The complementarity of wind power and solar energy

The inherent complementarity of wind and solar energy resources is beneficial to smooth aggregate power and reduce ramp reserve capacity. This article proposes a progressive approach to assess the wind-solar complementarities in Shandong province, China for the preliminary planning of hybrid energy systems.

China is rich in wind- and solar-energy resources. In recent years, under the auspices of the "double carbon target," the government has significantly increased funding for the development of wind and solar ...

Our study also highlights the strong complementarity effects in an energy mix of hydropower, solar power and wind power across Europe, which is reflected in a negative or very low covariance on ...

Understanding the spatiotemporal complementarity of wind and solar power generation and their combined capability to meet the demand of electricity is a crucial step towards increasing their share in power systems without neglecting neither the security of supply nor the overall cost efficiency of the power system operation.

To face the challenge, here we present research about actionable strategies for wind and solar photovoltaic facilities deployment that exploit their complementarity in order to minimize the volatility of their combined production while guaranteeing a certain supply.

Then, the changes of wind and solar energy complementarity and net load fluctuation are predicted in the 2030s and 2060s under the SSP2-4.5 and SSP5-8.5 scenarios. Overall, climate change is anticipated to have a negative impact on the future complementarity of wind and solar energy. In the 2060s, on an hourly scale, the complementary characteristic ? P ...

The strong stochastic fluctuations of wind and solar power generation (Variable Renewable Energy, VREs) leads to significant challenges in securing generation-load balance for power systems with large shares of VREs [1, 2].Thanks to the regulation ability of hydropower and the complementarity between hydro-wind-solar multiple energy, the complementary operation ...

The effect of climate change on the complementarity between wind and solar photovoltaic power was assessed in North America for the near future (2025-2054) under the CMIP6 SSP2-4.5 and SSP5-8.5 future climate scenarios. The analysis was carried out using a CMIP6 multi-model ensemble that had been previously validated with the ERA5 ...

In this paper, we analyse literature data to understand the role of wind-solar complementarity in future energy systems by evaluating its impact on variable renewable energy penetration, corresponding curtailment, energy storage requirement and system reliability. Results show that wind-solar complementarity significantly

increases ...

Several studies have focused on investigating the exploitation of wind and solar PV power production complementarity to cope with VREs variability and reduce the flexibility requirements [12,14-16].

These authors have evaluated complementarity between wind, solar and hydropower generation by means of comparing fluctuations and ramp rates between individual power generation (IPG) and combined power generation (CPG). The method has been tested using a region in China as a case study, and their findings suggest that complementarity ...

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Complementarity can be improved by changing the ratio of solar and wind ...

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Analysis of literature data shows that wind-solar complementarity significantly increases grid penetration compared to stand-alone wind/solar systems without the need of energy storage, and was found to reduce ramping need ...

Complementarity can be improved by changing the ratio of solar and wind power. Complementarity between wind power, photovoltaic, and hydropower is of great importance for the optimal planning and operation of a combined power system.

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