

## SolarGrid Energy Solutions

# Power supply system wind and solar complementarity



## Overview

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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. How can a complementary development of wind and photovoltaic energy help?

The complementary development of wind and photovoltaic energy can enhance the integration of variable renewables into the future energy structure. It can be employed as a unified solution to address the discrepancy between the supply and demand of power within the power system .

Does spatial and temporal complementarity of wind and solar power match electricity demand?

Therefore, analyzing the spatial and temporal complementarity of wind and solar power and their matching characteristics with electricity demand is of great significance for constructing reliable and cost-effective high-proportion renewable energy systems.

How to assess complementarity of wind and solar power?

In these studies, correlation analysis (e.g., Pearson correlation coefficient and Kendall's correlation coefficient) and fluctuation characteristic measurements (e.g., standard deviation, slope rate, and range) are the primary methods used to assess the complementarity of wind and solar power.

Should wind and solar energy be integrated into power system planning & Operation?

Integrating the complementarity of wind and solar energy into power system planning and operation can facilitate the utilization of renewable energy and reduce the demand for power system flexibility [5, 6].

Do wind-wind and solar-solar power match electricity demand?

The temporal complementarity of wind-solar power, the spatial complementarity of wind-wind and solar-solar power between different provinces, and the matching characteristics of wind and solar power with electricity demand are revealed at annual and seasonal scales. The main conclusions are as follows.

How will wind and solar complementarity change in China?

The wind and solar complementarity in China is lower in the east and higher in the west. On an hourly scale, the complementary shows a downward trend, especially in central and eastern China. The peak-valley difference and fluctuation of net load demand will increase in China particularly under SSP5-8.5.

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### Exploiting wind-solar resource complementarity ...

Aug 21, 2020 · In this paper, we analyse literature data to understand the role of wind-solar complementarity in future energy systems by evaluating its impact ...

### A review on the complementarity between grid-connected solar and wind

Jun 1, 2020 · In power systems with a significant share of solar and wind power, it is crucial to study correlations between power sources to match consumers' requirements and optimize ...

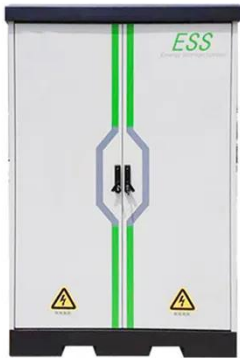


### Capacity planning for wind, solar, thermal and ...

Nov 28, 2024 · This article proposes a coupled electricity-carbon market and wind-solar-storage complementary hybrid power generation system model, ...

## A review on the complementarity between grid-connected solar and wind

oThe combined use of wind and solar power is crucial for large-scale grid integration.oReview of state-of-the-art approaches in the literature survey covers 41 papers.oThe paper proposes an ...

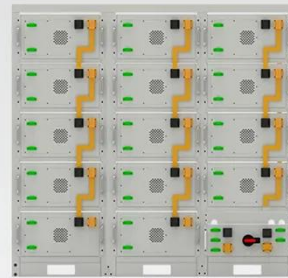


## A review on the complementarity of renewable energy sources...

Jan 1, 2020 · One of the commonly mentioned solutions to overcome the mismatch between demand and supply provided by renewable generation is a hybridization of two or more energy ...

## Variation-based complementarity assessment between wind and solar

Feb 15, 2023 · The complementarity between wind and solar resources is considered one of the factors that restrict the utilization of intermittent renewable power sources such as these, but ...



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## Analysis of offshore wind energy and solar photovoltaic ...

Jan 1, 2025 · This paper studies the



regional complementarity of offshore wind power (OWP) and inland solar PV technologies to satisfy the corresponding regional electric demand from 2016 ...

## Complementarity assessment of wind-solar ...

Jul 10, 2019 · Abstract The inherent complementarity of wind and solar energy resources is beneficial to smooth aggregate power and reduce ramp reserve ...



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## Wind and Solar Hybrid Power Plants for Energy Resilience

Aug 16, 2025 · Understanding where to build hybrids for resilience value, rather than bulk power supply, has not been fully explored in previous studies. Therefore, in this study, we complete a ...

## (PDF) Exploiting wind-solar resource

...

Aug 1, 2020 · In this paper, we analyse literature data to understand the role of wind-solar complementarity in future

energy systems by evaluating its impact

...

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## Geophysical constraints on the reliability of solar and wind power

Oct 22, 2021 · Here the authors find that solar and wind power resources can satisfy countries' electricity demand of between 72-91% of hours, but hundreds of hours of unmet demand may ...

## The impact of complementarity on power supply reliability ...

Oct 15, 2018 · The results indicate that both temporal complementarity (expressed as coefficient of correlation) and storage capacity has non-linear impact on the hybrid system capacity to ...

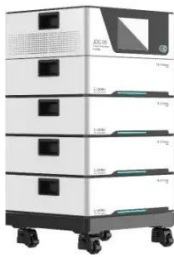
...



## A new solar-wind complementarity index: An application to ...

Jun 1, 2024 · Energy complementarity is a promising approach in the realm of renewable energy systems, enabling the

integration of multiple energy sources to achieve a stable and ...



## Temporal and spatial heterogeneity analysis of wind and solar power

Sep 1, 2024 · When evaluating source-source complementarity (i.e., the temporal complementarity of wind-solar power and the spatial complementarity of wind-wind power or ...



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## Assessing the complementarity of future hybrid wind and solar

Mar 1, 2023 · A multi-model ensemble of 10 global climate models from the CMIP6 project was used to analyze the complementarity between wind and solar photovoltaic power in North ...

## On the spatiotemporal variability and potential of complementarity ...

Aug 15, 2020 · Germany's low complementarity potential reinforces the need to systematically advance other options for mitigating the individual

volatilities of wind and solar such as energy ...

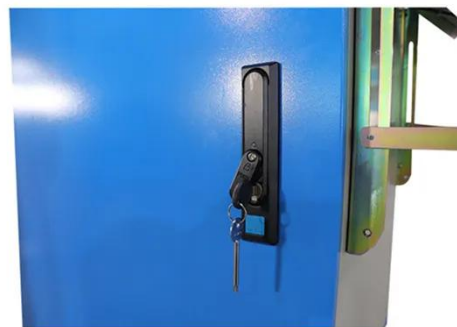


### **Integration of hybrid renewable energy sources ...**

Oct 19, 2023 · The results confirms that the one-month scale is the most effective time scale for using wind-solar complementation from negative correlation ...

### **Wind-solar technological, spatial and temporal ...**

Apr 1, 2024 · This allows us to identify and quantify benefits in three dimensions: spatial (across countries), temporal (at different timescales) and technological (solar, onshore and offshore ...



### **Assessing the impact of climate change on the optimal solar-wind ...**

Apr 1, 2025 · This study used global climate models to evaluate the impact of climate change on the complementarity,

stability, and hybrid power generation potential of wind and solar energy ...



## Investigating the Complementarity Characteristics of Wind and Solar

Dec 1, 2021 · This study explores the potential of renewable power to meet the load demand in China. The complementarity for load matching (LM-complementarity) is defined firstly. ...



## Solar power supply system with wind and solar complementarity

Do primary wind and solar resources complement the demand for electricity? Couto and Estanqueiro have proposed a method to explore the complementarity of primary wind and ...

## Exploring Wind and Solar PV Generation Complementarity ...

Aug 10, 2020 · The method is applied to a Portuguese case study and results show that coupled scenarios based on the strategic combined development of

wind and solar generation provide ...



12 V 10 AH



## **(PDF) Exploiting wind-solar resource ...**

Aug 1, 2020 · Results show that wind-solar complementarity significantly increases grid penetration compared to stand-alone wind/solar systems ...

## **Exploiting wind-solar resource complementarity ...**

Aug 21, 2020 · Resource complementarity carries significant benefit to the power grid due to its smoothing effect on variable renewable resource output. In this ...



## **Globally interconnected solar-wind system addresses future ...**

May 15, 2025 · Accelerating energy transition towards renewables is central to net-zero emissions. However, building a global power system dominated by



solar and wind energy ...

## Exploring Wind and Solar PV Generation ...

Aug 10, 2020 · Understanding the spatiotemporal complementarity of wind and solar power generation and their combined capability to meet the demand of ...



## A novel metric for evaluating hydro-wind-solar energy complementarity

Nov 1, 2024 · The strong stochastic fluctuations of wind and solar power generation (Variable Renewable Energy, VREs) leads to significant challenges in securing generation-load balance ...

## Optimizing the design of stand-alone hybrid renewable energy systems

This study analyzes the impact of temporal complementarity between wind and solar sources on the optimal design

of stand-alone hybrid renewable energy systems with storage (HRES).



## Review of mapping analysis and complementarity between solar and wind

Nov 15, 2023 · The analysis of GDAS wind speed and solar radiation has proved to be an essential source of information, allowing the identification of promising areas for the ...

## Temporal and spatial heterogeneity analysis of wind and solar power

Sep 1, 2024 · Establishing new electrical power systems dominated by renewable energy is a key measure to ensure that China achieves its carbon peak and carbon neutrality goals as ...



## An in-depth study of the principles and technologies of ...

technologies that combine wind and solar energy, are particularly important because they improve the stability and

efficiency of energy supply. Through the analysis of technological innovation ...



## Optimizing wind-solar hybrid power plant configurations by ...

Jan 3, 2025 · The intermittent nature of wind and solar sources poses a complex challenge to grid operators in forecasting electrical energy production. Numerous studies have shown that the ...



## The wind-solar hybrid energy could serve as a stable power ...

Oct 1, 2024 · In addition, the authors found that the complementary strength between wind and solar power could be enhanced by adjusting their proportions. This study highlights that hybrid ...

## Investigating the Complementarity Characteristics of Wind and Solar

Dec 1, 2021 · Abstract: This study explores the potential of renewable power to meet the load demand in China. The complementarity for load

matching (LM-complementarity) is defined ...

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## Complementary potential of wind-solar-hydro power in ...

Sep 1, 2023 · The temporal potential of wind-solar-hydro power varies greatly, with daily potential is more volatile than monthly. Seasonal and spatial heterogeneity of the complemental ...

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