Wengang Chen, Xinrui Wang, RuiMin Tian, Yuze Ji, Helong Liu and Yafei Yuan, 2025, Coordinated optimization scheduling of wind, solar, hydro and methane power generation with adjustable methane, *Frontiers of Energy Research,* Section on Sustainable Energy Systems 19 March 2025, vo. 13. https://doi.org/10.3389/fenrg.2025.1563828

Abstract To enhance methane utilization in coal-rich regions and integrate methane power generation with distributed renewable energy systems, this study proposes a coordinated optimization dispatch model with adjustable methane-fired generation. The methodology first establishes a methane transmission model incorporating virtual storage characteristics based on coal mine power supply topology and extraction processes, then develops a multi-resource optimization framework integrating wind, solar, hydropower, and methane under distribution network constraints, equipment operation limits, and coal mine safety requirements. Through case studies in a Shanxi coal mine under multiple scenarios, the results validate the model's effectiveness in improving methane utilization and coordinating hybrid energy resources, with the proposed fuzzy-enhanced IGDT (F-EIGDT) method demonstrating enhanced robustness against source-load uncertainties compared to conventional approaches. The study confirms methane's dual role as fuel and virtual storage medium in mining-area power systems, providing a safety-constrained coordination paradigm for fossil-renewable integration, while suggesting the need for further optimization of long-term storage strategies.

\website\IGT\chen-etal2025abs.tex 21.3.2025