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An integrated water-energy simulation and multi-objective optimisation framework

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Historically, water and energy systems infrastructure planning and operation have been undertaken in isolation or with limited coupling. These approaches do not adequately recognize the complex interrelations between these systems, and using them introduces a risk of deploying inefficient planning and operational interventions. This risk will become more pronounced in the coming decades due to increasing pressures on water and energy resources, and opportunities could be lost regarding the integration of renewable energy sources. In this work, we present a new generalised and integrated system simulation and multi-objective optimisation framework that simulates water-energy interactions, and links the simulators to multi-objective evolutionary algorithms (MOEAs). The framework is generic and can be used to undertake planning level optimisation of interventions of integrated water and energy systems. The framework is applied to a synthetic case study that incorporates multidimensional interrelations among water and energy systems, exploring different trade-offs between water and energy system users. Results show the approach is capable of tackling complex links between both systems and guide decisions such that they consider the whole integrated system's performance.