

The Water-Energy Nexus and Droughts in Germany's Rivers

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Extended Abstract

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Abstract Summary

This study examines the impact of drought-induced hydrological constraints on electricity generation and resource adequacy in Germany. With climate change increasing the frequency and severity of droughts, water availability becomes a critical factor for energy systems, as thermal power plants depend on river water for cooling and fuel transport. Despite this, such interactions are often neglected in energy system modelling, where thermal plants are typically assumed to be fully available.

Focusing on thermal power plants along the Rhine, this study combines plant-level production and unavailability data with hydrological indicators, including water level, temperature, and drought conditions. A stepwise empirical approach is applied, starting with descriptive analysis and cross-correlation, followed by panel data fixed-effects regression to quantify the relationship between hydrological conditions and plant performance. The estimated effects are then integrated into a resource adequacy model to assess their implications for energy security in Germany.