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Entropy, pricing and macroeconomics of pumped-storage systems

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We propose a pricing scheme for the enhancement of macroeconomic performance of pumped-storage systems, based on the statistical properties of both geophysical and economic variables. The main argument consists in the need of a context of economic values concerning the hub energy resource; defined as the resource that comprises the reference energy currency for all involved renewable energy sources (RES) and discounts all related uncertainty. In the case of pumped-storage systems the hub resource is the reservoir's water, as a benchmark for all connected intermittent RES. The uncertainty of all involved natural and economic processes is statistically quantifiable by entropy. It is the relation between the entropies of all involved RES that shapes the macroeconomic state of the integrated pumped-storage system. Consequently, there must be consideration on the entropy of wind, solar and precipitation patterns, as well as on the entropy of economic processes –such as demand preferences on either current energy use or storage for future availability. For pumped-storage macroeconomics, a price on the reservoir's capacity scarcity should also be imposed in order to shape a pricing field with upper and lower limits for the long-term stability of the pricing range and positive net energy benefits, which is the primary issue of the generalized deployment of pumped-storage technology.

Keywords: Entropy, uncertainty, pricing, hub energy resource, RES, energy storage, capacity scarcity, macroeconomics