

## **Abstract**

Transmission Constrained Generation Expansion Planning (TC-GEP) optimization has been solved majorly using the less reliable DC power flow analysis. In this paper, the TC-MOGEP problem is formulated based on AC-power flow analysis and considering presence of variable/intermittent Renewable Energy Sources (vRES). vRES related constraints in terms of resource availability and variability are considered to ensure reliability and security of supply. The paper studies the dynamics brought about by inclusion of both AC-power flow analysis and vRES in TC-GEP optimization. When considering AC power flow constraints, feasible TC-GEP results were achieved up to the fourth year of optimization (45MW). Beyond this load, no feasible solutions could be obtained even with increased investment in generation sources due to divergence of the AC-based power flow analysis. The divergence was caused by unsatisfied constraints majorly overloading of existing transmission lines. Though penetration of vRES in the optimized expansion plans slightly increased the generation investment cost by 2.5% it significantly reduced the operational cost by approximately 50% resulting to an overall cost reduction of up to 19%. Using the proposed formulation and solution methodology a 6.5% and 4.5% annual average share of vRES were realized in installed capacity and energy mix respectively. This penetration level resulted to a 55% reduction in CO<sub>2</sub> emissions.