The substitutability of energy storage and thermal power peak regulation

Is there a trade-off between energy storage and peak regulation?
In the meantime,the trade-off between deploying energy storage and leveraging the deep peak regulation capacity of existing thermal generators remains to be explored.

What are the three stages of peak regulation of thermal power units?
According to the output characteristics of thermal power units during peak regulation operation, they can be divided into three stages: regular peak regulation (RPR), deep peak regulation with out oil (DPR) and deep peak regulation with oil (DPRO), as shown in Figure 1. Schematic diagram of thermal power unit peaking process.

What is the optimal energy storage allocation model in a thermal power plant?
On this basis, an optimal energy storage allocation model in a thermal power plant is proposed, which aims to maximize the total economic profits obtained from peak regulation and renewable energy utilization in the system simultaneously, while considering the operational constraints of energy storage and generation units.

How does peak regulation affect the operating state of thermal power units?
While at the phase of normal peak regulation,the operation cost increases as the power output increases. Therefore,for economic operation,the optimal operating state of thermal power units better be maintained near the lower limit of normal peak regulation. Fig. 3. Deep peak regulation cost of thermal units.

Can thermal power units meet the increasing demands of regulation?
However,restricted by the motion inertia and friction loss of mechanical equipment,the adjustment speed of thermal power units cannotmeet the increasing demands of regulation . Energy storage technology has gained significant attention over the years as a new resource for adjusting and solving the shortage of flexible resources [11,12].

Does a higher renewable penetration rate reduce thermal power units' operation cost?
This is because increasing the penetration of cost-free renewable generation decreases the operation cost of thermal power units,as shown in Fig. 16,Fig. 17,Fig. 18. However,with a higher renewable penetration rate,the total operation cost might increasedue to the penalty of renewable curtailment.

First, an energy storage lifespan degradation model based on equivalent cycle counts is constructed, along with a thermal power unit peak shaving cost model based on output fluctuations. Second, an optimized joint ...

Energy storage is one of the most effective solutions to address this issue. Under this background, this paper proposes a novel multi-objective optimization model to determine ...

2) When the virtual power plant combined with thermal power plants participates in intra-day peak regulation, the output power adjustment range of its internal energy storage devices is limited, the charging and ...

According to the energy flow direction, the CSP plant has two operating modes: load mode of peak regulation and power source of peak regulation. During the low-demand period, EH can convert the excess wind power into heat energy. The CSP plant is equivalent to a load. The CSP plant not only supplies electrical energy to the power grid but ...

However, the frequency regulation ability of battery energy storage system to substitute thermal power units has not yet been quantified. In this paper, it introduces two frequency regulation method models. In the proposed models, the influence of different energy storage participation degrees on the effect of frequency regulation is analyzed ...

This paper first analyzes the impact of wind power and photovoltaic negative peak regulation characteristics on regional power grid peak regulation, and then proposes a coordinated peak ...

As far as existing theoretical studies are concerned, studies on the single application of BESS in grid peak regulation [8] or frequency regulation [9] are relatively mature. The use of BESS to achieve energy balancing can reduce the peak-to-valley load difference and effectively relieve the peak regulation pressure of the grid [10].Lai et al. [11] proposed a ...

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First, an energy storage lifespan degradation model based on equivalent cycle counts is constructed, along with a thermal power unit peak shaving cost model based on output fluctuations. Second, an optimized joint operation model is developed.

This paper proposes to enhance the flexibility of renewable-penetrated power systems by coordinating energy storage deployment and deep peak regulation of existing thermal ...

This paper first analyzes the impact of wind power and photovoltaic negative peak regulation characteristics on regional power grid peak regulation, and then proposes a coordinated peak regulation control strategy based on multi-scale signal decomposition theory for energy storage and thermal power units, and verifies the effectiveness of the ...

Energy storage (ES) can mitigate the pressure of peak shaving and frequency regulation in power systems with high penetration of renewable energy (RE) caused by ...

Addressing renewable energy (RE) curtailment in power systems necessitates a comprehensive strategy

leveraging peak regulation resources from both the power and load sides. On the power side, deep peak shaving of thermal power plants can mitigate surplus electricity during periods of high RE production. On the load side, energy-intensive ...

BESS(battery energy storage system) is a kind of flexible and high-quality power grid regulation resources, which has fast output response ability and flexible configuration mode. It can significantly improve the peak load regulation ability of power grid by cooperating with conventional regulating power sources such as thermal power units, and ...

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A two-layer scheduling method of energy storage that considers the uncertainty of both source and load is proposed to coordinate thermal power with composite energy storage to participate in the peak regulation of power systems. Firstly, considering the characteristics of thermal power deep peak regulation, a cost model of thermal power deep peak regulation is ...

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