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Entropy, pricing and productivity of pumped-storage

Georgios Karakatsanis (1,2), Hristos Tyralis (1), and Katerina Tzouka (1)

(1) National Technical University of Athens (NTUA), Greece (georgios@itia.ntua.gr), (2) Technische Universität München (TUM), Germany (georgios.karatsanis@tum.de)

Pumped-storage constitutes today a mature method of bulk electricity storage in the form of hydropower. This bulk electricity storability upgrades the economic value of hydropower as it may mitigate –or even neutralize- stochastic effects deriving from various geophysical and socioeconomic factors, which produce numerous load balance inefficiencies due to increased uncertainty. Pumped-storage further holds a key role for unifying intermittent renewable (i.e. wind, solar) units with controllable non-renewable (i.e. nuclear, coal) fuel electricity generation plants into integrated energy systems. We develop a set of indicators for the measurement of performance of pumped-storage, in terms of the latter's energy and financial contribution to the energy system. More specifically, we use the concept of entropy in order to examine: (1) the statistical features -and correlations- of the energy system's intermittent components and (2) the statistical features of electricity demand prediction deviations. In this way, the macroeconomics of pumped-storage emerges naturally from its statistical features (Karakatsanis et al. 2014). In addition, these findings are combined to actual daily loads. Hence, not only the amount of energy harvested from the pumped-storage component is expected to be important, but the harvesting time as well, as the intraday price of electricity varies significantly. Additionally, the structure of the pumped-storage market proves to be a significant factor as well for the system's energy and financial performance (Paine et al. 2014). According to the above, we aim at postulating a set of general rules on the productivity of pumped-storage for (integrated) energy systems.

Keywords: pumped-storage, storability, economic value of hydropower, stochastic effects, uncertainty, energy systems, entropy, intraday electricity price, productivity

References

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