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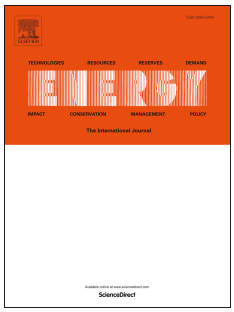

The increasing impact of weather on electricity supply and demand

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The increasing impact of weather on electricity supply and demand

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Abstract

Wind and solar power have experienced rapid cost declines and are being deployed at scale. However, their output variability remains a key problem for managing electricity systems, and the implications of multi-day to multi-year variability are still poorly understood. As other energy-using sectors are electrified, the shape and variability of electricity demand will also change. We develop an open framework for quantifying the impacts of weather on electricity supply and demand using the Renewables.ninja and DESSTINEE models. We demonstrate this using a case study of Britain using National Grid's Two Degrees scenario forwards to 2030.

We find the British electricity system is rapidly moving into unprecedented territory, with peak demand rising above 70 GW due to electric heating, and intermittent renewable output exceeding demand as early as 2021. Hourly ramp-rates widen by 50% and year-to-year variability increases by 80%, showing why future power system studies must consider multiple years of data, and the influence of weather on both supply and demand. Our framework is globally applicable, and allows detailed scenarios of hourly electricity supply and demand to be explored using only limited input data such as annual quantities from government scenarios or broader energy systems models.

Keywords: electricity; renewables; wind; solar; demand; weather variability

Highlights:

- Electricity supply and demand are becoming increasingly weather-dependent
- We demonstrate a globally-applicable framework using high-resolution open-source data
- Britain could expect dramatic changes to its electricity system in the near-term future
- 2030 sees net negative demand days while nuclear baseload is severely squeezed
- Heat electrification could see peak demand increase by 20% in 15 years