THE CONVERSATION

How to achieve sustainable clean water for everyone

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The provision of clean, safe drinking water in much of the world is one of the most significant public health achievements of the past century – and one of the foundation stones of a healthy society. In the developed world, most people are able to take this service for granted and pay very little for it.

But even if there is not a large economic cost, a global environmental cost is being paid for the luxury of this service. Water systems extract large quantities of water from the environment, require energy, chemicals and infrastructure to treat and pump water to our houses, then require more energy and infrastructure to remove waste, treat it, and return some of that water to the environment complete with contaminants (at low levels, but still present).

In the UK, water services are based on legacy infrastructure systems; the country lives off Victorian engineering. These systems are ageing and deteriorating and will require unprecedented investment to be fit for the future. Therefore the country needs to reimagine its water services to deliver water sustainably via systems that are affordable, adaptable and resilient.

London's Victorian sewage system. Kirsty Wigglesworth / PA Archive/Press Association Images

Water security under threat

Global population growth is threatening the security of water supply and when coupled with the impacts of climate change, it is clear that our historical approach to the provision of water may not remain feasible. Increasingly stringent drinking water quality and environmental discharge standards protect us from pollutants but require increasingly complex and energy-consuming treatment. Leakage of water from ageing infrastructure wastes more of this precious resource, yet the costs of replacing that infrastructure seem insurmountable.

Perhaps it is time to reconsider the one-size-fits-all approach of large centralised infrastructure and instead pursue a suite of solutions tailored to local needs. Could it be possible to have water systems that have no adverse impact on the environment, or better yet – water systems with positive impacts for people, society, the environment and the economy?

Such a transformation of water systems will require new technology but also new ways for people to interact with water. Research into treatment technologies such as low-pressure membrane systems that will work under gravity flow without pumps could have great potential for treating a variety of water sources at a variety of scales.

But will people want to install a device in their homes to create drinking water from, for example, rainwater in their neighbourhood pond? And what regulatory and policy frameworks would be required to enable this? There is a need for such devices to be engineered to be fail-safe to protect public health in the event of equipment malfunction.

Crowdsourcing change

Mobilisation of people could offer great transformative potential for our water systems. For example, engineering researchers are working to design treatment systems to remove fats, oils and grease from sewers before they cause major blockages, known as "fatbergs". However, such technology would not be required if all users of the system jointly protected the infrastructure by disposing of fats in another way.

So the sustainable water systems of the future also need the disruptive innovation of collective mobilisation to deliver and support transformation. Energy-saving measures are being implemented throughout urban water systems including pumping at non-peak times and recovering heat from wastewater. But there is potential for a closer linkage between the water and energy systems by considering the synergies between distribution systems for both utilities.

The drive to install renewable energy is stressing the electric grid and distribution systems, which were not designed to handle the decentralised sources and variable inputs that characterise renewables such as solar and wind power. The opportunity exists for water systems, which operate at the neighbourhood level just like electricity networks, to be configured to act as energy storage systems to offset the variability in electric power generation to store heat or energy in the form of pressurised water. Research is ongoing to determine the full potential and optimal scales for such interactions between water and electric grids but could offer a way to optimise existing infrastructure for both utilities.

These examples give some insight into how technology will be essential to transform our current unsustainable systems to deliver adaptable and resilient water services across a range of futures and contexts. Large, centralised infrastructure may still be required in densely populated areas – in these situations disruptive solutions need to work with the existing systems because high population density does not allow for land-intensive solutions and legacy infrastructure is too expensive to just abandon.

Given the 50-to-100-year service life for water infrastructure, a change in philosophy is needed now to avoid another century of unsustainable water service. Such disruptive innovations, when combined in a way to suit each distinct context, could deliver sustainable water solutions for all – from megacities to remote rural communities, to the rapidly developing parts of the world.

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