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Implementation of innovative, resource-efficient urban water systems depends on wide-ranging cooperation

New technology that makes energy capture from waste water and re-use of grey water possible can contribute to energy- and resource efficiency — but the widespread application of such technology requires a new, collaborative approach, shows a new study. Taking radical innovation in urban water systems beyond the pilot stage will require cooperation between a variety of stakeholders, suggest the findings of expert interviews and workshops.

Urban water systems manage water resources in urban areas, including water supply and waste-water treatment and disposal. Although radical innovations to water systems have been suggested in recent research — for example, separating the waste water produced so that it can be used for different purposes, such as heat recovery or re-use — in Germany, these have generally only been implemented at house or block level in pilot schemes, say the researchers.

To identify measures that could promote wider use of novel technologies, the researchers carried out a literature review, 24 expert interviews and six workshops with professionals from utility companies, water authorities and other interested professionals, gathering their knowledge and opinions on novel water technology. Analysing their findings, the researchers investigated what kind of strategic opportunities could be harnessed to promote novel urban water systems, as part of the netWORKS 3 project in the cities of Hamburg and Frankfurt am Main.

Through the interviews, the researchers found that municipal and industrial experts agree there is need for action in the waste-water sector. However, they identified obstacles to action, including:

- legal restrictions and uncertainties;
- financial and economic uncertainties;
- uncertainties regarding an ideal design.

For example, the experts noted that there were legal uncertainties related to supplying tenants with service water (water that does not meet drinking-quality standards) and drinking water. That is, additional drinking-water connections might become necessary, or indeed a regulation requiring washing machines and dishwashers to be separately connected to a service water system. For water companies to pursue innovation, therefore, they would need political backing, which would also help to address fears of non-compliance with higher-level regulations such as the EU Urban Waste Water Treatment Directive[1,2] and the German Federal Water Act.

Novel, collaborative governance structures are needed to guide the innovation process, say the researchers. For example, one responsible organisation (e.g. a water utility) should lead the innovation, working in collaboration with other interested parties (e.g. urban planners). Key players, not necessarily in the same organisation, are needed to take on the roles of coordinator, advocate, motivator and innovation leader. For example, the researchers identify the Hamburg Wasser municipal utility company as the innovation leader where a novel system has been implemented in 800 homes at the city's Jenfelder Au site. The system collects blackwater (from toilets) through vacuum technology, which uses a fraction of the water used by traditional toilets. This water is used to produce biogas for heating and electricity, in a facility located in the same district. The cooperation patterns are not fixed for the whole process, but they might change between the phases of planning, implementation and operation of the novel system. The cooperation needs to be appropriate for the specific phase.

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1. Council Directive 91/271/EEC;

2. Member States are free to apply the Directive in the most appropriate way, as long as the resulting environmental protection is equivalent to that required by the Directive. However, any possible obstacle in the application of these new technologies would need to be solved by the Member States.

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Implementation of innovative, resource-efficient urban water systems depends on wide-ranging cooperation *(continued)*

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The novel technology used in Hamburg also highlights how innovation can require new rules and realigned responsibilities. For example, new guidelines are required for the construction and operation of such systems and revision of wastewater legislation may be required to authorise options other than gravity-fed sewer collection. According to the researchers, it may also be the case that, for a well-functioning system, the transfer point of water from the private domain to the domain of public infrastructure may have to shift from the boundaries of private property to the pipes and toilet inside a home. In this way, authorities have access rights to the whole system, for example to conduct maintenance on a vacuum toilet, and the responsibility for the system is clearly demarcated.

Cooperation between parties is key to initiating the implementation of new technology, say the researchers. For example, representatives from building authorities, public services and investors, and environmental and health policy authorities must work together. Cooperation will be supported by suggested actions, as in Hamburg Wasser's *Manual for Vacuum Technology*, which offers guidance to the building sector on this novel technology.

Traditional urban water management in Germany is based on a uniform, centralised approach, note the researchers. Water supply and waste-water treatment are both the responsibility of the municipality. Novel technologies, for example new infrastructure for recovering waste water, often require a more decentralised system, with technology applied at the house, block or local-area level. As this infrastructure can be owned or operated by private companies, developers or individuals, rather than the water utility, this can present a new business opportunity for municipal utility companies — an aspect of innovation that should be positively harnessed.

Providing service water from grey-water and rainwater management, and separate collection and treatment of black water (waste toilet water), can also be of commercial interest. For example, biogas can be produced from black water and heat recovered from sewers, for profit. Public water utilities could be given responsibility for ensuring the proper operation of privately run facilities, in accordance with environmental and public health laws, according to the study. Utility companies could also earn extra income from the implementation and management of such new facilities.

Novel technologies need to be integrated into infrastructure development planning early in the process. With input from stakeholders, local development plans can highlight where water systems can contribute to energy efficiency and climate protection. Institutional arrangements are needed to ensure stakeholders, such as urban planners and water utilities, all cooperate in this process.

The researchers conclude that innovation in urban water systems cannot be seen from the perspective of a single company or utility, but requires cooperation between public actors and other stakeholders throughout the whole process, and the intensity of cooperation among different actors may change over time (planning, implementation, operation). Joint aims need to be determined and stakeholders need to be willing to take risks to go beyond conventional systems. New business opportunities can provide an incentive, while synergies with energy and resource conservation aims, as well as green infrastructure (e.g. through provision of irrigation water), also show the importance of cross-organisational collaboration to optimise the benefits from future urban water systems.