Title: A process integration approach for design of hybrid power systems with energy storage

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Abstract: Selection of energy storage technology in hybrid power systems (HPS) is vital due to the unique advantages and capabilities offered by different storage technologies. For an optimal operation, the efficient and economical storage system for an HPS should be selected. This work introduces a new systematic generic framework to determine the most cost-effective storage technology for an HPS. A Power Pinch Analysis tool called the AC/DC modified storage cascade table has been developed to optimise the HPS by considering various storage technologies. The economics of the various types of storage modes was analysed, taking into account the associated energy losses, among others. The method was applied to two case studies with different power trends to evaluate the effect of storage efficiencies and storage form on the performance of HPS. A superconducting magnetic storage system of 26.12 kWh capacity, that gives an investment payback period of 3.6 years, is the most cost-effective storage technology for the small-scale household system in Case Study 1. For the large-scale industrial application presented in Case Study 2, the Lead-Acid battery with a capacity of 15.38 MWh gives the lowest payback period (1.43 years).