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Towards Harmonised Availability Modelling of Power Plants in Resource Adequacy Assessments: A Stochastic Framework and Insights from a European Case Study

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Extended Abstract

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Abstract Summary

As power systems integrate more weather dependent renewables and energy limited resources such as storage, hydro and demand response, they show stronger temporal and spatial dependency structures in available resource capacity. Adequacy concerns are increasingly driven by system wide weather patterns and other correlated events that resource adequacy assessments (RAAs) must capture to remain informative for security-of-supply policies. RAAs evaluate the ability of a power system to reliably meet projected electricity demand under uncertainty. A central but scarcely harmonized component of these analyses is the modelling of thermal generator availability. Current practice ranges from simple forced outage rate based representations to duration based stochastic models, yet these choices are rarely justified within a common framework. While studies usually report which availability models they use, the rationale for these choices is rarely discussed systematically, and modelling practices differ substantially across studies, raising questions about the robustness and comparability of adequacy results.

This paper proposes a methodological framework to structure and assess availability models in RAAs. We classify availability models as stochastic processes along five dimensions: state representation, temporal dynamics, dependence structure across units, treatment of planned outages, and aggregation level. In addition, we distinguish between methods to compute adequacy metrics, namely analytical and Monte Carlo approaches. Using a pan European case study, we run a series of experiments in which all system inputs are held constant while only the availability model is varied. We quantify how adequacy metrics such as Loss of Load Expectation and Expected Energy not Served, as well as the temporal structure and severity of scarcity events, change across models. Preliminary results indicate that different availability models can lead to differences in adequacy metrics and scarcity patterns. The framework provides a structured basis to understand these sensitivities and to make availability related modelling choices in RAAs more transparent.

Presenting Author Biography

Marius Tillmanns studied Business Administration and Mechanical Engineering at RWTH Aachen University, including semesters abroad at Norges teknisk-naturvitenskapelige universitet (NTNU) Trondheim, Norway, and the University of Waterloo, Canada. He received his B.Sc. in 2016 and M.Sc. in 2020. Since June 2021, he has been a research associate and doctoral candidate at the Chair for Energy System Economics, E.ON Energy Research Center, RWTH Aachen University, and since October 2024 he has worked as Chief Engineer. His research focuses on security of electricity supply in interconnected, sector-coupled large-scale power systems, energy system optimisation, and modelling of electricity markets and decentralised flexibility resources.