

Co-optimizing network investment, reconfiguration, and third-party flexibility for congestion management in active distribution networks

M. Valarezo Rivera; T. Gómez San Román; J.P. Chaves Ávila; C. Alcarruz; P. Mancarella

Abstract-

This paper introduces a unified optimization model to evaluate three coordinated strategies for congestion management in distribution networks: investment in new assets, distribution network reconfiguration, and the procurement of third-party flexibility. Unlike existing models that consider these strategies in isolation, the proposed approach jointly optimizes capital and operational expenditures, explicitly capturing their trade-offs. This integrated perspective aligns with evolving regulatory frameworks that advocate for the coordination of conventional planning with operational and market-based flexibility. The model is applied across a range of scenarios, including load growth, varying flexibility capacities and costs, and different weightings of representative days.

Results indicate that reconfiguration alone may suffice under moderate demand growth, while greater availability of third-party flexibility can defer or substitute costly grid reinforcements. Under higher congestion conditions, the coordinated deployment of all three strategies delivers the most cost-effective and operationally robust outcomes. The analysis further reveals that grid reconfiguration dynamically alters the eligibility of service providers to deliver flexibility, underscoring the importance of incorporating reconfiguration into the design of third-party flexibility mechanisms and distribution network planning. The paper concludes by identifying key implementation challenges and future research directions, including the selection and weighting of representative days, assessment of switching costs, reliability of reconfigured topologies, uncertainty modeling, and the implications of coordinating multiple flexibility mechanisms for congestion management.

Index Terms- Distribution network reconfiguration; Congestion management; Distribution network planning; Flexibility services; Third-party flexibility; Topology optimization

Due to copyright restriction we cannot distribute this content on the web. However, clicking on the next link, authors will be able to distribute to you the full version of the paper:

[Request full paper to the authors](#)

If your institution has an electronic subscription to International Journal of Electrical Power & Energy Systems, you can download the paper from the journal website:

[Access to the Journal website](#)

Citation:

Valarezo, M.; Gómez, T.; Chaves, J.P.; Alcarruz, C.; Mancarella, P. "Co-optimizing network investment, reconfiguration, and third-party flexibility for congestion management in active distribution networks", International Journal of Electrical Power & Energy Systems, vol.172, pp.111094-1-111094-19, November, 2025.