Energy Internet Load Optimization and Dispatch



Overview

The paper presents the key issues of optimal dispatch and offers an outlook on the future development trends, aiming to provide a reference for energy transition and sustainable development.

Key Takeaways

Energy Internet load optimization and dispatch leverage advanced forecasting, multi-objective optimization, and AI-driven control to efficiently manage distributed energy resources and renewable integration.

Overview

Energy Internet systems integrate multiple energy carriers, distributed energy resources (DERs), and renewable generation to create a flexible, low-carbon grid. Load optimization and dispatch aim to balance supply and demand, minimize operational costs, maximize renewable utilization, and ensure system stability. Key challenges include the intermittency of renewables, stochastic load demand, and coordination among diverse energy assets such as batteries, electric vehicles, and combined heat and power systems.

Optimization ApproachesMulti-Objective Optimization Models consider multiple objectives simultaneously, such as operating cost, renewable energy utilization, and revenue from storage and electric vehicles. Constraints include day-ahead demand forecasts, renewable generation predictions, and network power flow limits. Techniques like the min–max unification method reconcile conflicting objectives, enabling coordinated dispatch across DERs.

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Deep Reinforcement Learning (DRL) DRL algorithms, including Deep Q-Network (DQN) and Twin Delayed Deep Deterministic Policy Gradient (TD3), are applied to economic dispatch problems. These methods model the system as a Markov Decision Process (MDP), allowing adaptive control without explicit uncertainty modeling.

DR

L improves convergence speed, robustness, and economic efficiency under fluctuating renewable generation and load demand. Hybrid Forecasting and Dispatch Advanced architectures like LSTM-Transformer models provide multi-scale temporal-spatial load predictions, reducing forecasting errors. Coupled with scenario-based stochastic optimization, these models lower operational costs while maintaining stability.

Federated feature extraction and carbon-aware scheduling enhance scalability and interoperability with legacy infrastructure.

Practical Benefits

Cost Reduction: Optimized dispatch can reduce operational costs by over 10% in real-world grid scenarios. Renewable Integration: Improved forecasting and adaptive control increase the utilization of solar and wind energy. System Stability: Multi-objective and AI-driven approaches ensure voltage, frequency, and power flow constraints are respected.

Scalability: Distributed optimization frameworks allow coordination across microgrids, community energy systems, and large-scale grids.

Conclusion

Energy Internet load optimization and dispatch combine predictive analytics, multi-objective optimization, and AI-based control to manage complex, renewable-rich energy systems efficiently. By integrating forecasting, storage, and adaptive dispatch strategies, these approaches enhance economic performance, renewable utilization, and grid reliability, supporting the transition to sustainable and intelligent energy networks.

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The safety and stability of modern power systems are undergoing various challenges, introduced by the integration of fluctuating renewable generation. In this paper, we present a

Reinforcement Learning Based Energy Internet System Optimal Dispatch

However, the multi-timescale coordination of multiple coupled heterogeneous energy sources, the multi-subject game interaction of source-grid-load-storage, and the high-dimensional non-convexity of the

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