# Optimal Placement and Sizing of Photovoltaics and Battery Storage in Distribution Networks

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A two-step optimization approach is proposed to study the effects of adding a battery energy storage system (BESS) to a distribution network incorporating renewable energy sources. In this paper, the first step finds the optimal size and placement of the photovoltaic (PV) arrays that lead to the lowest possible losses, cost and voltage deviation from the reference bus, while the second step starts by performing another optimization in order to find the optimal size and placement of the BESS that lead to a further reduction in the same objectives. The optimized Grid-PV and Grid-PV-BESS configurations are subjected to a time domain power flow (TDPF) so that the annual energy losses and voltage profile of each bus can be observed. The paper provides a novel formulation that treats the problem as a multi-objective optimization and uses the Genetic Algorithm (GA) technique to reach optimal configuration in both steps. An Institute of Electrical and Electronic Engineers (IEEE) 13-Bus test feeder is used to demonstrate the usefulness of the proposed technique.