# Managing the Water and Energy Nexus – What's needed in a water utility for the future

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*Water utilities provide access to safe drinking water, a complex challenge in an increasingly thirsty world. Here, Hassan Aboelnga and Dragan Savić discuss the multifaceted nature of this challenge, the deeply interconnected problem of energy, and the principles that water utilities will need to follow if they are to deliver their core function in an uncertain future.*

The key function of water utilities everywhere is to provide easy access to safe drinking water and sanitation to the public. These essential services not only support public health but also provide wider socio-economic benefits. The current COVID-19 emergency has emphasised the importance of access to water and sanitation. Water utilities have historically delivered water and sanitation services with a regulatory/compliance approch. This has led to a risk-averse mentality which has, in turn, resulted in 1.2 billion people gaining access to the water network at home but not continuously. It's called an intermittent water supply.

Huge financial costs are incurred by water utilities that operate water supply systems that abstract, treat and pump water, but see much of it lost before it reaches users. The world's yearly volume of non-revenue water is around 126 billion cubic metres per year—half of which is lost in water-scarce countries. Reducing these high levels of non-revenue water must be at the forefront of the water utility of the future, which

will also enable them to reduce the energy expended and the risk of water contamination – in other words: fewer holes, fewer risks and better revenue.

Today, many water utilities face unprecedented challenges in ensuring safe, reliable and sustainable water supply and sanitation services for all. Traditional approaches may not be adequate in addressing the complexity of emerging water challenges.

## A world of water stress

The water utility of the future must move from today's business-as-usual approach (ie, managing water as a linear system of using and then disposing of water), to one based on a circular system. There needs to be changes in planning from goals based on infrastructure delivery to the aim of running resilient and safely managed water and sanitation services. It's like Albert Einstein observation: 'We cannot solve our problems with the same thinking we used when we created them'

The world's demand for water and energy is likely to surge in the next few decades. Population growth and urbanization, coupled with climate change, will drive growing demand by people, farms and businesses. Cities are the driving force of the global economy as they generate around 80% of global GDP. Today, half of the global population resides in cities, a percentage that is expected to increase to two-thirds by 2050, further straining supplies. By 2035, energy consumption will grow by 50% which will increase the energy sector's water consumption by 85%. This has enormous implications for the emerging middle-class and future spending power in cities.

While the need for a paradigm shift in the water supply and demand is inevitable, exactly what that transformation will look like in many parts of the world – especially in the most water-stressed countries – is far from certain. From Jordan to India to Botswana, 17 countries around the world are currently under extremely high-water stress, meaning the demand for water in these countries currently exceeds water supply (according to the World Resources Institute).

In what's becoming an increasing trend, many cities around the world such as Cape Town, South Africa, and Chennai are literally running out of water, with enormous risks to community, business continuity and growth. The dramatic declaration of Day Zero – the day on which the city runs out of water – has caught the attention of the world and has become a red alert for cities under water stress.

By analyzing these situations, some cities have managed the water crisis and avoided Day Zero with measures that were innovative and effective but far from perfect.The water crises were mainly caused by a prolonged drought or mismanagement of water resources. Severe water shortages are already affecting many cities and almost one-fifth of the world's population suffer today from intermittent water supply, and another 500 million people are rapidly approaching the situation of living under high water stress.

We're likely to see many more Day Zero situations in the future, mile-long queues of people walking or waiting to collect drinking water, trucks that deliver water to drought-stricken regions (often of unknown quality) and sometimes poor governance and management leading to sewage flowing out of water taps.

Understanding the main causes and the crucial role of energy in the water sector has implications not only for more efficient resource utilization but also for averting Day Zero situations and ensuring water security at national, regional and international levels.

Cities could reach a Day Zero situation due to a range of causes (Figure 1), including water scarcity, development of a system beyond its initial design parameters and capacities, weak governance and user behavior.

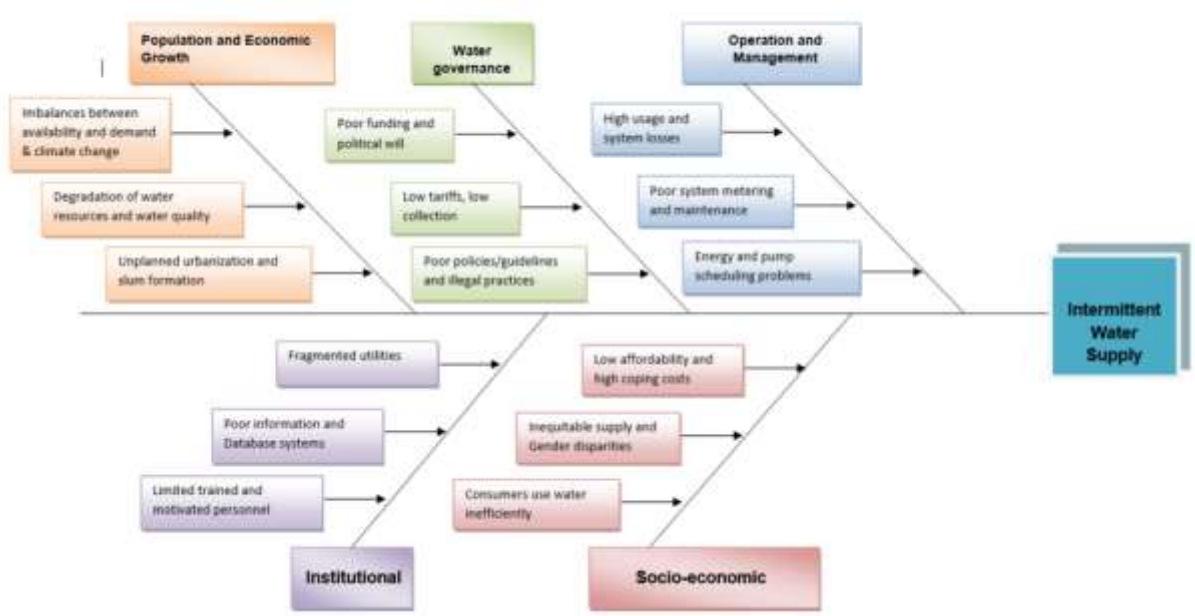


*Figure the major causes of Day Zero and intermittent water supply, (Aboelnga. 2019)*

## The water and energy nexus

Water and energy are highly interdependent as energy generation requires water and energy is used in agriculture and for the provision of water services in cities. For example, water is required for mining, fuel production, hydropower generation and power plant cooling; while energy is used for irrigation of arable land and in the entire urban water cycle from pumping, conveyance, treatment and distribution, to heating water in our houses to wastewater collection, treatment and discharge into water bodies.

This interrelationship is often described as the energy-water nexus, and idea which gained considerable attention in recent years with huge implications on the water sector. A salient feature of the nexus is that saving water saves energy, which in turn reduces greenhouse gas emissions (implicated in climate change). Energy efficiency programs offer opportunities for achieving significant water savings to mitigate water scarcity, and similarly, water efficiency programs (eg, involving a reduction in the high levels of non-revenue water) offer opportunities for providing significant energy savings, especially in energy scarce countries. Furthermore, saving water and energy also contributes to climate change mitigation.

Providing safe drinking water is a highly energy-intensive activity. Energy can account for up to 30% of the total operating costs of water and wastewater utilities and, in some developing countries, this can be as high as 40% of the total operating cost. Meanwhile, 15% of the world's total water withdrawals, on average, are used for energy production.

The sustainability of water supply in many countries is not only affected by water governance and scarcity but also by energy policies and the limited access to energy sources. In most countries, the water and energy systems have been developed,

managed, and regulated independently, which causes a significant impact on both water-scarce and abundant countries. For instance, despite the high-water availability in a country like Ethiopia, the water supply systems do not have access to the required energy to pump and distribute water to people. On the other hand, water scarcity in Jordan is coupled with energy shortages where rising electricity tariffs are putting great pressure on the sustainability of water resources. While electricity tariffs have been rising steadily over recent years, water tariffs stayed the same. The disparity between the revenues from water tariffs and the operating costs (involving energy) threatens not only the financial sustainability of the water utility but also national water security.

### How to become the 'water utility of the future'?

Many water utilities face a range of complex challenges. These include ageing infrastructure, limited financial resources, increasing threats to watersheds and aquifers, more stringent compliance and public-health standards, and increasing water and energy demands.

Digital technologies have the potential to deliver significant impact on and improvements to the water sector. We now have the ability to sense and collect information about everything and the amount of information available is unprecedented. (Consider this, 90% of the information in the world has been created in the last two years alone). The water sector has already started to benefit from digital transformation and examples of the operational efficiencies include reduced response times by 20%, increases in work reutilisation by 25%, 15% reductions in energy use across the network and other benefits related to better informed strategic decision making (eg, asset management and long-term resource planning).

In addition to these solutions, the water utility of the future needs to embrace the following principles:

- **Do more with less:** Diversifying water and energy resources are key for ensuring water security, while demand-side management is essential before diversifying water resources to close the vicious cycle of mismanagement of water services.
- **Fit for purpose solutions:** There is no one-size-fits-all solution for water utilities around the world. The water community, including development banks, embraces approaches and solutions that do not fit local conditions. For example, intermittent water supply systems require a completely different form of planning, management and operation from continuous water supply systems.
- **From linear to circular systems:** The circular economy embraces three basic principles: (1) Eliminating waste and pollution, (2) Keeping products and materials in use, and (3) Regenerating natural systems. To achieve that, we need to rethink the role of wastewater as waste that has to be rid of and a risk to public health while transforming it into an opportunity and resource that can help us mitigate water scarcity risks and improve food and energy security.

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