



Development of Variable Renewable Energy for Ghana: Impact on the Management of Hydropower Akosombo Reservoir

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Electricity production in Ghana is shifting towards more fossil-based production in recent periods and amidst the high rates of increasing electricity demand, additional production systems are still needed. However, to achieve the aims of the Paris Agreement, a great deal of decarbonization is required thus a climate-friendly option is to massively develop Variable Renewable Energy (VRE) such as solar and wind power. In this study, the variability of potential solar power production was estimated for selected locations homogeneously distributed over the country while that for potential wind power was assessed for only the coastal offshore region. At sub-daily scale, solar power was observed to have a very high variability with the coefficient of variation (CV) for the average sub-daily cycle computed to be 124% as compared to 14% for wind power. At daily time scale however, wind power was observed to have a higher variability with a seasonal coefficient of variation calculated to be 41% as compared to 13% for solar power.

Due to the high variation of solar and wind energy in time, incorporating them in the power system requires the presence of a large flexibility system to cope with the temporal mismatch between production and demand that will be introduced. In this study, the Akosombo hydroelectric dam was used as a flexible power production facility to balance the temporal fluctuations of VRE production. Being used for this purpose, it was expected that higher share of VRE in the power system will lead to a change in the storage and release strategy of the Akosombo dam. Its storage variation was thus simulated with Deterministic Dynamic Programming for a reference case with no VRE production and a number future VRE production cases. It was found that in all scenarios tested, the seasonality of storage in the dam was not significantly affected by VRE production. However, relative to the reference scenario, a higher proportion of wind in VRE production leads to an increase in water level of the dam during its peak months at the end of the rainy season.