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Editorial: Advances in flexibility exploration and utilization for low carbon power systems

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Editorial on the Research Topic
Advances in flexibility exploration and utilization for low carbon power systems

Introduction

Aiming at the carbon neutrality mission worldwide, renewable energy becomes a critical focus in the low-carbon future. Integration of large-scale renewable energy leads to the profound changes of power systems, while intermittency and uncertainty become the new features and challenges of system operation. Therefore, a more flexible and intelligent system is expected, for the consumption of highly penetrated renewables.

In this context, flexible resources, no matter from the source side, the grid side, or the demand side, are significantly desired. Flexibility exploration and utilization are correspondingly becoming the research focuses of both academic and industrial fields. For supporting the realization of low-carbon power systems, the Research Topic of "*Advances in Flexibility Exploration and Utilization for Low Carbon Power Systems*" was launched in the journal Frontiers in Energy Research. Within the 6-month submission period, there are in total 16 manuscripts received and finally 5 articles accepted for publication after careful peer-to-peer review. The contributed articles cover both the device-level and system-level, which are summarized as below.

Device-level flexibility exploration and control

Zheng et al. designed three optimized strategies to improve the reliability of the three-level active neutral-point-clamped inverters under different load conditions, based on the proposed modulation strategies of both passive and active commutation modes. This work provided the technical basis for the flexibility exploration of inverters on grid side.

Yang et al. presented a multi-timescale disposal strategy for wind-integrated power systems, while the dynamic feature of electric vehicle charging station is thoroughly

modelled as flexible ramping capacity. By doing so, the disposal level of tight power balance problem is effectively promoted by demand side flexibility resources.

System-level flexibility coordination and optimization

Increasing flexibility resources ask for effective coordination in system level.

Wang et al. applied device-level-based digital twins to monitor physical signals for power tracking, and proposed a consensus control-based distributed power tracking system for power grid simulation. Furtherly assisted by the communication network, the computational efficiency was accelerated, in addition to the privacy protection of the regulation resources.

Wu et al. proposed a long short-term memory prediction-correction-based multi-timescale optimal control strategy for energy storage. By utilizing the optimized energy storage, the effect of peak shaving is improved, along with the increased operating income.

Zhang et al. established a refined model of the electrolyzer and hydrogen fuel cell, and then proposed an optimal scheduling model based on day-ahead long-time-scale optimization and intra-day model predictive control hierarchical rolling optimization. The work resulted in the realization of the optimal economic scheduling for the electro-hydrogen integrated energy systems.

Conclusion

In summary, this Research Topic collection covers the flexibility exploration and utilization from device-level to system-level, whose achievements have the potential to inspire the realization of a low carbon network. However, there are still many challenges and opportunities related to the flexible regulation in the green future, and more theories and technologies need to be further investigated.

Author contributions

YL: Writing–original draft. HZ: Writing–review and editing. YG: Writing–review and editing. TH: Writing–review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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