Enlight Series

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Utilization of Solar and Battery Technologies in Ending Power Blackouts in Nigeria

Introduction

Do you know anyone in Nigeria who has never experienced grid power supply blackouts? My guess is no. I almost knew someone, and this is how it happened. Some years back, on one fateful night, my toddler son cried out loud immediately after a power blackout occurred at his grandparents' house. It dawned on us that he cried because he had just experienced his first power outage. While Nigeria remains the energy access deficit capital of the world, with about 85 million Nigerians lacking access to electricity, this challenge presents a huge opportunity. Most rural communities use off-grid solar and battery technologies to address the energy access gap. Thanks mainly to funding from multilateral development banks such as the World Bank and African Development Bank, with implementation by the Rural Electrification Agency of Nigeria. All On, an impact investor, supports many Nigerian energy startups in this regard. However, a considerable opportunity exists to provide a stable and reliable electricity supply to homes, businesses, and institutions already connected to the national power grid. Aside from security issues, power remains one of the major issues that must be addressed if we return to economic recovery. A stable and growing power supply system is needed to achieve a stable economy. So why do we frequently experience blackouts in Nigeria?

Background

These blackouts may occur voluntarily or involuntarily at the local electricity distribution company (Disco) level. Voluntarily, they may occur when load-shedding practices by Discos ensure that the insufficient power supply from the national grid is rotated amongst different areas to ensure everyone gets some supply at some time. They may also happen involuntarily when faults along the distribution feeder lines occur and cause the local power supply to be cut off. Earthing of most electrical installations can significantly address this. At the national electricity generation and transmission level, these blackouts may result from a national power grid system collapse. This is explained in NERC's Q4 2022 Quarterly Report, which states that "when electricity demand is higher than the supply, the grid frequency drops, which can cause some power plants to shut down automatically. This further exacerbates the frequency imbalance and can lead to a full or partial system collapse." A recent long-running record of no grid collapse since the six grid collapse events of 2022 was cut short on Thursday, September 14.

Rather than focus on what caused or causes grid collapses, let us focus on what can be implemented to prevent grid collapses and more frequent blackouts. While decentralizing the grid can be part of the solution, we also examine leveraging renewable energy technologies. Maybe we can look at this from a smaller scale by using some of our homes as an example. You may have seen this play out when you observe a small petrol or diesel generator that is undersized struggling to meet the load in a building. After some time, the generator shuts down. This is similar to what happens on a larger Scale at the national power grid level, where one of the power generators may shut down and cause an imbalance, which causes other generators to shut down, resulting in a system collapse. It, therefore, becomes clear that our power blackout and grid collapse problems are rooted in our power supply deficit problem as we cannot meet demand. It's already common knowledge that power generation supplied and useable in homes, businesses, and institutions in Nigeria has hovered around 4,000MW for over a decade while we have a lot of stranded capacity (about twice the useable supply). Moreover, the national power transmission and distribution grids have proven to lack the characteristics of being called smart grids.

Battery Energy Storage Systems

As part of the initiatives to address this power outage issue, the Nigeria Electricity Regulatory Commission (NERC) recently launched a power outage reporting system to monitor and report customer power outage complaints and enforce timely supply restoration across the country. There are also plans to install smart feeder meters to accurately measure the quantity and quality of power supplied at different nodes on the grid. But to close the significant demand-supply gap, there is also a need to look at the way solar and battery technologies are presently used worldwide to add new electricity generation capacity that is affordable and achievable in a very short time. Maybe we can also look at this from a smaller scale by using some of our homes as an example. When a grid electricity supply outage occurs in our homes or businesses, we mostly augment our insufficient grid power supply with inverter plus battery systems, which are small Battery Energy Storage Systems (BESS) to provide backup power supply. Solar panels often power these systems to provide a reliable alternative power source. Note that these solar plus battery systems mostly come smart and can provide accurate supply metering from the solar panels, batteries and even the grid. In residential areas, solar panels can provide power during the daytime, and batteries can support the evening. When the batteries run out, the grid can provide a nighttime supply. Imagine a larger solar plus battery energy system connected to the transformer close to our homes, businesses, or institutions. This could be seen as a small interconnected solar hybrid mini-grid. Transformers are already connected to hundreds of homes, businesses, and institutions, and they are struggling to supply power on a 24/7 basis. Imagine an even larger solar plus battery energy system connected to the substation close to our home, businesses, or institution. Are you thinking what I am thinking already?

Opportunities

BESS mostly come containerized and can be in varying sizes ranging from as low as 50kW to as high as 100MW and even larger. When coupled with solar, these advances in energy storage systems may be part of the solution to our power supply deficit problem and could make our grid smart in today's AI-driven world. A 100MW BESS can supply 20MW of load for up to 5 hours. This could meet the load in some 33kV feeders. These systems already work in different parts of Nigeria but are mostly not connected to the national grid. In 2017, within two months, Telsa supplied and installed a 100MW BESS in rural South Australia to power 30,000 homes for an hour to reduce the pressures from grid imbalances that often lead to power supply outages. The big battery installed can absorb brief blips on the surrounding grid, thereby reducing outages for residents and easing the burden on businesses and facilities that would have lost money, products, etc., during those outages. The installation of the BESS also reduced the amount of carbon-emitting fossil fuel that needs to be burned in power backup generators in homes, businesses, and institutions. Can you see the carbon credit revenue-generating opportunity already?

Conclusion

There may be a few other routes that could be taken to achieve uninterrupted supply. But, from reading this, you may have followed the simple logic presented and seen from the South Australia example that we can try to use solar-powered BESS, which is presently working in Nigeria today, to solve our never-ending power blackout and grid collapse problems.

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