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Capacity expansion of supply-demand water resource systems under different regulatory drivers

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Capacity expansion models optimise the schedule of upgrading or expanding infrastructure so that future supplies can meet demand. What to build, when and at what size (capacity) are the basic questions posed. Optimal expansion of supply-demand networks is a classical systems analysis problem. Traditionally single objective cost minimization formulations use mixed integer linear programs (MILP) to solve for spatially and temporally aggregated planning problems that are computationally tractable. The optimisation formulation means regulatory drivers can be represented and their influence on infrastructure development decisions assessed. But embedding regulatory structures and drivers is not easy in a brittle math programming framework so this remain a challenge as shown in the presentation. New methods using multi-objective global search can embed detailed quasi-operational models that allow a new level of detail and complexity into capacity expansion planning. This paper compares several MILP formulations with a multi-objective evolutionary formulation on the expansion of the UK's Thames basin conjunctive use water management system. The system considers new supplies using desalination, conjunctive use artificial recharge schemes, a transfer scheme or a new large surface water reservoir. How supply planning decision drivers are represented and the limitations of both supply-demand infrastructure optimisation frameworks are discussed.