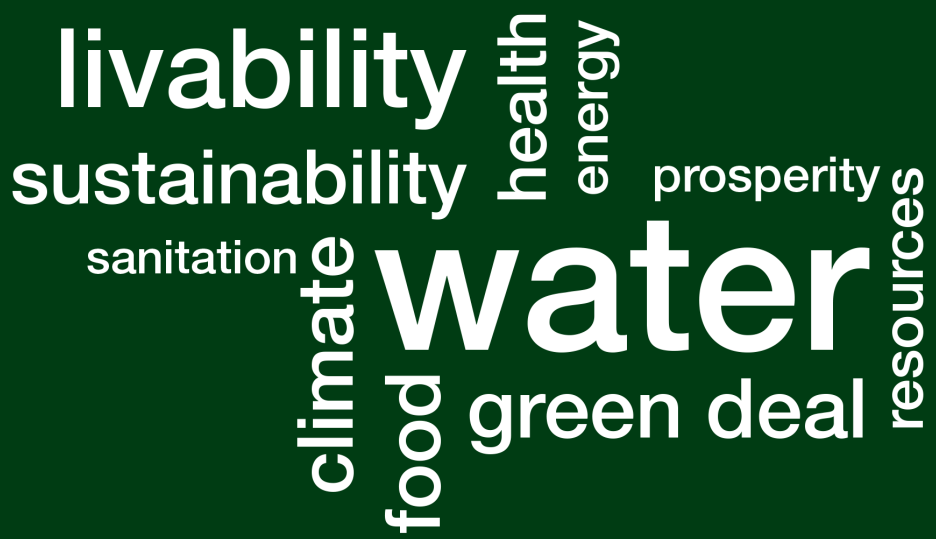


Water in the world

local and global challenges

Index

Publisher: AVK Group A/S
Editor in chief: Michael Ramlau Hansen, AVK
Concept and text: Kragelund Kommunikation A/S
Layout: Lise Østergaard and Sanne Aude, AVK, Spirit ApS
Published: March 2021, Printed 1,000 copies

TIME FOR ACTION

Water is the basis of all life. But when looking objectively at how drinking water and wastewater is handled across countries, a depressing and scary picture emerges. Water scarcity and discharge of wastewater created massive problems all over the world. The current situation is untenable for both millions of people today, for future generations, and not least for the earth that we all share.

Unfortunately, the fact is that it is only getting worse. A large number of factors will inevitably accumulate and exacerbate the problem in the next years. Every day, we are really only enhancing the problems and challenges because we are doing way too little across the globe.

Something MUST be done. A look into the data and knowledge of the WHO, UNESCO, IEA, IWA and other authoritative sources paint a gloomy picture of a world where resources are not treated respectfully. The many different consequences are scary and every day we do not act will only aggravate matters.

But there is a small light in the dark – we can have significant impact on the progress and on solving the problems. We already possess the knowledge, the know-how, the technologies and the products that could begin making a difference tomorrow, could begin reducing problems, and could begin providing better lives for many people. A lot of individual projects document this.

On behalf of the entire world, we can rejoice that there is an increasing political attention to water challenges and an increasing political understanding that action is required. We must appreciate the increased attention to the UN sustainable development goals, and on a European level, the revised drinking water directive is another step in the right directions.

Water supply and the way it is arranged influences a whole range of fundamentals of our lives. Our hope is that this paper can help communicate knowledge and understanding of the interlinked dimensions of water challenges. And hopefully also a better understanding that something MUST be done.

Niels Aage Kjær
Owner, CEO
AVK Group

WATER SCARCITY

Water scarcity will be one of the biggest challenges of the future

Lack of water is one of the biggest challenges of our time and the problems will grow exponentially in the decades to come. Today, 2.1 billion people do not have a reliable water supply in their homes *(Ritchie & Roser, 2019)*, and by 2025, 1.8 billion people are expected to endure absolute water scarcity *(UN, 2015).*

At the same time, half the world's population will live in water-stressed areas *(WHO)*. An increasing number of cities experience permanent or occasional water scarcity because of excess consumption and drought, and before 2030, 60% of the European cities with more than 100,000 inhabitants will suffer lack of drinking water.

"We have a supply-demand deficit. Populations are growing and growing up. The standard of living is increasing."

Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)

Cities are running out of water

London, Tokyo and Jakarta are only three examples of cities that are facing rapidly intensifying water supply challenges.

In London, where the population increases by 100,000 every year, the demand for water is expected to exceed the supply within a decade, and serious scarcity may well be a reality before 2040. To complicate matters even more, the most important water resources of the city are vulnerable due to the risk of pollution from sewers in case of flooding *(Ritter, 2018c)*.

Already in 2014, Tokyo was the world's largest city to face shortage of water. The city which is home to more than 35 million people relies heavily on surface water. 30% of the city's water is tapped from groundwater while the remaining 70% derives from rivers, lakes, rainfall and remote snow parks. This makes the city's water supply highly exposed to droughts which are becoming ever more frequent *(Ritter, 2018d)*.

In Jakarta, the biggest challenge is the lack of water resources and as a consequence, only a third of its inhabitants have running water. 96% of the water in the river is highly polluted, and the groundwater which is essential to 65% of the inhabitants, is sinking because of excess consumption of the ground water. The matter is additionally complicated by the fact that 97% of the city is covered by asphalt which prevents rain from trickling into the ground. This cuts off the fresh supply to groundwater storage *(Ritter, 2018b).*

"Water is globally the most important resource and the only resource that is not publicly traded."

Hans-Martin Friis Møller, CEO, Kalundborg Forsyning, Chairman, Danish Water Forum (2020)

WATER LOSS

Today, we are wasting the water for tomorrow

In many places in the world, water is a scarce resource. Despite this, worldwide between 35% and 40% of the water we gain and produce from different sources is wasted. More than a third of the produced drinking water never reaches the end user *(Værum, 2019)*.

Behind these average figures, you find water loss of between 5% and 80% across countries. In Europe, the average water loss is 26% while in Denmark, it is only 7%. This means that a quarter of all the drinking water that is produced in Europe, is wasted *(Grundfos, n.d.)*.

Globally, approximately 32 billion cubic metres are lost every year, half of these in developing countries. Every day 45 billion cubic metres of water is lost in developing countries, and if half of that could be saved, it would cover the needs of 90 million people *(Kingdom et al., 2016)*.

”Water loss is the worst – it is a waste of an often-sparse resource and also of the resources (energy, labour and write-off of infrastructure) used to extract the water.”

Bjørn Kaare Jensen, Vice chairman, Danish Water Forum, President, European Water Association (EWA) (2020)

We lack knowledge of the actual extent of water loss

Many countries have quantified their national water loss, but those numbers are largely based on very rough estimates. Across Europe, there is no exact knowledge of the extent of water loss. This is the reason why the new drinking water directive of the EU has dictated that water companies producing more than 10,000 cubic metres of drinking water a day, or supplying more than 50,000 people, must measure their leakage.

This is not an easy task to perform, and the EU commission has given the water companies a 5-year deadline to collect the necessary knowledge. The plan is that the specific water loss will form the basis for determining a threshold which the EU countries will be under an obligation to respect within a number of years *(AVK Group, 2020)*.

“You have to look at the whole water cycle in its entirety and recognize that all water within the cycle is good water, including leakage, grey and black water. With this perspective you can reduce your water footprint. Unfortunately, most decision makers do not have this perspective.”

Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)

POLLUTION

We are polluting our own drinking water

A lack of attention to and decades of neglect of the handling of wastewater from households, industry and agriculture has resulted in the drinking water of hundreds of millions of people being severely or even dangerously polluted *(WHO, 2019a).* We know how the consequences of diverting untreated wastewater into Nature, but even so we continue to do so for 80% of the world's wastewater. In addition, many wastewater systems are poorly maintained, meaning that leaks are frequent and posing a risk of pollution to the surrounding water reservoirs *(Grundfos, u.å.)*.

As a consequence, water that is produced from rivers and lakes is increasingly threatened by pollution. Hundreds of millions of people already live with a contaminated drinking water resource *(WHO, 2019a)*.

In the US alone, more than 125,000 polluted water reservoirs have been identified. The costs for cleansing these will amount to an estimated 130 billion USD as a minimum *(National Academy of Sciences, 2012)*.

"Sustainability is the only solution to the water problem, and economically it is the best solution."

Lars Schrøder, Direktør, Århus Vand (2020)

HEALTH

Polluted drinking water costs millions of lives

Every year, almost 300,000 children die from water-related diseases. This corresponds to a child dying every other minute *(Water.org, n.d.)*. Two billion people only have access to excrement-polluted drinking water, and every year, 480,000 people die from diarrhoea caused by contaminated water *(WHO, 2019a)*.

Every year, one million people die from diseases related to water, sanitation and hygiene *(Water.org, n.d.)*. Water-related diseases impacts developing countries the hardest; especially children under the age of five. 30% of the deaths of children in developing countries are caused by lack of clean water and sanitation *(OECD, 2011, p. 14)*.

The quality of drinking water, both from the tap and bottled, is furthermore challenged by an exponential growth in the volume of micro plastics which constitute a potentially major health risk *(WHO, 2019b, p. 1).*

Clean water saves lives and money

If the entire global population had access to clean drinking water, sanitation and hygiene, the combined global extent of disease could be reduced by up to 10%. Particularly the incidence of diarrhoea and malaria would be greatly reduced *(WHO, 2019a)*.

The combined effect of reducing the load of disease by 10% would be enormous when measured against macroeconomic factors such as living standards, productivity and socioeconomics. In 2016 alone, 1.9 million deaths could have been avoided by adequate and proper water supply, sanitation and hygiene *(WHO, n.d.).*

Water problems are a huge burden on healthcare

Better access to water of a proper quality can cause less disease and better public health. A long list of diseases like cholera, diarrhoea, hepatitis A and polio transmit through water and poor sanitation *(WHO, 2019a)*.

Globally, clean drinking water and better sanitation can give cost savings in the healthcare of 10%, corresponding to a staggering 260 billion USD. In those regions where the challenges of water, sanitation and hygiene are the gravest, savings may amount to 25% *(WHO, 2012, p. 5).*

ENERGY

We use a lot of energy for no reason

Globally, the rate of water loss is 35% to 40%. A third, no less, of the globally produced drinking water is wasted. In principle, this means that a third of the energy used in the production and distribution of the water is wasted too *(Værum, 2019)*.

The global water industry uses approximately 120 MTOE per year, roughly corresponding to the combined energy consumption of Australia. More than half the energy consumption of the water industry is covered by electricity, corresponding to roughly 4% of the global consumption of electricity.

If we extrapolate from the current situation, the energy consumption of the water industry will increase with 50% by 2030. If water loss is not reduced, a third of the increase in energy consumption will be wasted as well *(IEA, 2016).*

> *"We can shut down all coal-fired power plants in the EU from one day to the next if we implement the knowledge and technology at our disposal today."*
>
> *Lars Schrøder, Direktør, Århus Vand (2020)*

Water-consuming energy production will increase significantly

The consumption of water for energy production will increase, as the need for energy is expected to rise with 40% by 2040. The increase will greatly alter the current geographical distribution of the global energy consumption. In the EU and Japan, energy consumption will decrease while the US and North America will remain as is. The largest increase is expected in developing economies where energy consumption is projected to increase by 45% towards 2040.

The energy consumption in India will double towards 2040 and the Middle East and Northern Africa will see a surge of 60%. By 2040 the energy consumption of Africa will be larger than that of the EU.

Thus, the significant increase in water-consuming energy production will be observed in those regions that face the biggest challenges in terms of their water supply *(IEA, 2016, pp. 40-41).*

Additional cleansing of wastewater will put additional pressure on the energy consumption

Over 80% of the world's wastewater is discharged directly into Nature without being cleansed and the negative consequences are devastating *(Grundfos, n.d.)*. Therefore, wastewater treatment will be increased in the years to come which will strain the energy consumption even more and subsequently the water consumption for energy production.

In industrialised countries, 42% of the electrical consumption in the water industry is used for wastewater treatment. In developing countries, the energy consumption for wastewater treatment still plays a minor role as only a small part of the wastewater is treated. As the wastewater treatment expands, the energy consumption follow *(IEA, 2016).*

> *"Even though we possess the technology to handle wastewater more efficiently, we have accepted a low standard for a long time. We still treat our wastewater like we did in 1960."*
>
> *Hans-Martin Friis Møller, CEO, Kalundborg Forsyning, Chairman, Danish Water Forum (2020)*

CLIMATE

Our water loss has a vast negative climate impact

The production of water is energy-intensive, and the global water industry consumes roughly the same amount of energy as Australia *(IEA, 2016, pp. 122-123).*

With an extensive water loss of an estimated 40%, the consequence is that perhaps as much as 40% of the energy consumption is wasted. In other words, the world has a completely unnecessary climate impact. Or if you want to turn perspective upside-down – this is an obvious opportunity to reduce the climate impact.

> *"Many people are not aware that the amount of energy consumed by the water industry cause a heavy climate footprint."*
>
> *Bjørn Kaare Jensen, Vice chairman, Danish Water Forum, President, European Water Association (EWA) (2020)*

Bottled water is a severe environmental load

The use of bottled water is increasing in many countries, including such places where high-quality tap water is available. In the US, more than 11 billion USD is spent on bottled water every year, and one of the richest men in China has built his fortune on bottled water.

Bottled water increases the environmental and climate footprint due to a high level of energy consumption and pollution. The production of one litre of bottled water requires almost 2000 times the amount of energy required to produce a litre of tap water, and in 2016 alone, in the US, 17 million barrels of oil were spent in the production of plastic bottles *(Zyga, 2009)*.

With the revised drinking water directive of the EU, the ambition is to ensure better quality and availability of tap water which is assumed to increase trust in tap water's quality and thereby reduce the amount of purchased bottled water. This will have a significant positive environmental impact through the reduction of energy consumption, of plastics pollution and of the volume of microplastics in the seawater and the drinking water *(Europa-Parlamentet, 2018).*

WASTE OF FOOD

Food waste puts additional strain on the water challenges

Every year, approximately 1.3 billion tonnes of food are either wasted or thrown out on a global scale. This roughly corresponds to a third of all produced food. Agriculture and food production require large amounts of of water, meaning that the water used for producing wasted food is wasted too *(Gustavsson et al., 2011, p. 4)*.

Equivalently a third of the energy that is used in agriculture and food production is wasted too, and a large part of that energy has been produced through a large consumption of water. Waste of food is primarily a problem of the Western world. The waste of food per capita in the US and EU is 95-110 kg per year while in Africa and South East Asia, it is 6-11 kg per year *(Gustavsson et al., 2011, p. 5).*

> *""The world will face big food supply problems if we don't solve the growing challenges of a fair allocation of water in water-stressed areas."*
>
> *Bjørn Kaare Jensen, Vice chairman, Danish Water Forum, President, European Water Association (EWA) (2020)*

CITIES ARE SINKING

Cities are sinking as excess consumption lowers the groundwater level

Jakarta and Mexico City are facing direct and scary consequences from having over-exploited their groundwater resources. Jakarta, Indonesia, is sinking faster than any other city in the world. A massive growth in population has strained the groundwater which is the water source for 65% of the people living in the city *(Ritter, 2018c)*.

A large number of wells, many of which are illegal, are draining the underground making the city subside so rapidly that certain areas have sunk four meters in recent years. Now, 40% of Jakarta is below sea level, mainly because of the decrease of the groundwater level *(Ritter, 2018c).*

Mexico City is facing an explosive increase in population and the city's water resources cannot keep up with the massive demand. In a desperate hunt for water, they dig deeper every day, causing a severe lowering of the groundwater level. As a consequence, certain parts of the city subside 30 centimetres every year *(Ritter, 2018d).*

FINANCIALS

Money is gushing from the water system

Year after year, billions of cubic metres of water are gushing through cracks and leaks in the water distribution network. No less than 40% of the water produced never reaches an end user. The financial impact of the enormous global water loss is estimated at around 260 billion USD *(WHO, 2012, p. 5).*

While this is happening, the water industry is facing gigantic investments in maintenance and upgrading due to a generally outdated infrastructure *(EWA, n.d.)*.

"We must demonstrate the business case to authorities and the providers of financing. In Bangladesh we replaced 3,000 km water pipes and reduced NRW from 76% to 7%. After a few years, it gave a positive financial result."

Hans-Martin Friis Møller, CEO, Kalundborg Forsyning, Chairman, Danish Water Forum (2020)

Financial suboptimisation ends up very costly

Like many other industries, water supply is significantly impacted by a financial suboptimatisation. Investment budgets are driven down which subsequently puts a heavy and persistent strain on expenditure and operational budgets.

This makes water suppliers spend unnecessarily high amounts on distribution grid maintenance and over time, those expenses far outweigh the immediate saving of the construction phase. The average costs for repairing a pipe fracture or leak can skyrocket.

The direct correlation between the quality of facilities and the operating expense are often overlooked and every time something has to be replaced because of failure or wear and tear, it costs many times the amount it would cost to invest in a better and more durable product.

Clean water may act as a catalyst for economic growth

Clean water is not just about supplying healthy and safe conditions of life to people. Analyses show that a responsible handling of water resources and a subsequent better access to water and sanitation can boost the economic growth of a country and so contribute to a reduction of poverty and a general improvement of living conditions *(WHO, 2019a)*.

A study suggests that for every dollar invested in water and wastewater infrastructure, the private BNP output will increase to six dollars (WWAP, 2015 p. 47).

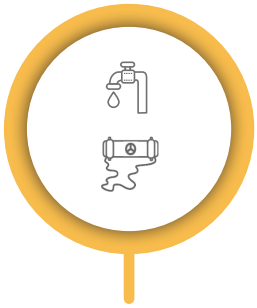
Investments in water and sanitation improve conditions of life and BNP

Giving people better access to clean water directly impacts their primary living conditions. But added to this are several spill-over effects which when accumulated greatly impact the development of a society. When people need to spend less time fetching water, they can spend more time being productive in other areas. Better and cleaner water means fewer sick days and less medical costs which improves the finances of the individual and subsequently of their contributions to society *(WHO, 2019a).*

In the same way, better access to clean water can improve the living conditions of children significantly in a multitude of ways. They have fewer sick days, and they are better equipped for keeping up at school. This causes long-term positive effects for the life of the individual child and for society *(WHO, 2019a).*

WATER IN THE WORLD

WATER SCARCITY AND WATER LOSS



2.1 bilion people do not have safe water in their homes.

In 2025, 1.8 billion people are expected to live with absolute water scarcity.

In 2025, half of the world's population will live in water stressed areas.

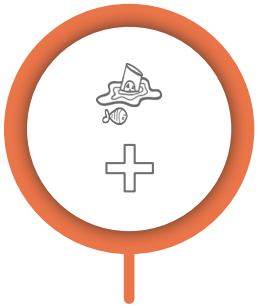
On a global scale, the total water loss is between 35% and 40%.

Nationally, water loss is between 5% and 80%.

Globally 32 billion m3 of water is lost, half of this is in developing countries.

Global water loss has a value of more than 260 billion USD.

POLLUTION AND HEALTH



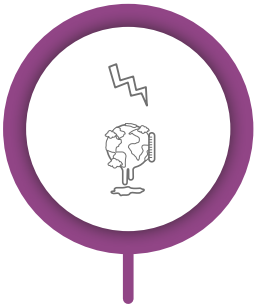
80% of the world's wastewater is led untreated back into nature.

2 billion people use drinking water, which is polluted by faeces.

Every year 1 million people die of water, sanitation and hygiene related diseases.

Every year almost 300,000 children die from water reated diseases.

ENERGY AND CLIMATE



4% of the global energy consumption is used in the water sector.

35% to 40% of energy used in production and distribution of water is wasted due to water loss.

One third of the food that is produced globally is thrown away. One third of the water used for food production is therefore wasted.

CHALLENGES OF THE FUTURE

The world's population is expanding to 9-10 billion by 2100.

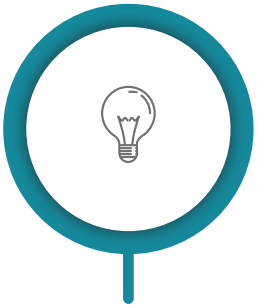
70% of the world's water consumption is used in agriculture, expanding food production. Growing food production will stress water resources.

The population in cities will increase from 3.9 billion today to 6.3 billion in 2050.

The cities' demand for water will increase by 70% up until 2050.

The global water consumption will increase by 55% in the period 2000-2050 due to increasing wealth.

POTENTIALS AND SOLUTIONS



Clean water and better sanitation can globally assist the health sector save 10% corresponding to US$ 260 billion.

Clean water acts as a catalyst for economic growth. US$ 1 invested in water and wastewater infrastructure will increase the private BNP output more than US$ 6.

Water infrastructure lifetime can be extended through investments smaller than the expenses needed to manage breakdowns or leakages.

Wastewater is a massive energy source.

"We could make a huge difference if the politicians in the EU and the rest of the world had the courage to make demands and say that water loss at more than 10% is a waste of resources."

Lars Schrøder, Direktør, Århus Vand (2020)

THE CHALLENGES ARE ONLY GETTING BIGGER

Water-challenged countries face the highest increase in population

The population of the world is growing rapidly, and in parallel so does the need for water. The UN predicts 9.7 billion people by 2050, and 10-11 billion by 2100. Other prognoses expect the increase to peak in 2064 at 9.7 billion and subsequently a decrease to 8.8 billion in 2100.

Behind those numbers are radical demographic differences at both national and regional levels. In Western countries where the water supply is generally better, the population figure falls or stabilises. In several African countries, the population will double, triple or almost quadruple towards 2100 *(Vollset et al., 2020).*

The biggest population increases are thus found in those countries where the infrastructure is the least developed. 9 out of the 10 countries with the poorest access to clean water are found in Africa south of the Sahara, where only a fourth of the population has access to safe drinking water *(IEA, 2016).*

Urbanisation aggravates the problems

In 2019, just over half of the world's population (55%) lived in cities. By 2050, the share has increased to two out of three (68%) *(The UNESCO Courier, 2019).*

In actual figures, the population figures of the cities increase from 3.9 billion today to 6.3 billion by 2050 *(UN-Water, n.d.)*. Most of these people will live in overcrowded slum with inadequate water supply and sanitation or none at all.

At the same time, cities are growing. In 2018, we had 33 megacities, each of more than 10 million people. By 2030, this number is expected to be 43. The number of cities with at least one million people is expected to rise from 548 in 2018 to more than 700 by 2030 *(UN, 2018, p. 2)*.

Due to their massive size, those big cities experience huge challenges of water infrastructure and of lack of adequate water resources. Added to this is the fact that the demand of the cities for water will increase by 70% towards 2050 *(Grundfos, u.å.).*

"Engineers like to build. Reducing leaks is not sexy."

Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)

Prosperity increase consumption of water

As the world develops and prospers, the need for water will increase significantly. The global demand for water is expected to rise by 55% between 2000 and 2050. The growing need for water is caused by increased production of goods and energy and by the household consumption – all mainly due to growing wealth and improved living conditions *(Leflaive, 2012).*

Climate change
is accelerating water stress

Climate change is increasingly causing extreme weather, threatening both the availability and quality of water. In many places, droughts are becoming more frequent, and this stresses the supply to groundwater and surface water reservoirs. Other places experience massive amounts of down pour which results in flooding and pollution of crucial water reserves; i.e. wastewater from sewers, polluted water, seawater etc. Climate change will most likely cause sea levels to rise, which may result in saltwater intruding the groundwater and thereby polluting it.

> *"We have a responsibility to assign greater value to water."*
>
> *Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)*

Increased prosperity increases energy consumption which increases water consumption and subsequently the energy consumption

Water and energy are inextricably linked. Water is a necessary ingredient in the production of almost any kind of energy and within the energy industry, the electric industry is the main consumer of water. In Europe, 43% of the freshwater consumption is used for cooling down power plants and in the US, it is close to half the combined consumption *(WWAP, 2014, p. 3)*.

Improved living standards will lead to a radical increase of the energy consumption and given that a significant part of the energy production is using large quantities of water, this will cause the water usage to increase by 55% towards 2050 *(Leflaive, 2012)*.

Simultaneously, an increase in attention to cleansing wastewater will inevitably mean a larger request for energy. Currently, an average of 25% of the used electricity of the water industry is used for collection and treatment of wastewater *(WWAP, 2015 p. 47).*

FOODS

Agriculture and food production
among the heaviest consumers of water

The rapidly growing population of the earth needs to eat, and food production naturally keeps up with the growing population. 70% of the globally spent water is used in farming, 20% is used in industry, and a mere 10% of the total amount of water is used in households. Without contest, agriculture is the type of industry that uses the biggest quantities of water. Behind that number is great variation as in some developing countries, farming is responsible for as much as 95% of the total amount of water spent *(OECD, n.d.; WWAP, 2015 p. 47).*

> *"The amount of water needed is increasing, and there is increasing competition from other sectors such as food production."*
>
> *Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)*

MASSIVE NEEDS FOR INVESTMENTS

Outdated infrastructure causes
massive needs for investments

A recurring feature of most water companies is that by far the biggest share of their distribution grid is outdated and even antiquated compared to the requirements and the possibilities that the companies are now facing. Particularly in the cities, the current distribution grid cannot keep up with increased demand caused by the universal inflow of residents *(OECD, 2014, p. 3)*.

The extent of failure and leakage is on the rise, and and water supplies are generally facing massive and accumulated requirements of maintenance and renovation of the distribution grid. That task can only be solved through very comprehensive investments *(EWA, n.d.)*.

BIG DIFFERENCES

Diversity and multiplicity
across water companies

All water companies in the world have one task – to deliver clean and safe drinking water to people. But their conditions and qualifications for solving this task are characterised by great diversity which in and of itself is a barrier for cooperation and knowledge-sharing about the solutions to the water challenges.

The diversity is mirrored in the physical settings and the access to water resources such as surface water, ground water or sea water. But the extensive variation is also apparent in big divergences of the setting, in terms of parameters like demography, national economics, political system and legislation.

"Without regulatory requirements, the infrastructure of the water industry will not be properly maintained."

Lars Schrøder, Direktør, Århus Vand (2020)

FRAMEWORK CONDITIONS

Framework conditions of the water industry
are an impediment to improvement

Even though many water companies realise that there are significant financial and economical gains to be achieved by reducing water loss, they are still hesitant to take action. This is because they face political, financial or technical challenges which impede improvement projects *(PPIAF, 2016)*.

At the same time, most supply companies are struggling with old infrastructure systems which challenge the need for constant renewal and effort to ensure the quality of the distributed water. Often the water industry is decentralised, often leading to an inefficient "wait-and-see-approach" when it comes to problems and challenges *(UNESCO, 2016, pp. 15-28)*.

End users rarely pay the actual price

The price of a cubic metre of water varies tremendously from country to country, ranging from being free of charge to being very costly. Across supply companies, the end user's price rarely reflects the costs associated with the extraction and distribution of the water. This is a challenge to the water companies that are often underfunded and so financially unable to solve the problem of water loss and similar problems *(Sy & Ahmed, 2016).*

> *"It's not true that we don't have the resources. We need to recognize that we're all in this together and our prioritization must reflect this."*
>
> *Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)*

The water industry needs incentives to improve

Across countries, water companies do not have the incentives to streamline processes and reduce water loss. Prices are often politically determined and do not reflect actual costs of production and distribution of water. Water companies are not even awarded if they carry out improvements, nor are they punished if they do nothing *(Sy & Ahmed, 2016).*

In Denmark, significant incentives have caused the national water loss to become as low as 7%. Since 1996, all consumers have been required to install water meters to monitor and if necessary, reduce the amount of water spent. In addition, water companies with a loss rate of more than 10% must pay punitive charges to the State *(DANVA, 2019, p. 3)*.

POTENTIALS AND SOLUTIONS

Wastewater contains enormous energy potential

The world needs more and cleaner energy and through many projects, it has been proven that wastewater contains enormous energy potential. Despite this, 80% of the world's wastewater is led untreated into Nature and so we literally throw away large volumes of sustainable energy *(Grundfos, n.d.)*.

When wastewater is treated, the residual product can form the basis of biogas which is a clean source of energy. Biogas is used in many places all over the world, but the use is still sporadic. In Lille and Stockholm, city buses run on biogas and in cities such as Memphis, Chennai and Beijing, energy is generated based on wastewater *(Mizerny, 2016; TVA, 2017; Frangoul, 2016; IWA, 2018, p. 7)*.

Danish water treatment facilities cover a large part of their own energy consumption. Among Danish pilot projects are Ejby Mølle (near Odense, Denmark) which based on wastewater, produces 188% of the energy the treatment plant itself spends *(VandCenter Syd, n.d.)*.

Kalundborg Forsyning (Supply of Kalundborg) uses reverse cycle heating systems to extract heat from the wastewater and so covers 30% of the heat consumption of the supply area *(DANVA, 2019, p. 2).*

Less developed countries can fast track via technology

It is possible to achieve the UN SDG 6 of access to clean water for all without causing a dramatically increased global energy consumption.

First of all, the amount of water that is required for everyone to get access to, forms only a minor part of the combined global demand for water. Secondly, with the current technologies and solutions, it is possible to construct water supplies which from the beginning keep water loss at an absolute minimum and with a very modest energy consumption *(IEA, 2016, pp. 122-123).*

THE ROLE OF WATER COMPANIES

The water industry itself holds the key to the solution

For every percentage the water loss is reduced, the water company has an income or a saving which accumulates over the subsequent years. If a larger share of the produced water is charged, the income increases at no extra cost. If water loss is reduced, then the same amount of energy will produce less water which in turn reduces the costs for energy and service and operations.

If leakages and water losses are reduced through pressure control, the lifespan of the entire water system is prolonged which is financially beneficial. If pressure control is used with patterns of consumption, the amount of rupture and leakages is significantly lowered, which in turn reduces the costs for repairs and mending of damages requiring immediate attention. If consumers are motivated to reduce the amount of water spent, there is a direct spill-over effect on the production costs of the water company *(Værum, 2019)*.

> *"We have technical know-how, we do have the money, but do we have the willingness?"*
>
> *Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)*

Water companies in the EU are instructed to carry out risk assessment analyses

In recognition of the challenges of the water industry, the latest drinking water directive from the EU tightens the requirements imposed on water companies. They must be aware of the risks that threaten the supply of safe drinking water. By 2026 all major water companies in the EU must have completed a risk assessment analysis which covers, the entire supply chain from extraction area, extraction process and water treatment to storage and distribution.

Based on their risk assessment analysis, the water companies must then take the necessary precautionary measures to minimise identified risks. As far as the EU is concerned, the purpose of the directive is that the water companies must start solving the growing water problems effectively and appropriately *(Europa-Parlamentet, 2018)*.

A holistic life-span approach opens up financial freedom to act

Habitual thinking and sub-optimisation should be replaced by a holistic life-span approach to products and service and operations. The life-span of infrastructure can be prolonged through investments that are smaller than the costs required to handle failure and leakage. This unlocks funding.

Fewer leaks and less water loss will prolong the lifespan of water reservoirs, reduce maintenance costs, reduce the amount of energy spent and subsequently the negative climatic impacts of energy consumption.

Covid-19 demonstrates that automation is the solution

Covid-19 has made clear that water supplies must be as independent as possible on the human 24-7 monitoring which is comme il faut in the industry. Being manned at all times is costly, risky and uncertain. Who will look after our vital infrastructure if employees fall sick?

Replacing current systems with automated ones can reduce the need to dig up piping for replacement which is both tedious and costly. In the same way, automatic adjustments can prolong the lifespan of existing pipe systems.

Automation and data about the condition of the network will make employees more mobile and reduce operational costs and maintenance expenses. This will mean large future savings *(Hansen, 2020).*

Third parties may accelerate water loss improvements

Supply companies that want to reduce water loss often encounter political, financial or technical challenges that make it difficult to carry out improvements. Experience shows that there are many benefits from engaging a third party who, through their knowledge and technology, can accelerate and implement improvements as cost-efficiently as possible. Comparative analyses have documented that third-party engagement can lead to 68% higher reduction of water loss than if companies try to solve the challenges themselves.

This means that initiatives to reduce water loss can in fact finance themselves *(PPIAF, 2016)*.

> *"In many cases, consumers are more willing to pay for their water than politicians give them credit for."*
>
> *Bjørn Kaare Jensen, Vice chairman, Danish Water Forum, President, European Water Association (EWA) (2020)*

THE ROLE OF END-USERS

End-users can significantly reduce the amount of water spent

Experiences from Japan and Denmark demonstrate that end-users play a major role in solving the water challenges, by reducing the amount of water they spend and so save water resources.

Japan has reduced its water loss from 20% to less than 5%. This has happened through a number of initiatives, including installing water-saving equipment in the homes of end-users at no extra cost *(JICA, 2017).*

In Denmark, end-users have halved the amount of water spent over a few decades. This has happened through a number of initiatives, ranging from financial incentives to free guidance on how to save on water *(Baltzer & Lange, 2018).*

What we choose to eat can reduce the amount of water spent

The water footprint of different foods varies greatly. As farming is responsible for around 70% of the total amount of water consumed globally, the choice of food quite significantly impacts the reduction of water consumptions and so can potentially consider the stressed water resources; both here and now, and long-term, when food production has to keep up with the dramatic rise in population *(Leflaive, 2012)*.

The amount of water spent to produce one kilogram of a number of basic plant foods are: Rice: 3-5,000 litres, soy: 2,000 litres, wheat: 900 litres and vegetables: 300 litres *(WWF, 2006, p. 10).*

The production of one kilogram animal foods is much more water-intensive; beef: 15,400 litres, mutton 8,800 litres, pork: 6,000 litres and chicken: 4,300 litres *(Mekonnen & Hoekstra, 2010, p. 5).*

THE ROLE OF SUPPLIERS

Many ways to achieve cost-efficient daily operations

Suppliers of the water industry are working systematically on improving every joint of the water supply chain to reduce water loss and to make daily operations and necessary maintenance as cost-efficient as possible. Over the last few years, an array of intelligent products has been developed that integrate with the newest innovative and cloud-based digital solutions that support the control systems of the water utilities.

The most recent tool in the toolbox is Smart Water-solutions for real-time surveillance of the water systems in terms of water loss, pressure, temperatures etc. These data make it possible to adjust the supply according to the current need which will impact the life-span of the grid positively as well as the number of leaks and pipe fractures.

Existing technology in combination with IoT may have great impact

Suppliers of the water industry have developed digital solutions where IoT-based products collect a long list of relevant data directly from the grid. These data are collected on a cloud-based software platform which enables the water utilities to monitor the grid in terms of specific parameters, such as e.g. pressure in the grid, the position of valves, and changes in flow and temperature.

Based on these data, the utilities have a qualified foundation on which to make relevant decisions of ensuring security of supply and of optimising service and maintenance and most importantly reducing water loss.

A specific example of digital monitoring of the water supply is in Japan, where the grid is constantly monitored using digital meters. This is one reason why Japan has succeeded in reducing water loss from 20% to less than 5% *(JICA, 2017).*

"We have to do more with less. Utilize the water more efficiently and reduce the water footprint."

Dr. Kalanithy Vairavamoorthy, Executive Director, IWA (2020)

Pressure adjustment can delay investments, reduce water loss and save energy

The consumption of water varies over the course of a day. This means that adjusting the pressure in the distribution grid to match the current demand is by far the most efficient and economical initiative to reduce water loss and leakage.

Experience and registrations from a number of water supplies that work with pressure adjustment show that an average pressure reduction of 36% halves the number of fractures and leaks. This obviously reduces water loss significantly and reduces the costs for repairs and prolongs the lifespan of the grid, which in turn postpones necessary investments.

As a bonus, pressure adjustment leads to smaller levels of energy being spent which positively impacts economy and climate. An example is the water supply in Copenhagen, where pressure adjustment has helped reduce water loss to a mere 4% even though many of the pipes of the grid are more than 100 years old *(Hansen, 2020)*.

Real-time knowledge is the fastest route to change and improvement

Many water supplies do not have accurate information about what goes on in the distribution grid. Every piece of information can help reduce water loss, leakage or pollution.

Water meters and the introduction of pressure management provide a lot of knowledge about the current state of the distribution grid, and the value of real-time knowledge cannot be overrated. It is the key to discovering leaks and planning renovations and upgrade based on actual needs instead of on guesswork and happenstance. The long-term effect will be massive and the effect in terms of sustainable handling of water resources will be recognised by future generations.

REFERENCE LIST

AVK Group. (29 May 2020). Leakage managment and water quality on EU's agenda. AVK Group. Retrieved from https://www.avkvalves.com/en/news/get-to-know-us/revised-eu-drinking-water-directive

Baltzer, S. & Lange, M.F. Danskernes vandforbrug er rekordlavt: Vi har kun en jordklode. Danmarks Radio. Retrieved from https://www.dr.dk/nyheder/regionale/midtvest/danskernes-vandforbrug-er-rekordlavt-vi-har-kun-en-jordklode

DANVA. (2019). Vand i Tal 2019. DANVA, Skanderborg. Retrieved from https://www.danva.dk/media/6199/2019_vand-i-tal.pdf

Europa-Parlamentet. (2018, 23 October). Drikkevand: nye regler skal sikre bedre vandkvalitet og mindre plasticaffald. Europa-Parlamentet. Retrieved from https://www.europarl.europa.eu/news/da/press-room/20181018IPR16523/drikkevand-nye-regler-skal-sikre-bedre-vandkvalitet-og-mindre-plasticaffald

EWA. (n.d.). WG Economics: Forum for discussion and knowledge sharing. EWA. Retrieved from https://www.ewa-online.eu/WG_Economics.html

Frangoul, A. (2016, 13 October). How India is turning sewage into energy. CNBC. Retrieved from https://www.cnbc.com/2016/10/13/how-india-is-turning-sewage-into-energy.html

Grundfos. (n.d.). Når mangel på vand er virkelighed. Grundfos. Retrieved from https://www.grundfos.com/dk/learn/research-and-insights/when-water-scarcity-becomes-a-reality

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., Meybeck, A. (2011). Global food losses and food waste – extent, causes and prevention. FAO, Rome. Retrieved from https://knowledge4policy.ec.europa.eu/publication/global-food-losses-food-waste-extent-causes-prevention_en

Hansen, M.R. (2020, 8 July). Lockdown periods have highlighted the need for automation. International Water Association. Retrieved from https://iwa-network.org/lockdown-periods-have-highlighted-the-need-for-automation/

IEA (2016). World Energy Outlook 2016. IEA, Paris, https://doi.org/10.1787/weo-2016-en.

IWA. (2018, 26 February). Wastewater report 2018: The reuse opportunity. The International Water Association. Retrieved from https://www.iwa-network.org/wp-content/uploads/2018/02/OFID-Wastewater-report-2018.pdf

JICA. (2017, March). Japan's experiences on water supply development. Japan International Cooperation Agency. Retrieved from https://www.jica.go.jp/english/our_work/thematic_issues/water/c8h0vm0000ammj2q-att/activity_01.pdf

Kingdom, B., Soppe, G., Sy, J. (2016, 31 August). What is non-revenue walter? How can we reduce it for better water service?. World Bank Blogs. Retrieved from https://blogs.worldbank.org/water/what-non-revenue-water-how-can-we-reduce-it-better-water-service

Leflaive, Dr. X. Water outlook to 2050: The OECD calls for early and strategic action. Global Water Forum. Retrieved from https://globalwaterforum.org/2012/05/21/water-outlook-to-2050-the-oecd-calls-for-early-and-strategic-action/

Mekonnen, M., & Hoekstra, A. Y. (2010). The green, blue and grey water footprint of animals and animal products. (Value of water research report 48; No. 48). Unesco-IHE Institute for Water Education. Retrieved from http://www.unesco-ihe.org/Value-of-Water-Research-Report-Series/Research-Papers

Mizerny, J. (2016). Biogas buses are the green solution for cities. EU in My Region. Retrieved from https://euinmyregion.blogactiv.eu/2016/07/04/biogas-buses-are-the-green-solution-for-cities/

National Academy of Sciences. (2012, 8 November). Clean-up of some U.S. contaminated groundwater sites unlikely for decades. Science Daily. Retrieved from https://www.sciencedaily.com/releases/2012/11/121108131818.htm

Ritchie, H. & Roser, M. (2019). Clean Water. Our World in Data. Retrieved from https://ourworldindata.org/water-access#citation

Ritter, K. (2018a, 16 February). Floods and Water Shortages Swamp Mexico City. Retrieved from https://www.circleofblue.org/2018/latin-america/floods-water-shortages-swamp-mexico-city/

Ritter, K. (2018b, 23 February). Jakarta, the world's fastest-sinking city, also faces rising sea levels and river pollution. Circle of Blue. Retrieved from https://www.circleofblue.org/2018/asia/jakarta-worlds-fastest-sinking-city-also-faces-rising-sea-levels-river-pollution/

Ritter, K. (2018c, 28 March). Water scarcity looms in London's future. Circle of Blue. Retrieved from https://www.circleofblue.org/2018/world/water-scarcity-looms-in-londons-future/

Ritter, K. (2018d, 4 April). Recurring dry spells fuel water wories in Tokyo. Circle of Blue. Retrieved from https://www.circleofblue.org/2018/asia/recurring-dry-spells-fuel-water-worries-in-tokyo/

OECD. (2011). Benefits of investing in water and sanitation: An OECD perspective. OECD Studies on Water. OECD Publishing, Paris, https://doi.org/10.1787/9789264100817-en

OECD. (2014). Managing water for future cities: Policy perspectives. OECD Publishing, Paris. Retrieved from https://www.oecd.org/environment/resources/Policy-Perspectives-Managing-Water-For-Future-Cities.pdf

OECD. (n.d.). Managing water sustainably is key to the future of food and agriculture. OECD. Retrieved from https://www.oecd.org/agriculture/topics/water-and-agriculture/

PPIAF. (2016, June). Using performance-based contracts to reduce non-revenue water. The World Bank, Washington. Retrieved from https://iwa-network.org/learn_resources/using-performance-based-contracts-to-reduce-non-revenue-water/

Sy, J., Ahmed, S. (2016, 16 June). In the market for good practices on performance-based contracts for non-revenue water management. World Bank Blogs. Retrieved from https://blogs.worldbank.org/ppps/market-good-practices-performance-based-contracts-non-revenue-water-management

The UNESCO Courier. (2019). Water and megacities. The UNESCO Courier, (2). Retrieved from https://en.unesco.org/courier/2019-2/water-and-megacities

TVA. (2017, 10 February). Turning Memphis wastewater into energy. Tennessee Valley Authority. Retrieved from https://www.tva.com/Newsroom/Turning-Memphis-Wastewater-into-Energy

UNESCO. (2016). Water, megacities and global change: portraits of 15 emblematic cities of the world.

UNESCO, Paris. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000245419

UN. (2015, August). New open-access database aims to get water-scarce countries 'more crop per-drop' - UN agency. United Nations. Retrieved from https://www.un.org/sustainabledevelopment/blog/2015/08/new-open-access-database-aims-to-get-water-scarce-countries-more-crop-per-drop-un-agency/

United Nations. (2018). The world's cities in 2018: data booklet. UN, New York. Retrieved from https://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf

UN-Water. (n.d.). Water and urbanization. UN-Water. Retrieved from https://www.unwater.org/water-facts/urbanization/

VandCenter Syd. (n.d.). Der er energi i lortet. VandCenter Syd. Retrieved from https://www.vandcenter.dk/viden/energi

Vollset, S. E., Goren, E., Yuan, C.-W., Cao, J., Smith, A. E., Hsiao, T., Bisignano, C., Azhar, G. S., Castro, E., Chalek, J., Dolgert, A. J., Frank, T., Fukutaki, K., Hay, S. I., Lozano, R., Mokdad, A. H., Nandakumar, V., Pierce, M., Pletcher, M., … Murray, C. J. L. (2020). Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. The Lancet. https://doi.org/10.1016/s0140-6736(20)30677-2

Værum, M.M. (2019, 13 May). Minimising bursts and leaks through pressure management. Kamstrup. Retrieved from https://www.kamstrup.com/en-en/blog/minimising-bursts-and-leaks-through-pressure-management

Water.org. (n.d.). The water crisis. Water.org. Retrieved from https://water.org/our-impact/water-crisis/

WHO. (2012, May). Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage. World Health Organization. Retrieved from https://www.who.int/water_sanitation_health/publications/global_costs/en/

WHO. (2019a, 14 June). Drinking-water. World Health Organization. Retrieved from https://www.who.int/news-room/fact-sheets/detail/drinking-water

WHO. (2019b). Microplastics in drinking-water. World Health Organization. Retrieved from file:///home/chronos/u-84cefa5907f3fc9b21a92b79ddd26e57a9f5926e/MyFiles/Downloads/9789241516198-eng.pdf

WHO. (n.d.). Estimating WASH-related burden of disease. World Health Organization. Retrieved from https://www.who.int/activities/estimating-WASH-related-burden-of-disease

WWF. (2006, January). Living waters: Conserving the source of life. WWF, Holland. Retrieved from https://www.ircwash.org/resources/living-waters-conserving-source-life-thirsty-crops-our-food-and-clothes-eating-nature-and

WWAP. (2014). The United Nations world water development report 2014: water and energy. UNESCO, Paris. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000225741?posInSet=1&queryId=6e8cb850-604c-4f81-9f44-4d5790f4cbf3

WWAP. (2015). The United Nations world water development report 2015: water for a sustainable world. UNESCO, Paris. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000231823

Zyga, L. (2009, 17 March). How much energy goes into making a bottle of water? Phys.org. Retrieved from https://phys.org/news/2009-03-energy-bottle.html

WATER IN THE WORLD

MIX
Paper from responsible sources
FSC® C134689

CO_2
CLIMATE NEUTRALIZED

NORDIC ECOLABEL
5041 0309
Printed matter