

# **Market-based TSO–DSO coordination: a comprehensive theoretical market framework and lessons from real-world implementations**

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## **Abstract-**

**This paper introduces a theoretical market framework (TMF) for conceptualizing and designing electricity markets, integrating transmission system operator and distribution system operator (TSO&ndash;DSO) coordination mechanisms. The TMF represents a comprehensive tool that formalizes new, innovative market concepts and their impact on existing markets, and outlines fundamental categories and decisions essential to market design. This paper, through the TMF, addresses the integration challenges posed by new mechanisms for system services. Utilizing the TMF, the study maps 13 European demonstrators&rsquo; TSO&ndash;DSO coordination solutions, identifying real-world challenges in designing and implementing novel system services markets. Drawing on these real-world insights, the paper offers market design and policy recommendations to address and overcome the specific challenges in market-based TSO&ndash;DSO coordination.**

**Index Terms-** TSO–DSO coordination; real-world demonstrators; electricity market design; system services

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## **Citation:**

*Chaves, J.P.; Damas Silva, C.; Gerard, H.; Troncia, M.; Willeghems, G. "Market-based TSO–DSO coordination: a comprehensive theoretical market framework and lessons from real-world implementations", Energies, vol.16, no.19, pp.6939-1-6939-28, October, 2023.*