

# **Multistage Robust Unit Commitment with Dynamic Uncertainty Sets and Energy Storage**

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## **Abstract**

The deep penetration of wind and solar power is a critical component of the future power grid. However, the intermittency and stochasticity of these renewable resources bring significant challenges to the reliable and economic operation of power systems. Motivated by these challenges, we present a multistage adaptive robust optimization model for the unit commitment (UC) problem, which models the sequential nature of the dispatch process and utilizes a new type of dynamic uncertainty sets to capture the temporal and spatial correlations of wind and solar power. The model also considers the operation of energy storage devices. We propose a simplified and effective affine policy for dispatch decisions, and develop an efficient algorithmic framework using a combination of constraint generation and duality-based reformulation with various improvements. Extensive computational experiments show that the proposed method can efficiently solve multistage robust UC problems on the Polish 2736-bus system under high dimensional uncertainty of 60 wind farms and 30 solar farms. The computational results also suggest that the proposed model leads to significant benefits in both costs and reliability over robust models with traditional uncertainty sets as well as deterministic models with reserve rules..

## **Keywords**

Robustness, Uncertainty, Computational modeling, Generators, Adaptation models, Optimization.