Republic of china energy storage for resilience

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In this work, the sustainable development status of China"s energy path was inspected better to understand key indications for energy transition and resilience. The goal was to understand some policy objectives and how the country measures relative to World top 35, other regions, and neighboring countries.

Reforming subsidies for water use, energy use in irrigation, and fertilizer production to support low-carbon land use in agriculture. Using eco-system compensation payments, developing an offset market and weather-related disaster risk insurance to encourage greater investment in carbon sinks and climate resilience.

This study explores the challenges and opportunities of China"s domestic and international roles in scaling up energy storage investments. China aims to increase its share of primary energy from renewable energy sources from 16.6% in 2021 to 25% by 2030, as outlined in the nationally determined contribution [1].

This study indicates that allowing up to 20% abated fossil fuel in China"s power generation system could reduce the power shortage rate by up to 9% in 2050, and increase system resilience...

Through the lens of scholarly discussion on law, resilience, and adaptive capacity, this article critically discusses the extent to which energy law and governance in China has been steered towards better resilience.

The line chart indicates the real-time power shortage under disasters (a snowstorms; c sandstorms; e droughts), and the bar chart shows the composition of the electricity consumption in a 3-hour cycle under disasters (b snowstorms; d sandstorms; f droughts). Note that b, d, f only show the electricity consumption under the optimal power system. The event times and intensities and the affected provinces are sourced from actual disasters in China, i.e., 14 January to 4 February 2008, for snowstorms, 15-17 March, 2021, for sandstorms, and 12-27 August 2022, for droughts.

Considering the vulnerability of variable renewable energy to weather variability (e.g., wind speed and irradiance), we measured the power system resilience to historical extreme climatic events by simulating and comparing the impacts of snowstorms, sandstorms, droughts, and heat waves on power shortages under power systems using zero-fossil fuel power generation and a high share of renewables combined with 16% abated fossil fuel power generation involving CCUS (i.e., the lowest-cost scenario). As shown in Fig. 4, both types of power systems are likely to be affected by these extreme climatic events, but the impact would be much less in the case of a high share of renewables combined with abated fossil power generation involving CCUS.

The hourly power output potential of onshore wind, offshore wind, solar PV, and stable nonfossil energy sources was projected separately. A downscaling approach based on real-time hourly climate information for recent decades was used to refine the provincial variable renewable output potential to the hourly scale. The specific prediction methods for each electricity supply source are described in Supplementary Note 1.

Referring to Fan et al.62, we developed a CCUS source-sink matching model based on a multiobjective optimization model with extended CO_2 emission sources from existing coal-fired power generation plants to existing coal- and gas-fired power plants. We also updated the storage site database in this study by expanding onshore storage sites to onshore and offshore storage sites. After source-sink matching, we obtained the distribution of power plants that could be prioritized for CCUS project retrofits and used this distribution to determine the maximum hourly generation potential in each province for different fossil fuel shares, with the data and assumptions referenced in Supplementary Note 2.

In this study, the electricity demand in 2050 was projected based on econometric models, accounting for different future socioeconomic development scenarios. Considering the future demand-side response (lowering the actual electricity demand) and capacity margin requirements (increasing the actual grid generation demand), a lower total demand scenario was chosen, suggesting that the demand response effect is greater than the capacity margin effect. Under this scenario, the total future electricity demand in China in 2050 would reach 14.53 trillion kWh, as expressed in Eq. (1).

In regard to annual provincial electricity demand prediction, a fixed-effects multiple regression model using the per-capita electricity consumption as the dependent variable was developed based on electricity consumption data for 30 Chinese provinces from 1995 to 2019. Then, the per-capita electricity demand in 2050 in each province was predicted according to the model estimations and the future projections of the independent variables. Combined with the future predicted population of China, the final projected electricity demand in 2050 in each province was further calculated. The econometric model is expressed in Eq. (2).