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Metabolic modelling to support long term strategic decisions on water supply systems

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Water resources are essential for the economic development and sustenance of anthropic activities belonging to the civil, agricultural and industrial sectors. Nevertheless, availability of water resources is not uniformly distributed in space and time. Moreover, the increasing water demand, mainly due to population growth and expansion of agricultural crops, may cause increasing water stress conditions, if combined with the effects of climate change. Under these circumstances, it is necessary to improve the resilience of water supply systems both in terms of infrastructures and environmental compliance. Metabolic modelling approaches represent a flexible tool able to provide support to decision making in the long term, based on sustainability criteria. These approaches mimic the water supply network through a set of material and energy fluxes that interact and influence each other. By analyzing these fluxes, a suite of key performance indicators is evaluated in order to identify which kind of interventions may be applied to increase the sustainability of the system. Here, we adopt these concepts to analyze the water supply network of Reggio-Emilia (Italy) which is supported by water withdrawals from both surface water and groundwater bodies. We analyze different scenarios, including possible reduction of water withdrawals from one of the different sources as a consequence of a decrease in water availability under present and future scenarios. On these basis, we identify preventive strategies for a dynamic management of the water supply system.