Swati Gupta, Sandeep Chawda, Bharat Bhushan Sharma, Pawan Kumar Pathak, Vivek Prakash and Sachin Sharma, 2026, Risk-aware decision making for coordinated wind-storage system under severe price uncertainty, *Energy Reports,* 15 (2026) 109005.

Abstract Wind power producers (WPPs) face considerable profitability challenges in deregulated electricity markets due to the stochastic and volatile nature of wind generation and price signals. To address these challenges, this paper proposes a risk-aware decision-making framework that coordinates wind power generation with energy storage systems (ESS) for profit maximization under severe price uncertainty. The framework is built on information gap decision theory (IGDT), a non-probabilistic approach particularly suited for environments with limited historical data and unknown uncertainty distributions. A hybrid energy sale strategy is employed, wherein a portion of wind power is directly sold in the market while the remainder is stored and dispatched strategically according to prevailing market conditions. Three mathematical formulations are developed: (i) a deterministic model to establish baseline profits, (ii) a robustness model to quantify tolerance against adverse price deviations, and (iii) an opportuneness model to capture potential gains under favorable deviations. These models incorporate realistic operational constraints, including ESS dynamics, wind generation limits, and market bidding requirements. Case studies using real-world wind and price data demonstrate the efficacy of the proposed IGDT-based approach. The results reveal the trade-off between robustness and profitability, and the efficient frontiers generated provide strategic insights into decision-making under uncertainty. The robustness analysis showed that the system could tolerate profit reductions down to \$15,133.81 under adverse deviations, while the opportuneness model identified profit improvements up to \$46,777.22 in favorable scenarios. Overall, this study offers a comprehensive, risk-aware framework for enhancing the economic resilience of WPPs in competitive electricity markets.

Keywords Electricity markets, Energy storage, IGDT, Price risk, Uncertainty, Wind power producers.

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