Underestimated climate change impacts on hydro-wind-photovoltaic complementary power systems

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Abstract: Hydro-wind-photovoltaic (PV) complementary power system (HWPCS) offers a promising solution for integrating intermittent wind and PV power. The regulation ability of reservoirs and the flexibility of hydro units can be used to complement wind and PV power, resulting in changes in the traditional operating patterns of hydropower stations (Cheng et al. 2023).

The energy production and reliability of a HWPCS are susceptible to climate change impacts. It is crucial to consider short-term operating patterns (e.g., variations in hydropower efficiency and intraday curtailment characteristics) in the long-term HWPCS operation for achieving more accurate simulations. However, current long-term evaluations of HWPCSs under climate change normally neglect these short-term operating patterns, which may lead to misestimations of climate change impacts.

This study proposes a generic framework to quantify the misestimation of climate change impacts on a HWPCS due to the neglect of short-term operating patterns. The variations in hydropower efficiency and the short-term power curtailment patterns are extracted by the *K-H* relationship and the piecewise power curtailment function, respectively. These extracted short-term operating patterns are then incorporated into a long-term operation model to simulate future operating results.

Results of a case study in the Yalong River Basin (China) validate that considering short-term operating patterns can effectively increase the accuracy of calculating long-term HWPCS power generation. Neglecting short-term operating patterns causes over-optimistic evaluations of future HWPCS performance. Specifically, the future HWPCS power generation and guaranteed rate are overestimated by an average of 1.02% and 1.09%, respectively, whereas the future power curtailment rate is underestimated by an average of 4.01%.

This study emphasizes the necessity of considering short-term operating patterns in long-term evaluations of HWPCSs. The proposed framework contributes valuable insights for the long-term operation and evaluation of HWPCSs under climate change.

REFERENCES

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