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Renewable Energy Storage Capacity Rating: A Forecast of Selected Load and Resource Scenario in Nigeria

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Abstract : As the drive towards clean, renewable and sustainable energy generation is gradually been reshaped by renewable penetration over time, energy storage has thus, become an optimal solution for utilities looking to reduce transmission and capacity cost, therefore the need for capacity resources to be adjusted accordingly such that renewable energy storage may have the opportunity to substitute for retiring conventional energy systems with higher capacity factors. Considering the Nigeria scenario, where Over 80% of the current Nigerian primary energy consumption is met by petroleum, electricity demand is set to more than double by mid-century, relative to 2025 levels. With renewable energy penetration rapidly increasing, in particular biomass, hydro power, solar and wind energy, it is expected to account for the largest share of power output in the coming decades. Despite this rapid growth, the imbalance between load and resources has created a hindrance to the development of energy storage capacity, load and resources, hence forecasting energy storage capacity will therefore play an important role in maintaining the balance between load and resources including supply and demand. Therefore, the degree to which this might occur, its timing and more importantly its sustainability, is the subject matter of the current research. Here, we forecast the future energy storage capacity rating and thus, evaluate the load and resource scenario in Nigeria. In doing so, We used the scenario-based International Energy Agency models, the projected energy demand and supply structure of the country through 2030 are presented and analysed. Overall, this shows that in high renewable (solar) penetration scenarios in Nigeria, energy storage with 4-6h duration can obtain over 86% capacity rating with storage comprising about 24% of peak load capacity. Therefore, the general takeaway from the current study is that most power systems currently used has the potential to support fairly large penetrations of 4-6 hour storage as capacity resources prior to a substantial reduction in capacity ratings. The data presented in this paper is a crucial eye-opener for relevant government agencies towards developing these energy resources in tackling the present energy crisis in Nigeria. However, if the transformation of the Nigeria. power system continues primarily through expansion of renewable generation, then longer duration energy storage will be needed to qualify as capacity resources. Hence, the analytical task from the current survey will help to determine whether and when long-duration storage becomes an integral component of the capacity mix that is expected in Nigeria by 2030.

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