

# **The impact of bidding rules on electricity markets with intermittent renewables**

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**Abstract—** The cycling regime of thermal power plants significantly increases in the presence of intermittent renewables, increasing fuel and operation and maintenance costs from startups. Some regional electricity market operators adopt complex bidding mechanisms to account for nonconvex cost components that are not reflected in the marginal cost of energy, while other markets rely solely on simple bids with revenue sufficiency conditions. This paper compares the impacts of different bidding rules on wholesale prices and on the remuneration of units in power systems with a significant share of renewable generation. We distinguish the effects of bidding rules from the effects of regulatory uncertainty that can unexpectedly increase renewable generation by considering two distinct situations: 1) an "adapted" capacity mix, which is optimized for any given amount of renewable penetration, and 2) a "nonadapted" capacity mix, which is optimized for zero renewable penetration, but operated with different nonzero levels of renewables. We show that, although in the transitory state the impact on remuneration of having a nonadapted system dominates over the effect of the startup remuneration mechanisms explored, in equilibrium, bidding rules play an important role in making power plants whole while impacting on the cost borne by consumers.

**Index Terms—** Adaptation, bidding rules, electricity markets, renewables.

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