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The illusion of "excess capacity" in Kenya

High-level takeaways from Lewis Waswa, Martin Kitetu, Mark Thurber, Murefu Barasa, Lily Odarno, and Steve Brick, "Reviewing the overcapacity claim: Insights from Kenya's electricity sector," *The Electricity Journal* 37 (2024) [1]

Summary: African countries, including Kenya, have declared they now have the capacity to generate more electricity than they need — so why hasn't energy poverty been solved? In a country like Kenya, with high shares of variable renewable energy, weak transmission infrastructure, and single points of failure, the simplistic metric of "excess capacity" is a poor measure of power system adequacy and can skew policy and funding choices.

Why it matters: The narrative that Kenya and other emerging markets have achieved sufficiency in electricity generation is inaccurate: When you count only "firm capacity" that can respond to system conditions as needed, Kenya is right on the edge of having insufficient reserves to meet peak demand. Relying on a simplistic capacity metric could cause policymakers and funders to neglect major power system vulnerabilities that must be addressed through the addition of dispatchable generation, strengthening of the transmission grid, and more carefully considered expansion of wind and solar.

Power system expansion and the narrative of excess capacity

Emerging markets and development funders have invested heavily in electricity generation capacity in recent years. In sub-Saharan Africa (excluding South Africa), annual electricity generation rose by 65% from 2011 to 2021, versus a global increase of 28% [2]. Now countries including Ghana, Cameroon, Rwanda, Ethiopia, Uganda, and Kenya have reported achieving "excess capacity": total generation capacity that exceeds peak demand (including a reserve margin).

The illusion of excess capacity with high variable renewables

But "excess capacity" is a thoroughly misleading metric, particularly in countries with large shares of wind and solar power. Kenya's total nameplate capacity in 2022 included 14% wind and 6% solar [3], and significantly more variable renewable capacity is slated to come online [4]. Kenya's high wind and solar shares make the excess capacity metric particularly misleading because:

- **Wind and solar have significantly lower average capacity factors than dispatchable units (like natural gas or hydropower).** As a result, they produce less energy than a

thermal plant of the same capacity. This can be partially accounted for by adjusting the nameplate capacity by the average capacity factor.

- **Variable renewables may be mismatched to load patterns.** Kenya's renewable plants may produce lots of energy — but possibly not at the times when people need it. For example, solar contributes almost nothing to meeting Kenya's evening demand peaks.
- **Wind and solar are not guaranteed to be available when needed.** Even if wind and/or solar resources are usually available at a particular time of day, their electricity production at any given moment will depend on the weather.
- **Wind and solar capacity in Kenya are geographically concentrated.** Wind and solar output in Kenya is geographically concentrated, with the Lake Turkana wind farm alone accounting for about 10% of Kenya's total generation capacity. This can produce large swings in renewable output at a single location in the grid, which have to be compensated for to meet demand and ensure grid stability.

At present, Kenya's hydropower resources play an important role in compensating for fluctuations in wind and solar generation, but hydro itself is vulnerable to erratic changes in weather patterns which affect precipitation levels.

Power supply adequacy is about more than generation capacity

Five of the eight major blackouts in Kenya in the last decade resulted from transmission failures, underscoring the extent to which generation capacity does not ensure reliable power supply [1]. Transmission is especially susceptible to being a single point of failure when it evacuates power from a single large generating station, as in the case of the Suswa – Loiyangalani line interconnecting the 310 MW Lake Turkana wind farm.

For better energy planning, leave excess capacity metrics behind

Simplistic excess capacity metrics can disrupt energy planning in important ways by:

- **Distorting consumer expectations for reliability.** Industrial, commercial, and residential consumers who hear in the media that their country has ample generation capacity may be particularly disturbed and unprepared when their power cuts out. More nuanced communication about the real challenges of the power grid could help build support for appropriate policy action.
- **Obscuring the need for dispatchable power.** Lumping variable and dispatchable resources together in simplistic capacity metrics can lead policymakers, potential investors (including development agencies), and consumers to neglect the importance of achieving a mix of generation sources that can maintain reliability.
- **Undervaluing investment needs outside of generation.** Investments in transmission and distribution are just as important as generation, particularly in a grid with high shares of intermittent renewables. A narrow focus on generation capacity can skew investment toward generation and lead policymakers (and development agencies) to declare victory prematurely.

Instead of relying on simplistic metrics such as excess capacity, governments need to holistically assess the obstacles to adequate and reliable power supply. These include deficiencies in transmission and distribution infrastructure, limited geographic and technological diversity of supply (including too few dispatchable resources for when wind and solar are absent), and unreliable fuel supply chains. Achieving total generating capacity that exceeds peak demand is a starting point, not the finish line.

Endnotes

1. Lewis Waswa, Martin Kitetu, Mark Thurber, Murefu Barasa, Lily Odarno, and Steve Brick, "Reviewing the overcapacity claim: Insights from Kenya's electricity sector," *The Electricity Journal* 37, 2024, https://doi.org/10.1016/j.tej.2024.107374.
2. BP, Statistical Review of World Energy, 2022, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf.
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