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Integrating product water quality effects in holistic assessments of water systems

While integrated assessments of sustainability of water systems are largely focused on quantity issues, chemical use, and energy consumption, effects of the supplied water quality are often overlooked. Drinking water quality affects corrosion rates, human health, applicability of water and aesthetics. Even small changes in the chemical composition of water may accumulate large impacts on city scale. Here, a method for integrated assessment of water quality is presented. Based on dose-response relationships a range of effects from different drinking water qualities is merged into a holistic economic assessment of water quality effects, production costs and environmental costs (water abstraction and CO₂-emissions). Considered water quality issues include: health (dental caries, cardiovascular diseases, eczema), corrosion (lifetime of appliances, pipes), consumption of soap, and bottled water. Results show that despite high production costs and increased CO₂-emissions, desalination of seawater can be overall beneficial for cities when the new water resource improves the supplied water quality. When water quality is included in the economic assessment it is shown that desalination can provide Copenhagen, Denmark, with an expected economic benefit up to €0.4±0.2 per m³ delivered water. Positive economic outcome is highly dependent on careful design of final product water quality from the desalination process. Similarly, results from Perth, Western Australia, show a potential positive outcome up to €0.3±0.2 per m³. Noteworthy, the environmental cost of increased CO₂-emissions were found to be minor in both cases. The results show the need for integrating water quality issues into holistic cost-benefit analyses and environmental life-cycle assessments of water systems.