THE SYSTEM-VALUE OF COMPETING ENERGY STORAGE

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Overview

Energy storage can play a crucial role in decarbonising power systems by balancing power and energy in time. Wider power system benefits that arise from these balancing technologies include lower grid expansion, renewable curtailment, and average electricity costs. However, with the proliferation of new energy storage technologies, it becomes increasingly difficult to identify which technologies are economically viable and how to design and integrate them effectively. Traditional methods to quantify the system-value of energy storage cannot assess multiple energy storage simultaneously. We explore two unanswered questions: how significant is the system-benefit from optimizing energy storage with competition compared to without and which energy storage is optimization relevant considering uncertainty.

Method

We assess multiple energy storage with a systematic deployment analysis, also addressing uncertainty. In total, we assess the system-value of 20 energy storage with and without competition across 40 distinct scenarios for a representative future power system in Africa. We use an open energy system model with global coverage that is suitable for investment and operational co-optimization, including grid infrastructure and detailed operating decision and constraints. Further, we apply this model to its already validated Nigerian power system, configure it with high temporal resolution (8760h) and a spatial interconnected 10 node system to represent the underlying grid and environmental information within the simplification. Within this model, we integrate for the first time 20 storage technologies, which data we collected and expanded from Pacific Northwest National Laboratory (PNNL).

Results

Through the comprehensive scenario tree, we finds that, apart from lithium and hydrogen, only seven energy storage are optimization-relevant technologies in the given region. The work also discovers that a heterogeneous storage design can increase power system benefits and that some energy storage are more important than others. Finally, in contrast to traditional methods that only consider single energy storage, we find that optimizing multiple energy storage options tends to significantly reduce total system costs by up to 29%.

Conclusion

The presented research findings have the potential to inform decision-making processes for the sizing, integration, and deployment of energy storage systems in decarbonized power systems, contributing to a paradigm shift in scientific methodology from single to multiple energy storage optimization based system-value assessment methods and advancing efforts towards a sustainable future.

References

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