

# Long-term issues with the energy-only market design in the context of electricity decarbonization: Insights from a system dynamics simulation model

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## Abstract

Decarbonization of energy systems is challenging but needs to happen. Despite a rich literature on energy transitions and electricity markets, there is a scant literature analyzing (1) how an energy-only market (EOM) design may yield energy mix trajectories that are compatible with decarbonization objectives and (2) the role of underlying investor behavior assumptions. This paper intends to bridge this gap and illustrate both aspects through electricity market model simulations. We study an illustrative case inspired by the Californian power system and highlight two main findings. First, an EOM complemented with a carbon price signal can reproduce the optimal mix trajectory but required assumptions are demanding and unrealistic (e.g. perfect rationality, full information about fundamentals, perfect coordination between decommissioning and investment decisions). Second, we characterize how the EOM-induced mix trajectory can considerably deviate from optimality when we relax these assumptions. We conclude that the desirable theoretical properties of an EOM are not robust to practical investor behaviors. Meeting decarbonization targets thus calls for a change in market design paradigm toward hybrid markets that combine a dedicated long-term investment module with short-term wholesale markets as we know them today.

**Keywords:** Electricity Markets, System Dynamics, Energy-Only Market, Investments

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