT services, so that parts of their economies can continue to function despite the social distancing and stay-at-home measures. Reliable electricity has also enabled people to work at home where feasible, protecting businesses, jobs and economies to some degree.



While it's clear that reliability is fundamental to increasing electricity access, utilities operating in developing countries can find it difficult to make improvements. Reliability issues are typically related to the capacity and quality of electricity systems.

They can, for example, be a result of insufficient electricity generation (the installed generation in most Sub-Saharan African countries is below the total potential electricity demand), ageing equipment and network fragility (leading to breakdowns on transmission and distribution lines, and in transformers), or maintenance requirements.

However, utilities in Sub-Saharan Africa have limited financial resources available to maintain and upgrade ageing infrastructure, repair breakdowns and invest in new equipment. As well as having limited access to affordable capital, funds are restricted because of low revenue collection rates and tariffs being set below cost-recovery levels.

#### Revenue collection

Revenue collection is constrained because of inaccurate meter readings and estimated billing practices, as well as non-payment of bills when consumers cannot afford to pay for their electricity. And during the COVID-19 pandemic, when lockdown restrictions are likely to have reduced people's ability to pay their bills, utilities' cash flows would have been further affected.

Some governments put short-term relief measures, such as subsidies or extending payment deadlines, in place so consumers could continue to have access to electricity. But unless compensated, this will have directly impacted utilities' revenues.

Electricity theft, through meter tampering or directly tapping into electricity lines, is another issue. In many developing countries, electricity theft is highly political, reflecting the often-prevailing view that energy is a right, rather than a private good, and legal penalties are not enforced. If electricity is unreliable, and the utility is seen to be delivering a poor service, consumers can often feel justified in making incomplete payments, or not paying for their electricity at all.

If utilities could deliver high-capacity, reliable electricity, it would boost the ability and willingness to pay for consumption. One study in Ghana found that firms would be willing

to pay 13% more for uninterrupted electricity access. However, utilities often become trapped in a cycle of low payment leading to restricted and low-quality supply.

A potential solution to breaking this cycle is currently being investigated through an EEG-funded research project. Jameel Poverty Action Lab (J-PAL) is evaluating whether advanced metering infrastructure (AMI) smart meters with prepayment can improve cost recovery, and thereby energy reliability and access. AMI technology can enable utilities to directly observe consumption in close to real time and can help them to detect theft and remotely disconnect non-paying consumers or transfer them to pre-payment. The system also encourages accurate metering and billing.

#### Tariffs

In many Sub-Saharan African countries, electricity tariffs tend to be set below cost-recovery levels. In Nigeria, for example, revenue currently covers approximately only 35% of total distribution company costs. It has been suggested that tariff revenues are not enough to cover operating expenses in 20 of the 39 electricity sectors in Sub-Saharan Africa.

Therefore, cost recovery could potentially be improved through tariff reform. In February 2020, it was reported that Southern African electricity users will pay more under plans by regional energy regulators to let their utilities charge tariffs that reflect costs and create funds to increase power generation. Some Sub-Saharan African countries have already embarked on tariff reform – including Ethiopia, Zimbabwe, Zambia and South Africa.

In Ethiopia, the reform involves a minor price increase for the first 12 months, followed by a steeper increase for the following three years. Customers consuming fewer than 50 kWh of electricity per month will see no change in electricity prices, and households or firms consuming more electricity will experience higher costs per kWh. An EEG project, led by Ethiopia's Policy Studies Institute, is evaluating the impact of the first phase on the demand for electricity among household and commercial consumers, as well as on the broader economy.

#### Grid performance

Another issue utilities face is a lack of accurate information about grid performance. Implementing measurement and data collection

tools – such as sensors and smart meters – costs money, making it difficult for under-resourced utilities to obtain a clear picture about system outages.

Utilities will largely rely on very low-quality information, and many won't know there has been an outage unless a customer reports it. Even when one is reported, the utility may not know when it started or how long it lasted, how many customers were affected, or what remedy may be needed. Therefore, important operational and investment decisions are being made by utilities and governments without them knowing the frequency, duration and geographic extent of reliability issues.

In response, a team from the University of California, Berkeley, has developed and deployed a suite of low-cost remote sensing devices to measure power outages, voltage fluctuations and frequency instabilities across households and businesses in Accra, Ghana, as part of a project part-funded by EEG. The technology is generating detailed reliability data and is much more accurate than existing systems.

The improved information will help utilities to assess the extent of outages quickly and accurately, so they can send repair teams to where they are most needed to better prioritise limited resources. With a little more analysis, the data may also help utilities to carry out better preventative maintenance. The project team is also using the data to develop rigorous measures of the socio-economic impacts of poor reliability and voltage fluctuations.

Electricity access remains a fundamental issue for developing countries, but attention also needs to be paid to reliability of supply and utility operations. While there is growing interest in the quality of on-grid electricity, the scope of the problem is not well understood, and few studies have analysed the causes and consequences of outages, or the ways in which policy makers can address them, meaning there are many knowledge gaps. Several EEG research projects are investigating ways to improve the reliability of electricity systems in developing countries. ●

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