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Addressing water resources risk in England and Wales: Long term infrastructure planning in a private, regulated industry

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Water resources planning is a complex and challenging discipline in which decision makers must deal with conflicting objectives, contested socio-economic values and vast uncertainties, including long term hydrological variability. The task is arguably more demanding in England and Wales, where private water companies must adhere to a rigid set of regulatory planning guidelines in order to justify new infrastructural investments. These guidelines prescribe a “capacity expansion” approach to planning: ensure that a deterministic measure of supply, known as "Deployable Output," meets projected demand over a 25-year planning horizon. Deployable Output is derived using a method akin to yield analysis and is commensurate with the maximum rate of supply that a water resources system can sustain without incurring failure under a simulation of historical recorded hydrological conditions. This study examines whether Deployable Output analysis is fit to serve an industry in which: water companies are seeking to invest in cross-company water transfer schemes to deal with loss of water availability brought about by European environmental legislation and an increase in demand driven by population growth; water companies are expected address potential climate change impacts through their planning activities; and regulators wish to benchmark water resource system performance across the separate companies. Of particular interest, then, is the adequacy of Deployable Output analysis as a means to measuring current and future water shortage risk and comparing across supply systems.

Data from the UK National River Flow Archive are used to develop a series of hypothetical reservoir systems in two hydrologically contrasting regions—northwest England/north Wales and Southeast England. The systems are varied by adjusting the draft ratio (ratio of target annual demand to mean annual inflow), the inflow diversity (covariance of streamflow sequences supplying the system), the strength of interconnectivity in the system (water transfer capability as proportion of demand), and the proportion of the target demand that can be drafted from climate-independent supply sources (such as plentiful groundwater supplies or desalination). The reservoir capacities are then adjusted such that all systems are perfectly and equally balanced under current design standards (Deployable Output equals demand) before being subjected to comprehensive reliability, resilience, vulnerability analysis using stochastically-derived replicates of the inflow sequences. Results indicate significant discrepancies in performance, highlighting major deficiencies with the currently-accepted planning metrics as a means to measuring and comparing water shortage risk across supply systems. These discrepancies are evident in both regions examined. The work highlights a need for a reassessment of the prescribed planning methodology to better reflect aspects of water shortage risk, particularly resilience and vulnerability.