

SAIEE Africa Research Journal

Supply and demand side flexibility options for high renewable energy penetration levels in South Africa

Peter Klein, Clinton Carter-Brown, Jarrad G. Wright, and Joanne R. Calitz

Energy Centre, Council for Scientific and Industrial Research, Meiring Naude Road, Brummeria, 0001, South Africa

Abstract

This paper presents a study on supply and demand side flexibility resources assessed for two South African power system expansion scenarios with high penetrations of variable renewable energy. The demand response opportunities associated with residential water heating as well as plug-in electric vehicles are included in order to demonstrate demand-side flexibility options. Supply-side options are based on existing and optimally deployed new-build generation technologies. The scenario based results indicate that the combination of cost reductions in wind, solar PV and stationary storage (batteries), results in economic deployment of batteries in South Africa. Battery storage complements flexibility provided by demand response and supply-side options. A notable outcome is the displacement of gas-fired turbines by batteries when assuming cost reductions for batteries in the future. Finally, despite the extensive deployment of battery storage, a significant 55 TWh of energy from solar PV and wind is curtailed. Therefore, effective sector-coupling could make extensive use of this curtailed energy in a number of ways to be identified as part of future research.