The Value of Seasonal Energy Storage Technologies for the Integration of Wind and Solar Power

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Supplementary information:

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1 Location of the power system

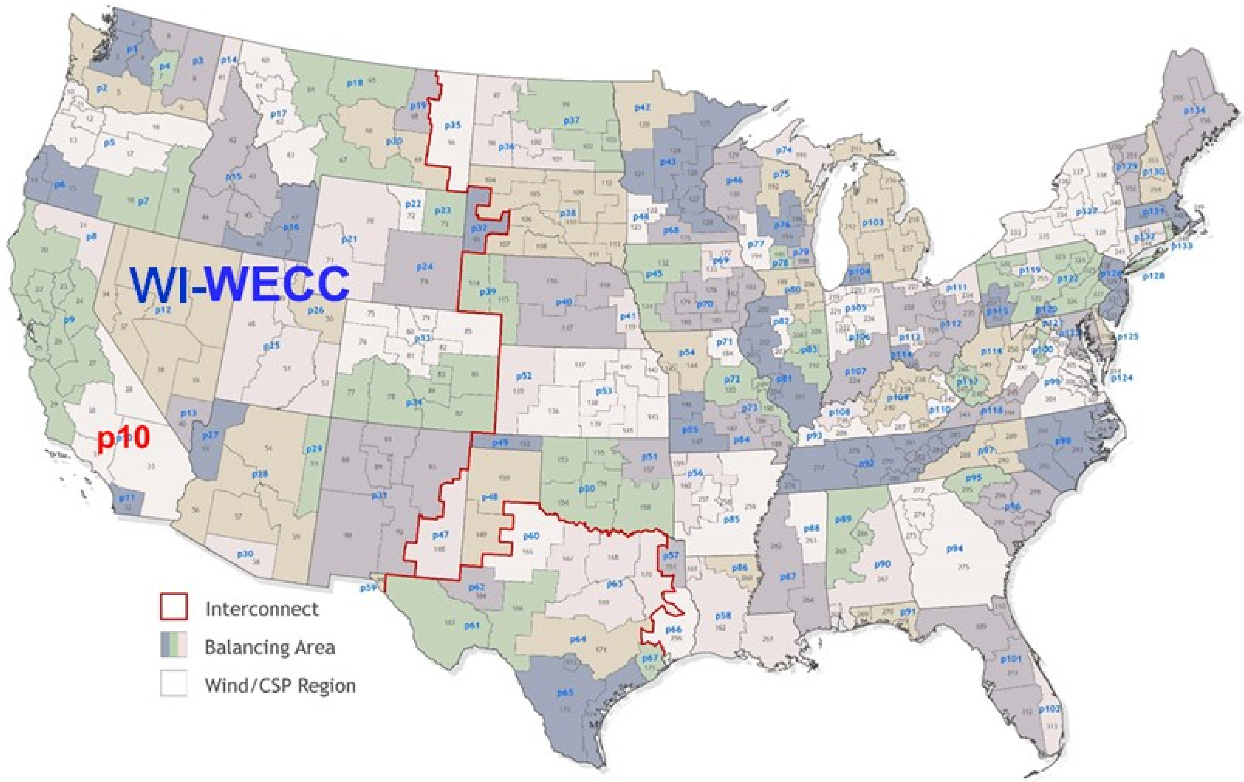

Fig. 1: Geographic location of the Western Interconnection (WI) power system, based on the capacity planning model Regional Energy Deployment System (ReEDS)[1,2]. The Western Electricity Coordinating Council (WECC) provides reliability support for the Western Interconnection. Region p10 corresponds to Southern California Edison (SCE) territory.

2 Optimal dispatch of the storage devices and impacts on locational marginal prices (LMPs)

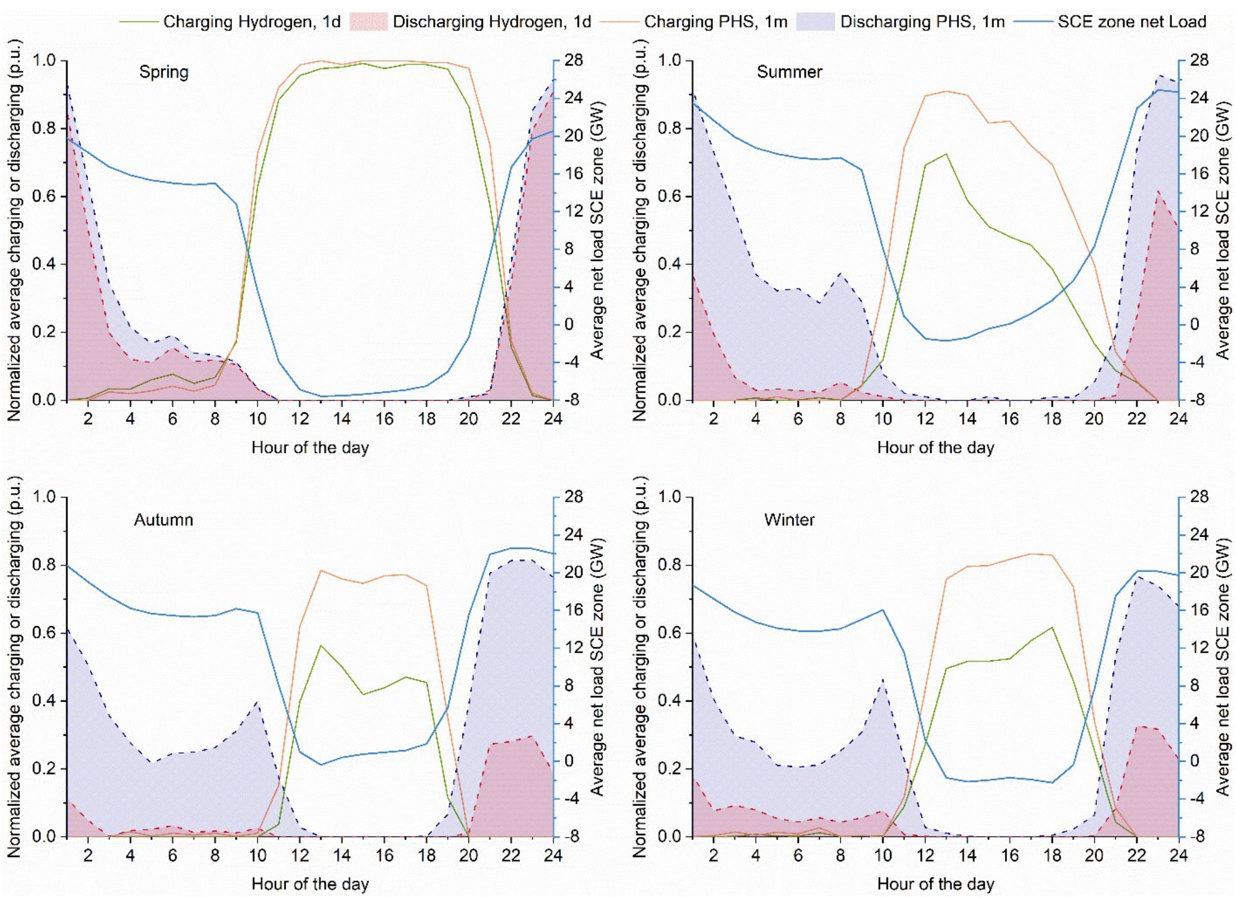

Fig. 2: Optimal dispatch of the seasonal storage devices in 2050. PHS = pumped hydro storage. The terms 1d and 1m denote 1 day and 1 month of storage discharge duration, respectively. The average charging/discarding power was normalized based on the power capacity of the storage devices, i.e., 2 GW.

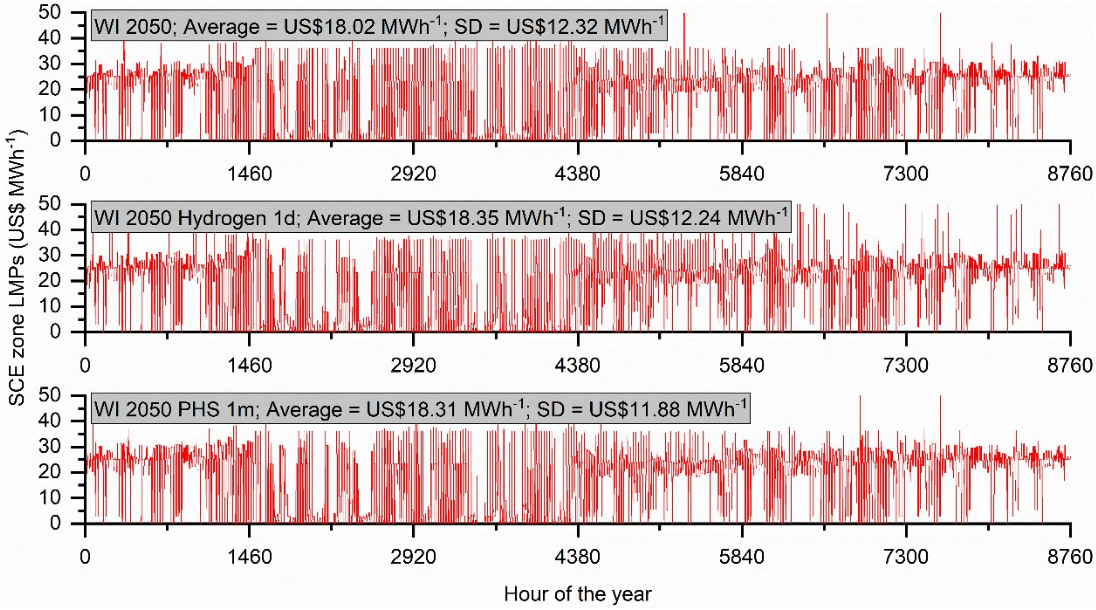

Fig. 3: Impacts of the seasonal storage devices on the LMPs at Southern California Edison zone for the Western Interconnection 2050 power system configuration. SD = standard deviation of the annual LMP time series.

3 System value and sensitivities for seasonal energy storage

3.1 Operational value and capacity value

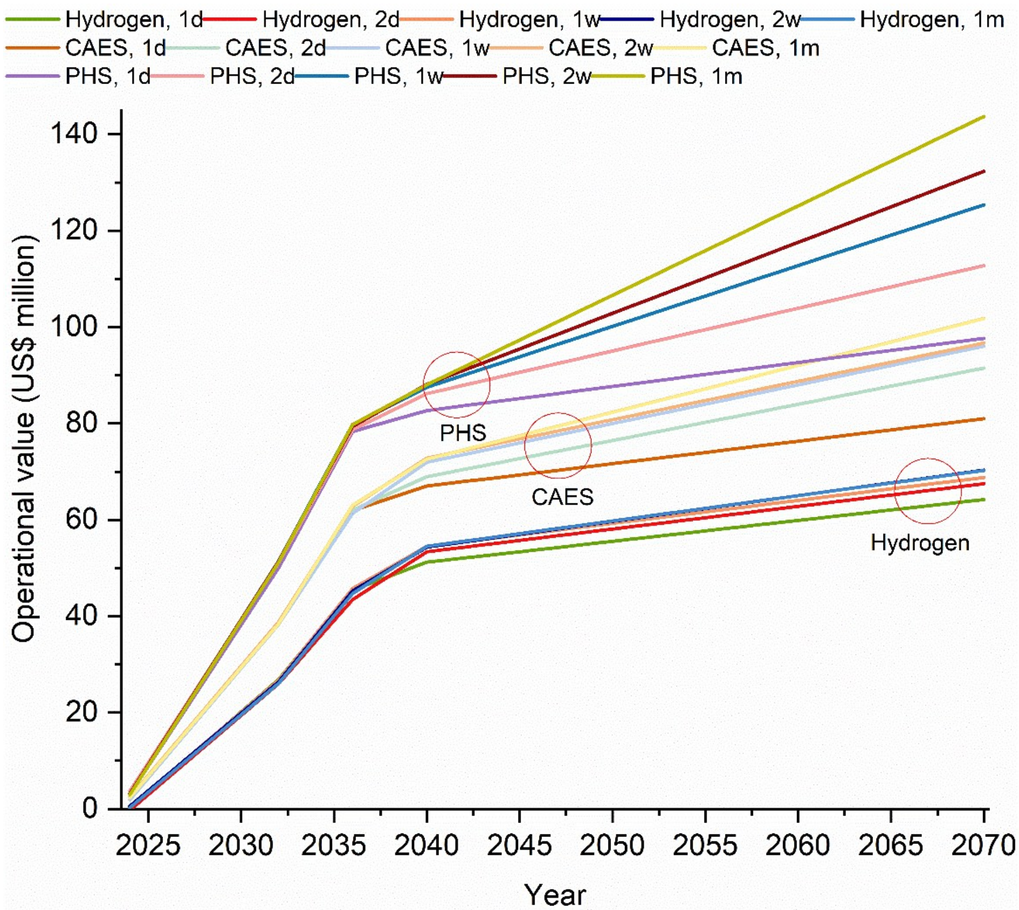

Fig. 4: Projected operational value for the 2024–2070 time frame.

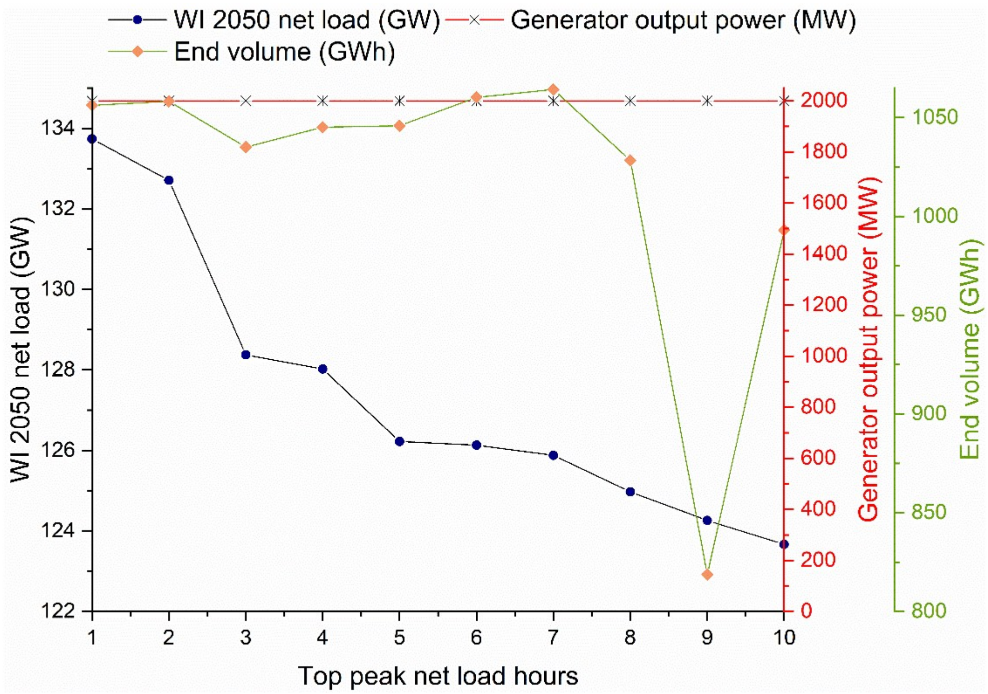

Fig. 5: WI 2050 top 10 peak net load hour versus the operation of the seasonal storage device (PHS, 1 month of discharge duration).

3.2 Sensitivities for seasonal storage

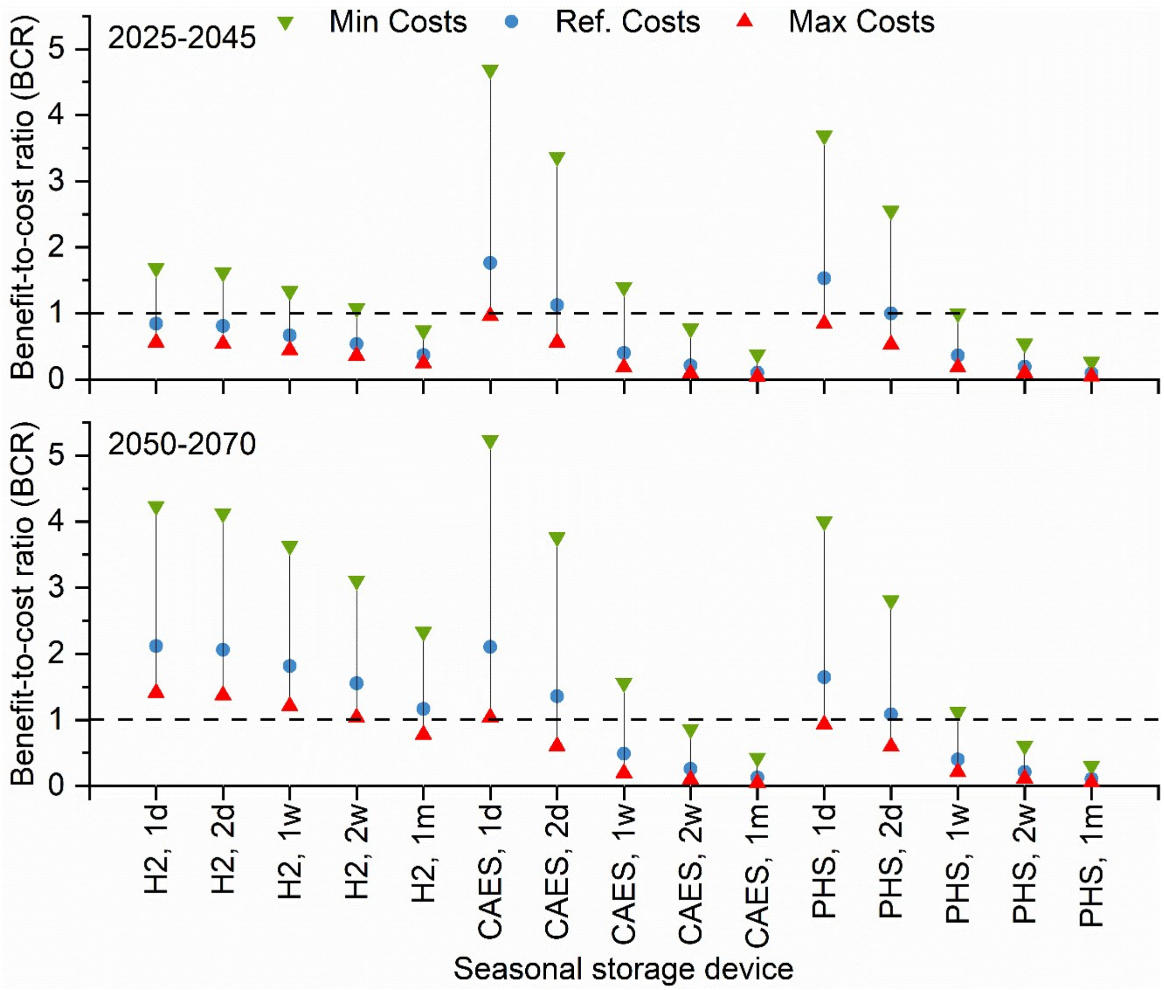

Fig. 6: Benefit-to-cost ratio for seasonal storage technologies. Time frames 2025–2045 (top panel) and 2050–2070 (bottom panel). H2 denotes hydrogen storage. Assuming avoided capacity cost of peaking generators at US$250 per kW-year.

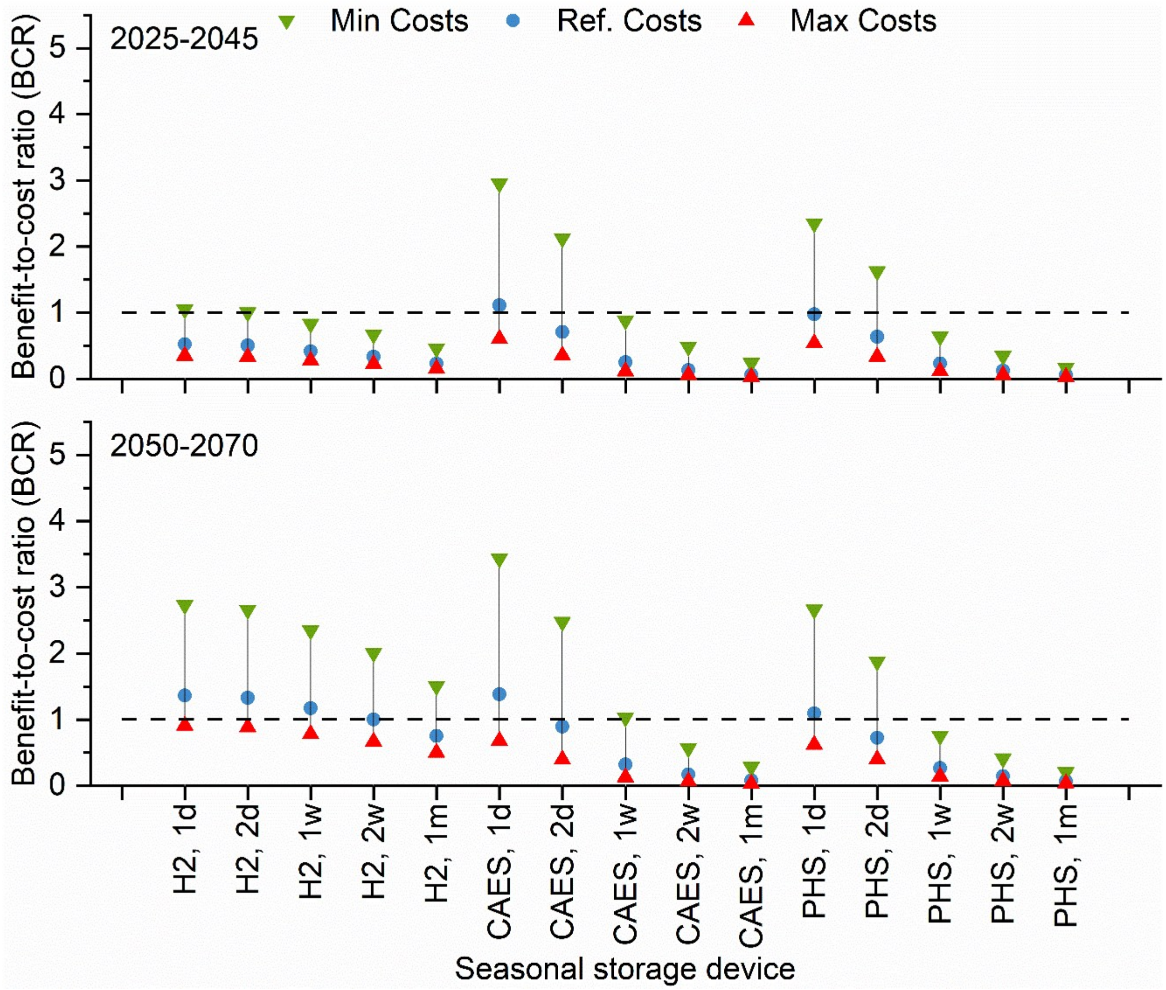

Fig. 7: Benefit-to-cost ratio for seasonal storage technologies. Time frames 2025–2045 (top panel) and 2050–2070 (bottom panel). H2 denotes hydrogen storage. Assuming avoided capacity cost of peaking generators at US$150 per kW-year.

References

1. Short, W. *et al. Regional Energy Deployment System (ReEDS)*. *National Renewable Energy Laboratory (NREL)* (2011). doi:10.2172/1031955

2. Cohen, S. M. *et al. Regional Energy Deployment System (ReEDS) Model Documentation: Version 2018*. *National Renewable Energy Laboratory (NREL)* (2019). doi:10.2172/1505935