

# TSO-DSO interface flow pricing: a bilevel study on efficiency and cost allocation

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## Abstract-

In the context of increasing distributed flexibility, enhanced TSO-DSO coordination is needed when procuring and activating flexibility. The literature shows that pricing the changes in the power flow over the TSO-DSO interfacing substation leads to optimal flexibility procurement cost in sequential TSO-DSO flexibility markets. This paper proposes a bilevel model, considering a TSO leader which sets interface flow prices freely, and DSO-followers in a Stackelberg game. This game-theoretical approach allows for the identification of regulatory risks and the testing of regulatory mechanisms. Based on two case studies, results show that, if left unregulated, the strategic TSO creates significant cost allocation distortions, creating unwanted financial transfers from DSOs to the TSO. However, when acting strategically, the TSO also activates (or leads to the activation of) economical flexibility providers, having as a reference the first-best option, namely the Common Coordination Scheme (CS). Leveraging on these results, a cap and floor mechanism is proposed, limiting unwanted cost allocation distortions and retaining incentives for efficient flexibility activations. Results showcase that a Fragmented CS with regulated interface flow prices could be an efficient second-best compared to the Common CS, outperforming other regulatory options found in the literature.

**Index Terms-** TSO-DSO coordination; Distributed flexibility; Bilevel optimisation; Interface flow pricing

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