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The Future of Hydropower: Assessing the Impacts of Climate Change, Energy Prices and New Storage Technologies

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The future of hydropower depends on various drivers, and in particular on climate change, electricity market evolution and innovation in new storage technologies. Their impacts on the power plants' profitability can widely differ in regards of scale, timing, and probability of occurrence. In this respect, the risk should not be expressed only in terms of expected revenue, but also of uncertainty. These two aspects must be considered to assess the future of hydropower.

This presentation discusses the impacts of climate change, electricity market volatility and competing energy storage's technologies and quantifies them in terms of annual revenue. Our simulations integrate a glacio-hydrological model (GERM) with various electricity market data and models (mean reversion and jump diffusion). The medium (2020-50) and long-term (2070-2100) are considered thanks to various greenhouse gas scenarios (A1B, A2 and RCP3PD) and the stochastic approach for the electricity prices. An algorithm named "threshold acceptance" is used to optimize the reservoir operations. The impacts' scale, and the related uncertainties are presented for Mauvoisin, which is a storage-hydropower plant situated in the Swiss Alps, and two generic pure pumped-storage installations, which are assessed with the prices of 17 European electricity markets. The discussion will highlight the key differences between the impacts brought about by the drivers.