As we have written previously, potable water reuse (recycling water to augment water supplies) is a promising way to diversify urban water supply portfolios. Direct potable water reuse (DPR), the injection of highly purified wastewater into drinking water systems, is among the newest, and most controversial, methods for augmenting water supplies.

DPR is garnering increasing interest, but does not come without risks.

In a new article, several of us examine the notion that emerging regulation of DPR may lack sufficient attention to catastrophic risks with low probabilities of occurrence, but high consequences. In other complex engineered systems, such black swan occurrences have emerged in seemingly "failsafe" systems with disastrous results. The Hindenberg, Titanic, Fukushima, and Deepwater Horizon are iconic examples.

The DPR industry is subject to similar types of risk, such as those related to an unintentional spill of pathogens into a city's drinking water supplies. We thus argue that proponents of DPR could benefit from broadening their risk management, by acting to 1) proactively develop a safety culture in utilities employing DPR, and 2) establish an effective industry-wide auditing organization. Developing independent oversight for DPR operation could ensure that quality and management requirements are set and enforced, and that any system failures or "near misses" are investigated and adequately responded to.


Image credit: Hazen and Sawyer

Two types of risk

In its simplest definition, risk is the probability of an event occurring times the consequences of that event. However, risk manifests in very different ways, and an important conceptual distinction can be made between risks with high probability and low consequences (e.g., flight delays), and low probability risks with high consequences' (e.g., airplane crashes). The latter ("LPHC risks"), include catastrophic, large-scale events with negative externalities, and resist market-like solutions such as compensation for risk. LPHC risks are more difficult to perceive accurately, let alone manage effectively. LPHC risks are often only implicitly considered, if considered at all, by regulators and managers.

Lessons from other industries

Seeking lessons on how to manage LPHC risk, we looked to the risk management literature and examined the history of three other industries: aviation, offshore oil, and nuclear. Each experienced catastrophic failures, and attempted to manage them at an industry level.

What is missing

Recent framework documents and draft regulations for DPR (mostly from California, which is most advanced in developing regulations) are forward looking, but show key gaps in preparing for human-induced system failures. Recent California legislation creates a pathway towards the regulation of DPR (Cal. Water Code §§13,560–70), mandating two reports from external panels. The advisory group report contains recommendations that explicitly focus on the human dimension of this complex technology. For example, the report recommends that Advanced Water Treatment Facility operators obtain special training and certification. While these recommendations are clearly related to elements of safety culture, the report does not seek to codify broader recommendations on the establishment of an industry-wide safety culture.

Further, independent oversight matters for sustaining compliance with basic safety standards. A number of governance forms have emerged in other sectors that could be adapted to DPR. In aviation, an industry-wide organization was created that assesses all accidents and 'near misses' and proposes safety enhancements on a voluntary basis. In the nuclear industry, mechanisms exist that facilitate knowledge transfer about safety issues and creates substantial peer pressure among plant operators to maintain the highest possible safety standards. Important elements of their governance include independence, transparency, oversight capacity and accountability.

Lessons

It is in the interest of the emerging DPR industry to avoid its own Fukushima event. A drinking water system mishap could have high “signal potential,” and could easily set back public acceptance of a technology that is already struggling against consumers’ psychological barriers (the “yuck factor”), a lack of broader societal legitimacy, and the industry’s general challenges with innovation. The industry could proactively address LPHC risks upfront, by working to develop effective plans for establishing utility safety cultures and effective oversight. Examples from the aviation, nuclear, and oil industry show that such interventions do not necessarily require new layers of regulation, but can be designed in efficient, participatory, and even voluntary ways.

While potable reuse may become an increasingly important part of water supplies in many regions, it is not yet viewed as an irreplaceable element of the urban water system. With public support still fragile, the industry may be particularly vulnerable to public opposition arising from a high-profile catastrophic failure. Avoiding, or preparing for, catastrophic failure is important for DPR’s credibility and mid- to long-term viability. We argue that creating safety-enabling systems is actually in the DPR industry’s self-interest. If an effective LPHC risk management system were established, technology proponents could convey the powerful message that “we safeguard your drinking water using the same methods that keep you safe when you fly on an airplane.” The positive effect of such a message on DPR’s social legitimacy could easily justify the effort necessary to be able to deliver it with confidence.

This post is based on a newly published article, currently available online:

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