



## **Complementing hydropower with PV and wind: optimal energy mix in a fully renewable Switzerland**

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Like several other countries, Switzerland plans to phase out its nuclear power production and will replace most or all of it by renewables. Switzerland has the chance to benefit from a large hydropower potential and has already exploited almost all of it. Currently about 60% of the Swiss electricity consumption is covered by hydropower, which will eventually leave a gap of about 40% to the other renewables mainly composed of photovoltaics (PV) and wind. With its high flexibility, storage hydropower will play a major role in the future energy mix, providing valuable power and energy balance. Our work focuses on the interplay between PV, wind and storage hydropower, to analyze the dynamics of this complex system and to identify the best PV-wind mixing ratio. Given the current electricity consumption and the currently installed pumping capacity of the storage hydropower plants, it appears that the Swiss hydropower system can completely alleviate the intermittency of PV and wind. However, some seasonal mismatch between production and demand will remain, but we show that oversizing the production from PV and wind or enlarging the reservoir capacity can be a solution to keep it to an acceptable level or even eliminate it. We found that PV, wind and hydropower performs the best together when the share of PV in the solar - wind mix is between 20 and 60%. These findings are quantitatively specific for Switzerland but qualitatively transferable to similar mountainous environments with abundant hydropower resources.