Article

Schaffhausen, March 2023

Decentralized water treatment – the solution for universal safe drinking water?

Climate change and the increasing global population are challenging the world's efforts to ensure that every person has access to safely managed drinking water by 2030. As a result, it is necessary to find technical solutions that reduce the operational costs of water distribution and make networks more flexible, resilient, and future proof. As it turns out, the answer might lie in moving away from traditional centralized infrastructure.

The United Nations define the access to safe water as "the most basic human need for health and well-being". Meanwhile, demand for water is rising rapidly due to a combination of growing population numbers, urbanization, and the needs of sectors such as agriculture, industry, and energy (Sustainable Development Goals, 2015). Furthermore, it has been estimated that over half of the world's population will live in areas with high water stress by 2030 due to water scarcity and climate change (International Decade for Action 'Water for life' 2005- 2015). At the same time, traditional centralized networks in cities are struggling as they are not designed for the increased loads caused by urbanization. In order to get closer to the goal of universal access, it is therefore time to answer a crucial question: Do we need to rethink water distribution?

But first, it is worth taking a short trip through history. Humankind, from Homo Sapiens all the way up to the 19th century, has always been aware of the fact that drinking good water was key to their survival. However, there was one major flaw: They ignored the importance of proper sanitation and, consequently, faced serious impacts on public health as well as the environment.

This was not always the case. There is evidence of centralized sewers being used as far back as 3500 BC in the Mesopotamian Empire, for example. But despite these technological feats, people in large urban centers learned their lesson the hard way. Even during devastating epidemics throughout the Middle Ages, the contributing factor of sanitation was not considered.

It took until the turn of the 19th century for centralized sewage systems to make a comeback – and change people's lives. Wastewater collection alone was singlehandedly responsible for an increased life expectancy of four years.

The current state of the global water sector

So why did centralized sewers have such a hard time throughout history? The answer is quite simple: They are expensive. Even today, it is estimated that around 70-75% of total costs within water networks are caused by pipes and pumps rather than the actual treatment or storage. If something goes wrong, replacing a mile of existing piping systems costs around half a million US-dollars.

Nevertheless, progress is being made, as documented by the World Health Organization (WHO) in the paper “Progress on household drinking water, sanitation and hygiene 2000–2020: Five years into the SDGs“ (2021). Between 2000 and 2020, 2 billion people have gained access to safely managed drinking water. This development means that around 74% of the world’s population now has access to safely managed water services, while 16% at least have access to basic services. However, in the same time period, the global population also grew from 6,1 billion to 7,8 billion. As a result, water services might have improved for 2 billion people, but at the same time, there are also 2 billion people who still suffer from a lack of safely managed water.

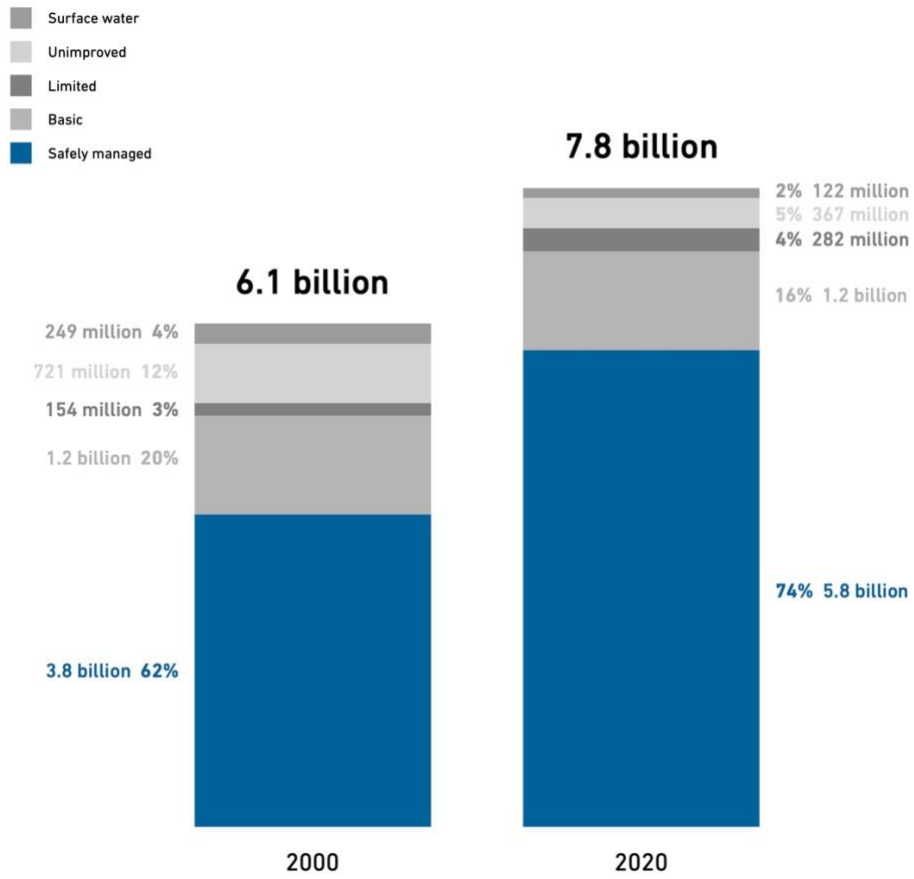

Figure 1: 2 billion people have gained access to safely managed drinking water since 2000. (Source: United Nations)

An additional issue can be found when comparing rural and urban water coverage. In 2020, 60% of rural areas around the globe had access to safely managed water, while cities had a coverage of 86%. Despite improvements since 2015 (the gap currently sits at 26%, down from 32%), two thirds of safely managed water are still found in urban areas.

What does this mean for the future? According to the WHO's research paper, the goal of universal access to safely managed drinking water by 2030 is unrealistic. To reach it, the current rate of progress would have to quadruple. This is reflected by the fact that global coverage has merely increased 4% between 2015 and 2020. Projections by the WHO for 2030 therefore only estimate a global coverage of 81%, which still leaves a large number of people behind.

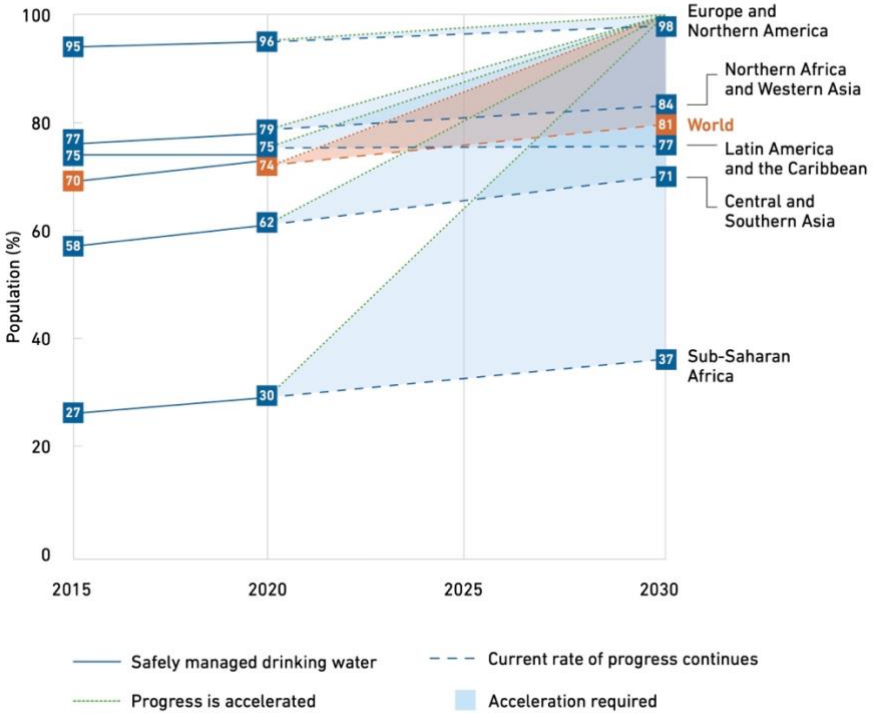

Figure 2: At the current rate of progress, the world is currently not on track to achieve universal access to safely managed drinking water. (Source: United Nations)

This is not a third world problem

It is easy to underestimate the sheer scale of the challenge. Lacking sufficient access to drinking water is certainly not only a problem in developing countries, as the Environmental Protection Agency's (EPA) surveys of US infrastructure show. In fact, large parts of the country's water infrastructure have an age problem. In Philadelphia, for example, the average age of the piping network is 76 years, with some active pipes installed before 1900 (CBS, 2021). But even across

the entire country, the quality of the networks appears to be declining. In 1980, 69% of drinking water pipes were classified as “excellent” and a mere 2% as “very poor”. 40 years later in 2020, it was estimated that the number of “excellent” pipes is only at 33% and, even more worryingly, that “very poor” pipes have seen a significant increase to 23%. As a consequence, $472,6 Billion USD are needed to maintain the nation’s water infrastructure – a goal that will not be met in the near future (EPA, 2018). The Biden administration’s $111 Billion USD water infrastructure investment brought forth in 2021 only covers 24% of this cost (US Water Alliance, 2021).

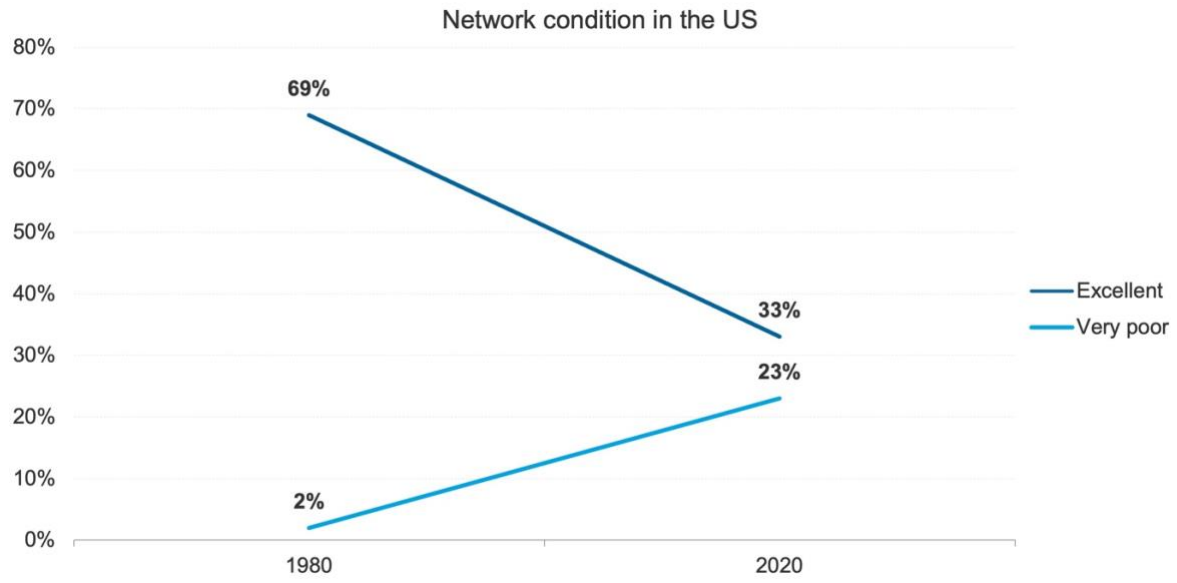

Figure 3: The number of very poor pipes in the US water infrastructure is projected to increase dramatically. (Source: Environmental Protection Agency)

For the American population, these developments pose a serious risk. In a 2018 study, it was estimated that up to 45 million Americans have potentially been exposed to unsafe drinking water (Allaire et al., 2018). A year later, the Natural Resource Defense Council (NRDC) and the Environmental Justice Health Alliance (EJHA) found that 44 million people receive water from 5.634 water systems that were responsible for a combined 23.040 health violations over just three years (Pullen Fedinick et al., 2019). On top of this, more than two million Americans do not have any access water and wastewater services in their homes (US Water Alliance, 2019).

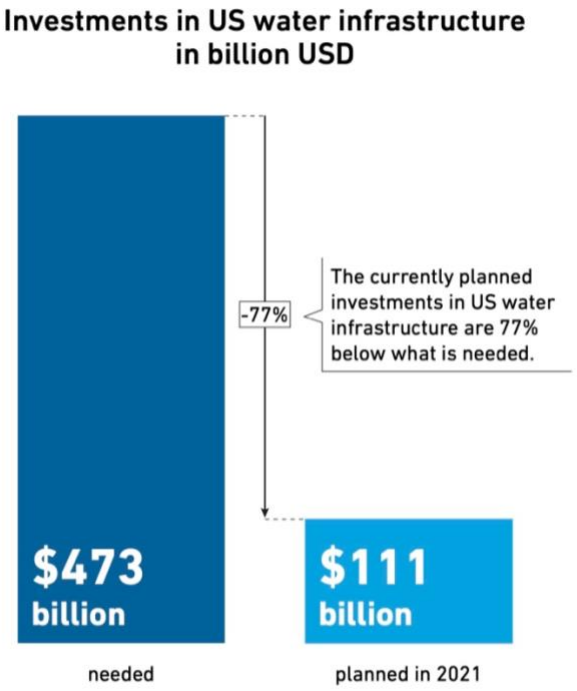

Figure 4: Currently, the planned investments only over a quarter of the costs to overhaul ageing water infrastructure in the US. (Source: EPA/US Water Alliance)

The future belongs to decentralized water

While the numbers paint a troubling picture of the current state of the global water sector, there are important developments that need to be considered. Compared to the beginning of the 20th century, the technical possibilities have completely changed. Today, utilities do not require 10 chemists in 10 treatment plants or even 10 pump operators at 10 pumps. Instead, a wide range of sensors and data streams allow water infrastructure to be controlled, monitored, and analyzed remotely.

This completely changes the operational costs of running a water network and can reduce a tremendous portion of the aforementioned 75% associated with pumping water through huge networks. Of course, this concept is not new and has previously seen success in the energy sector. But with the help of current technology as well as deregulation, it is possible to revolutionize the water sector: Moving from a struggling centralized infrastructure to digitally connected microgrids that are closer to people's homes. The name for this concept is distributed water.

Distributed water treatment solutions and micro-utilities can provide the necessary efficiency and, most importantly, flexibility to address global water challenges – now and in the future. They can be used by communities to modify, replace, or expand existing infrastructure and are suitable for cities, industry, as well as remote locations throughout the world. To achieve this, they utilize

technologies such as reverse osmosis that enable the production of potable water from a wide range of raw water quality levels (including brackish water and seawater). Reverse osmosis is a type of filtration that removes dissolved ions from water. A semi-permeable membrane allows pure water to pass through but rejects contaminants or larger molecules and is capable of removing 98% of total dissolved solids (Christina Tuser, 2021). In addition, systems can also feature sediment filters (against particles like dirt or rust) or carbon filters (against volatile organic compounds such as chlorine).

Indeed, the numbers already reflect that distributed water is slowly gaining traction. Looking back at the example of the US shows that $7,8 billion USD will be invested in distributed water and wastewater systems in 2023 (Owen, 2020). While this number may be smaller compared to the $22 billion currently spent on traditional water networks in the US as part of the five-year $111 billion investment program, the concept of distributed water allows for much more agility. These projects can yield faster results, whereas large infrastructure takes years to implement.

The concept of decentralized water can also be taken a step further. Point of Use applications refer to the many types of filtration that can be achieved in every single home. Instead of relying on utilities, homeowners can take matters into their own hands and ensure that the highest level of drinking water comes out of their taps. The market for Point of Use applications such as reverse osmosis is expected to triple by 2030, and many systems are increasingly affordable but also becoming more effective. While reverse osmosis filtration might have rejected two thirds of the incoming water as waste a few years ago, today this amount is less than 25%.

To understand the impact that decentralization has, it is worth widening the scope and also taking a look at industrial water. Between 1985 and 2015, the US industrial sector has reduced its self-supplied water usage by 43% (see waterdata.usgs.gov). Despite changes in the industrial landscape, a significant amount of this reduction can be attributed to modern technologies that allow water to be reused and recycled, as well as stringent sustainability guidelines. In practice, this means that industrial companies do not rely on large utilities or extract water directly, but rather outsource their water needs. Models such as Water-as-a-Service enable these companies to become more resilient, comply with environmental guidelines, and lower their impact on the local community. Finally, decentralized reuse and recycling is associated with lower costs. Especially in the context of climate change, this trend of decentralization will only increase over the coming decades.

Conclusion

Throughout history, humans have struggled to find an effective way to provide safe drinking water and effectively deal with wastewater. For a long time, centralized networks were thought to be the best solution, but high costs and complex infrastructure are currently slowing down the world's efforts to provide universal access to safely managed water by 2030. In addition, the numbers prove that lacking access to water is a global problem and cannot be solved unless something changes. However, distributed water and wastewater approaches are already showing that decentralization is the most effective way forward. These approaches are more flexible, cost-effective, and future proof thanks to advancements in technology.

Outlook

It has become clear that there is a growing shift towards decentralized water. But what does decentralized water actually mean? In the next part of this article series, the term will take center stage. The goal is to answer three questions:

- What counts as decentralized water?
- How is modern technology shaping decentralized water?
- Which type of decentralized water will prevail?

Author:

Antoine Walter, Senior Business Development Manager Wastewater Treatment at GF Piping Systems

Sources:

United Nations, *Sustainable Development Goals, Goal 6: Ensure access to water and sanitation for all,* 2015, https://www.un.org/sustainabledevelopment/water-and-sanitation/ (Accessed: 22 February 2023)

United Nations, *International Decade for Action 'Water for life' 2005- 2015*, www.un.org/waterforlifedecade/scarcity.shtml (Accessed: 22 February 2023)

World Health Organization, *Progress on household drinking water, sanitation and hygiene 2000–2020: Five years into the SDGs*, 2021, https://www.who.int/publications/i/item/9789240030848 (Accessed: 23 February 2023)

CBS, *With Aging Infrastructure, Water Main Breaks In Philadelphia Can Take Nearly 8 Months To Repair*, 2021, https://www.cbsnews.com/philadelphia/news/philadelphia-water-main-break-aging-infrastructure/ (Accessed: 24 February 2023)

United States Environmental Protection Agency, *EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment*, 2018, https://www.epa.gov/dwsrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment (Accessed: 24 February 2023)

US Water Alliance, *President Biden Introduces Plan for $111 Billion in Water Infrastructure Investment,* 2021, https://uswateralliance.org/news/president-biden-introduces-plan-111-billion-water-infrastructure-investment (Accessed: 24 February 2023)

Allaire, Maura et al., 2018, "National trends in drinking water quality violations", *Proceedings of the National Academy of Sciences*, Vol. 115, No. 9, https://doi.org/10.1073/pnas.1719805115

Pullen Fedinick, Kristi et al., *Watered Down Justice*, Natural Resources Defense Council, 2020, https://www.nrdc.org/resources/watered-down-justice (Accessed: 6 March 2023)

US Water Alliance, *Closing the Water Access Gap in the United States – A National Action Plan*, 2019, https://uswateralliance.org/sites/uswateralliance.org/files/publications/Closing%20the%20Water%20Access%20Gap%20in%20the%20United%20States_DIGITAL.pdf (Accessed: 23 February 2023)

Tuser, Christina, *What is Reverse Osmosis?,* Wastewater Digest, 2021, https://www.wwdmag.com/editorial-topical/what-is-articles/article/10938952/what-is-reverse-osmosis (Accessed: 6 March 2023)

Owen, David Lloyd, 2020, *Global Water Funding*. London: Palgrave Macmillan.

United States Geological Survey, *Water Use Data for the Nation*, https://waterdata.usgs.gov/nwis/water_use/ (Accessed: 6 March 2023)

Table of figures

Media contact:
Constanze Werdermann, Global PR Manager
constanze.werdermann@georgfischer.com
+41 76 33 99 218

About GF Piping Systems Ltd.
As the leading flow solutions provider for the safe and sustainable transport of fluids, GF Piping Systems creates connections for life. The division focuses on industry-leading leak-free piping solutions for numerous demanding end-market segments. Its strong focus on customer-centricity and innovation is reflected by its global sales, service, and manufacturing footprint and its award-winning portfolio, including fittings, valves, pipes, automation, fabrication, and jointing technologies.

GF Piping Systems has its own sales companies in 31 countries, which means it is always by its customers' side. Production sites in 36 locations in America, Europe, and Asia ensure sufficient availability and quick, reliable delivery. In 2022, GF Piping Systems generated sales of CHF 2'160 million and employed 8'085 people. GF Piping Systems is a division of Georg Fischer AG, founded in 1802 and headquartered in Schaffhausen, Switzerland.
www.gfps.com