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Power outages in Africa – An assessment based on regional power pools

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Abstract:
Africa continues to take significant strides towards power sector transformation and growth. New power plants are being constructed and electricity consumption continues to improve every year. However, amidst all these developments, crucial challenges remain. Africa, and sub-Sahara Africa in particular, has the lowest electricity access rate of any region in the world. For the small percentage of the population that has access to electricity, the quality of supply is very low. Power outages are frequent, long and widespread and have socio-economic ramifications. Yet, the extent of this power outage problem in Africa is not well documented. A few studies on this subject mainly investigate the economic impacts of outages while relying on a few case study countries. A comprehensive and accurate representation of the power outage situation in Africa is clearly missing. This study adopts a regional approach based on regional power pools to assess outage experiences, impacts and responses for the entire African continent. The study utilises freely available, country-level data from the World Bank to compute regional averages. The results reveal significant regional variations for all the parameters.

Key words: Power pool, Power shortage, outage experience, regional comparison

1. Introduction

There are five regional power pools in Africa. Comité Maghrébin de L'Electricité (COMELEC) was the first power pool to be established in 1989, with a vision of improving coordination amongst power sector players in member countries and ultimately to achieve regional power sector integration (ICA, 2016). The same vision is shared by the other four power pools namely; Southern African Power Pool (SAPP), West African Power Pool (WAPP), Central African Power Pool (CAPP) and Eastern Africa Power Pool (EAPP); which were founded in the latter years up to 2005 (ICA, 2016). Since the foundation of power pools, significant improvements in installed power

capacities, electricity consumption and electrification rates in the regions have been recorded. Yet, even with these marked advancements, considerable challenges to sustainable electrification in Africa still remain.

Africa, and sub-Sahara Africa in particular, has the lowest electricity access rate of any region in the world. Moreover, for the small percentage of population that has access to electricity, the quality of supply is very low (IEA, 2014). Power outages are a regular occurrence in many countries (Africa Progress Panel, 2017). On average, sub-Sahara Africa experiences nine power outages every month each lasting for about five and a half hours. These outages impact over 80% of the electricity users and have socio-economic ramifications (World Bank, 2017). Some authors have sought to study power outages on the continent. For example, (Andersen & Dalgaard, 2013) estimated the effect of power outages on economic growth in sub-Sahara Africa. This and other similar studies have yielded insightful results, albeit using a few selected case study countries. As such, these results do not ably portray the actual outage situation of the entire continent.

In order to more accurately and comprehensively represent the continental outage situation, this study adopts a regional approach. The approach used here is based on the five regional power pools of Africa. Freely available data, country-level data published by the World Bank is used to compute regional averages for selected characteristic parameters, that define outage experiences, impacts and responses. The ensuing results reveal significant regional variations for all the assessed parameters.

2. Methodology

Regional clustering: As indicated in (ICA, 2016), some countries at the interface between two geographical regions are members of two power pools. In this study, each country is allocated to a single power pool. This is necessary to facilitate easy illustration/mapping of the results.

Data: This study utilises the most recent freely available, country-level data from the World Bank enterprise survey database (World Bank, 2017). The enterprise survey database contains data on parameters that can appropriately characterize outage experiences, impacts and responses. However, data for these parameters is not captured yearly for all countries. This assessment, therefore, uses data published between the years 2010 and 2017. Data published before 2010 is deemed to be outdated.

Calculation: To estimate the regional power pool average for each characteristic outage parameter, the following simple mean equation is employed.

$$\mathrm{Pr} = \frac{\sum_i^n xi}{n} \qquad \text{.....} \qquad \textbf{Equation 1}$$

where,

Pr is the characteristic outage parameter for a given regional power pool, *r*
xi is the characteristic outage parameter value for a given country, *i* within a regional power pool, *r*
n is the total number of countries considered for the analysis under a given regional power pool, *r*

3. Results and discussion

Figure 1 illustrates the regional averages for power outage experiences. The results indicate that outages are a concern even in power pools that have well-developed power supply infrastructure. CAPP has the highest total duration of outages per month of 171.82 hours or 7.2 days. WAPP follows with a duration of 63.18 hours followed by EAPP with 30.38 hours. COMELEC, which is said to have the best power infrastructure and highest connectivity in Africa (ICA, 2016), has the least total outage duration of 3.332 hours followed by SAPP with 14.52 hours. On further analysis, it was also established that for all power pools, the exclusion from the analysis of one or two countries with highest or lowest total power outage duration significantly alters the total outage duration but does not change the already established performance and ranking of one power pool relative to the others.

Regional averages for percentage of electricity users experiencing power outages and losses attributed to electricity outages are shown in Table 1. The rankings of power pools for the outage impact parameters are

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similar to those for outage experiences. Results indicate that CAPP and COMELEC are the most and least impacted power pools respectively.

The gravity of the problem of power outages in Africa is further demonstrated by the fact that over 65% of electricity users in four of the five power pools experience power outages every month. In the two worst performing regions of CAPP and WAPP, this percentage exceeds 80%. In the best performing region of COMELEC, still, about 30% of electricity users experience outages.

The economic losses attributed to power outages by individual electricity users are substantial. These losses are above 5% of annual sales in most power pools. As shown by (Andersen & Dalgaard, 2013) and (Ostermeijer, 2016), power outages in Africa significantly affect productivity and efficiency of commercial and industrial firms.

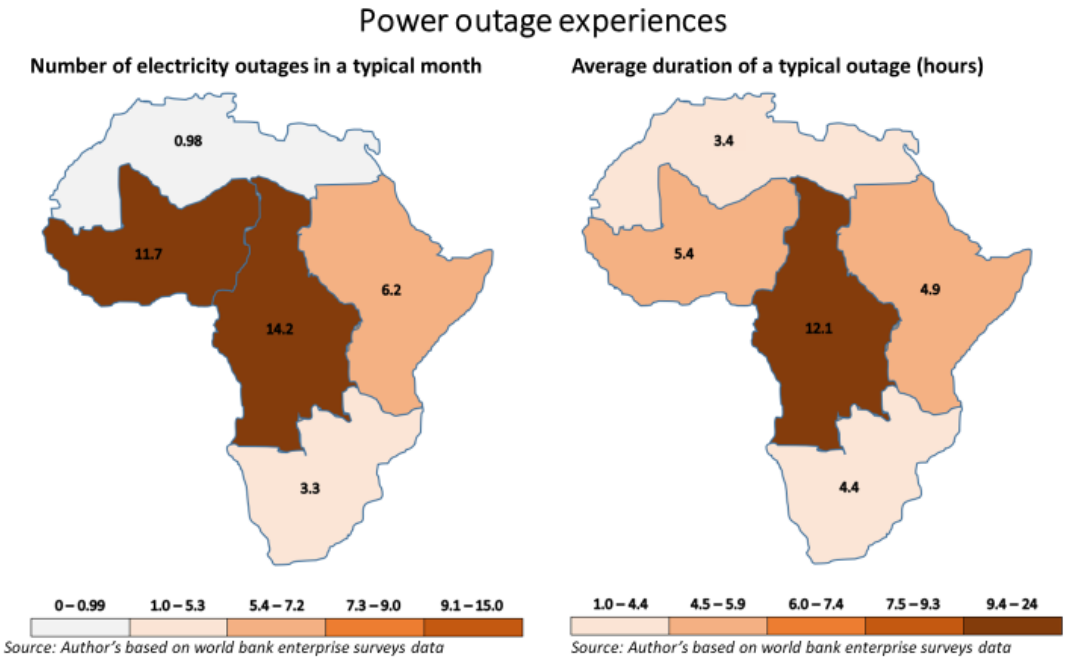

Figure 1: Power outage experiences in Africa

Table 1 also reports power pool results of the extent of generator ownership/sharing and generator utilization. The results obtained for generator ownership/sharing are positively correlated with those of outage experiences and impacts.

A difference, however, exists between the proportion of electricity users experiencing power outages (impact) and those owning/sharing a generator (response). In COMELEC and SAPP, less than 50% of the users who experience outages own/share a generator. This might imply that electricity users in these regions consider the outage levels and impacts to be insignificant. In the remaining power pools, however, outage experiences and related losses are substantial but the proportion of generator ownership is still less than 75%. Probably, this is due to lack of economic capacity to acquire and operate back-up generators, especially for small scale electricity users. Moreover, where electricity is mainly used for non-critical purposes such as lighting, other cheaper coping mechanisms (for example, use of candles or lanterns) can be adopted.

In all power pools, the amount of electricity that is derived from generator utilization as compared to the electricity needs of the user(s) is very small. This indicates either to lack of sufficient resources to own bigger generators or to high fuel costs in some regions. However, generator utilization is highest in CAPP (36.3%) and WAPP (33.9%), not because of high purchasing power or low fuel prices, but because extremely frequent, intense

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and erratic outages are driving electricity users to increasingly rely on individual electricity generation for most of their electricity needs.

Table 1: Power outage impacts and responses in Africa

	Impact of power outages		Response to power outages	
Region	Percent of firms experiencing power outages	If there were outages, average losses due to power outages (% of annual sales)	Percent of firms owning or sharing a generator	If a generator is used, average proportion of electricity from a generator (%)
COMELEC	30.9	2.3	11.6	21.4
WAPP	81.4	7.2	58.3	33.9
CAPP	86.7	11.0	62.8	36.3
EAPP	75.4	5.8	52.7	18.0
SAPP	67.8	4.8	32.2	19.3

Source: Author's calculations based on World Bank data

4. Conclusion and recommendations

In this study, we sought to assess and present the power outage situation in Africa. From the results, it is clear that power outages are still a big challenge on the continent. Outages are frequent, long and widespread and cause significant economic losses in most power pools. However, the outage experiences, impacts and responses vary across regional power pools. The best performing power pools for most outage parameters are COMELEC and SAPP. Interestingly, these were the first power pools to be founded on the continent. This underscores the importance of regional power pools in stimulating power sector development. Yet, just the creation of power pools cannot deliver the desired change. Rather, having in place a clear vision, roadmap and strong commitment of individual member countries to align their power sector plans with established regional goals and objectives can greatly contribute to delivering shared and sustainable power sector transformation in Africa.

The results of this study are generally indicative of the outage situation in the respective power pools. However, extra care should be taken when applying these results to individual member countries. A few countries with very high or very low values exist in all power pools. The results presented here may not ably represent the situation of these outliers.

This study assumed firm-level data to generally represent the experiences of all electricity users in a country. However, in future, similar studies should endeavor to incorporate residential electricity users' experiences which will undoubtedly enhance the relevance of the results.

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