

The background is a deep blue, textured surface, possibly water, with numerous small, bright droplets and bubbles scattered throughout. A vertical white bar is visible on the left side of the image.

AQUA

# WATER ES·SEN·TIALS

The Future of Water:  
A human and business priority

Point-of-View

# Content



Executive Summary

1 Origins and Types of Water on Earth

2 Role of Water in the World

2.1 Biological and Geological Role of Water

2.2 Social and Political Role of Water

2.3 Economic Role of Water

3 Water Pollution and Wastewater as a Problem of Humanity

4 Trends shaping the water industry

# Water is the resource of fundamental importance, the scarcity of which could slow down the global development

## Key figures



71,0% of Earth is covered in water



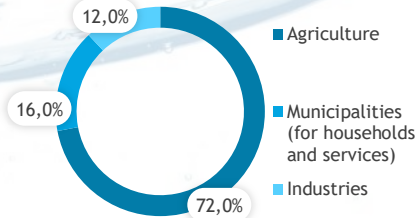
Water accounts for up to 75,0% of human body weight



10,0 billion tonnes of freshwater is used worldwide everyday

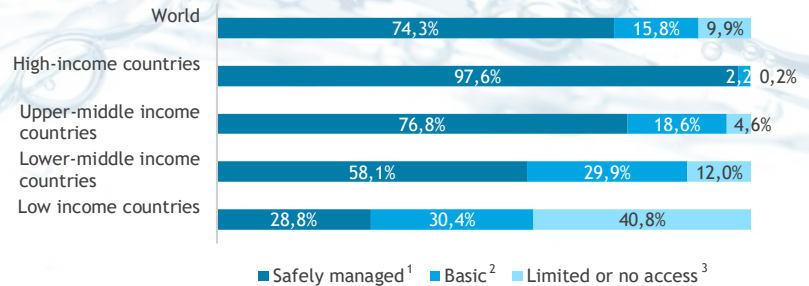
The origin of the water is still under debate – whether it emerged from the Earth's mantle or was brought by asteroids and meteorites billion years ago. However, it is difficult to overestimate the importance of water during the world history. Water plays a fundamental role in people's lives and global economic development.

## Global freshwater withdrawals usage as of 2021



In the modern world, especially in developed countries, water is taken for granted and people do not realise its true value. However, in 2021, more than two billion people live in water-stressed countries, of which 733,0 million live in high and critically water-stressed countries.

## Share of the population with access to drinking water facilities, 2020



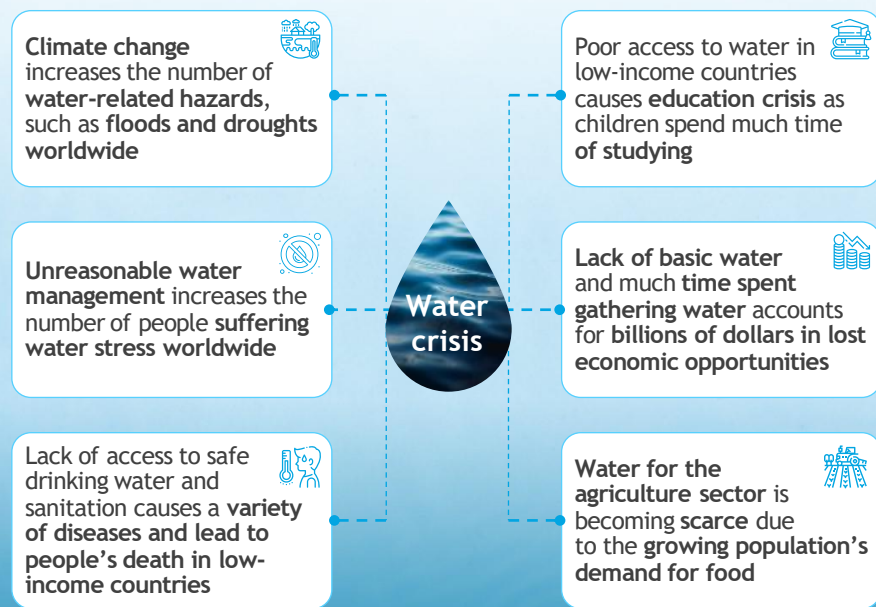
Water scarcity adversely affects production volumes and, therefore, global economic development, as well as causes significant socio-political tensions, such as conflicts in Africa and the Middle East.

Source: Our World in Data website; UN Water website; The World Counts website; Media overview

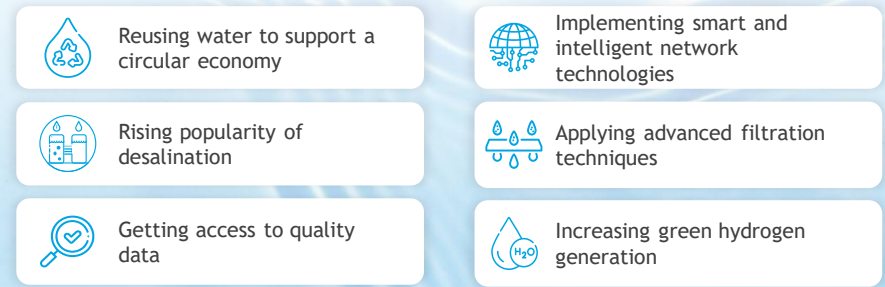
Notes: (1) Water source located on premises, available when needed and free from contamination; (2) Water source that is located closer than 30 minutes roundtrip; (3) Water source that is located farther than 30 minutes roundtrip or water from unprotected source, such as river, dam, lake, pond, etc.

# Efficient water management and introduction of innovative technologies will shape the future of water industry

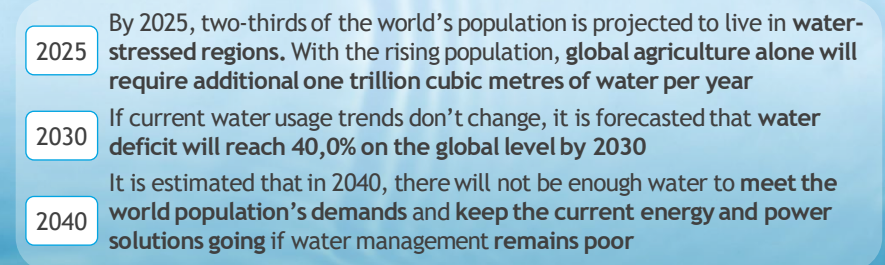
## Consequences of the water crisis



## Selected trends that shape water industry



## Future Water Outlook





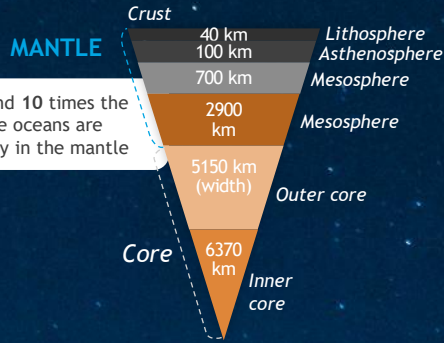
# ORIGINS AND TYPES OF WATER ON EARTH

# To this day the scientists are actively researching to agree on one single theory of the origins of water on Earth

The Earth is widely known as a “*Blue Planet*” due to abundant water on its surface. Yet, the origins of water on Earth remains a major debate subject with two competing theories of how the Earth went from the “rocky nothingness” to a water-rich “pale blue dot”

## Theory 1 – From Formation of Earth

The first theory argues that water was on the Earth since its beginning, as rocks found in a layer of the Earth, the mantle, contains water in the form of hydroxyl groups trapped with minerals, which can be released during volcanoes. As the pressure falls, the water vaporises and explodes into atmosphere as steam to later condense and fall back into Earth, filling the rivers and oceans.



## Theory 2 – From Outer Space

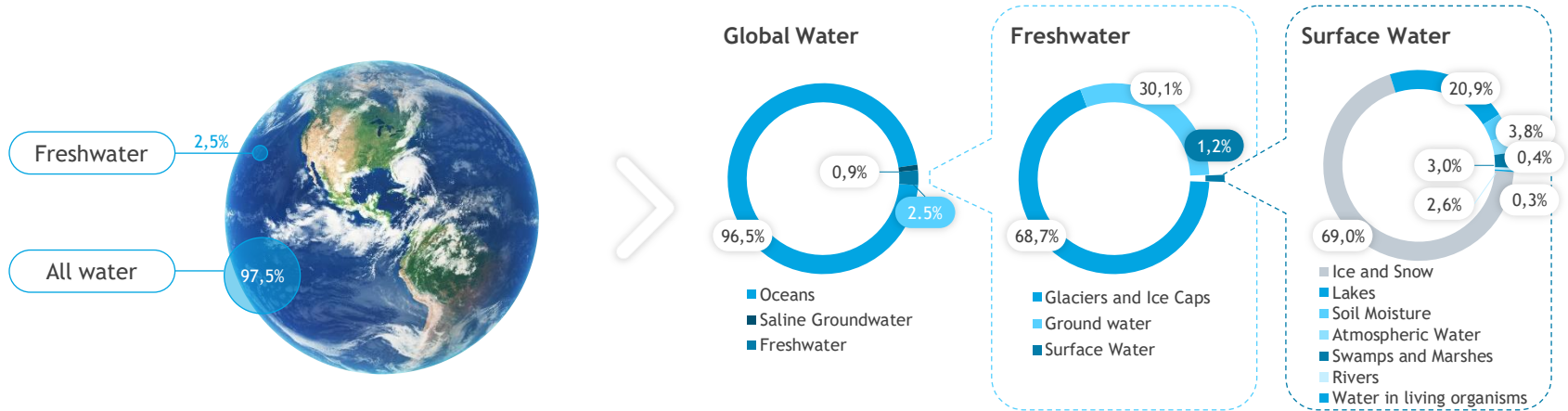
The second theory highlights that water arrived from outer space in the final stage of Earth’s formation, mostly facilitated by water-rich asteroids and comets colliding with the planet. Since the ratio of hydrogen and deuterium in the meteorite water was close to that of terrestrial water, scientists concluded that asteroids and comets were the likely source of Earth’s water.



It is highly likely that the truth lies in the middle and Earth’s water is a combination of endogenous and exogenous sources

# Less than 3% of all water on Earth is freshwater, yet only 1% is accessible, which makes it a rare resource globally

## Earth's Water Distribution



While more than 70% of Earth's surface is covered in water, only a small percent of water is fresh and even less of it is easily accessible. Around 97% of all Earth's water is being saline or ocean-based, with only remaining less than 3% of freshwater.



Despite its importance for humanity, freshwater is an extremely rare resource, as water distribution is very uneven. Around 69% of freshwater is trapped in glaciers and ice caps, and another 30% is under the surface in the form of groundwater.



# ROLE OF WATER IN THE WORLD



# Water is essential to support life on the planet, and it contributes to the global economy and social stability

Water touches every aspect of the world's development and has a major impact on people's lives in biological, social, and political terms. It drives economic growth, supports healthy ecosystems, and is essential and fundamental for life itself.

## Biological & Geological



Being the universal solvent, water is vital for the organisms as it participate in the oxygen and nutrients transportation in the cells, as well as in metabolism, and supports the cellular structure. Water makes up 60,0-75,0% of human body weight. Moreover, water links and maintains all ecosystems on the planet. It propels plant growth, supports native wildlife and provides dwellings for multiple amphibians, insects and other water-birtherd organisms.

## Social and political



Every person has a right to free fresh water access. Contaminated water could undermine efforts of combating extreme poverty and disease in the world's poorest countries. Water is vital for the access to energy sources, while uneven distribution of water leads to political conflicts between countries.

## Economic



Water is a vital factor for the global production, therefore reducing water supply would lead to slower economic growth worldwide. Water is extremely important for the number of other economic sectors as well, such as food, agriculture, energy and gas, processing and transport industries.

Roles of water





# BIOLOGICAL AND GEOLOGICAL ROLE OF WATER

# Water is a fundamental component of the Earth planetary development and a basis for evolution of the living systems



## Biological role

All forms of life on Earth requires water, it is the major component of all living systems, occupying most of the cell's volume. Due to its properties water ensures processes that organisms require to live.

- ▶ **Water is the universal biological solvent** that is critical for the delivery of nutrients in the cells and the removal of metabolites
- ▶ **Water serves as an essential buffer** to support the regular temperature due to its high specific heat capacity and regulate pH in biochemical mediums
- ▶ **Water is a participant in many biochemical reactions** and the principal reactant in the **photosynthesis process**, which is vital for living organisms being the major source of oxygen in the atmosphere



## Geological role

All water on Earth forms a **hydrosphere**, which is an important agent of geologic change through the hydrologic cycle.

**Water shapes our planet** by depositing minerals, aiding lithification, and altering rocks after they are lithified.

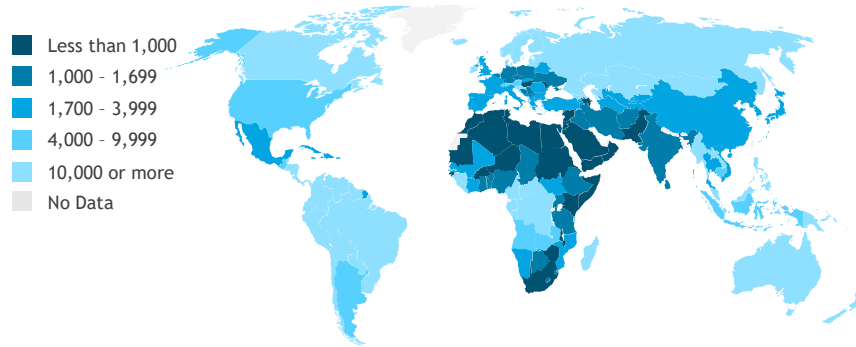
Hydrosphere comprises:

- ▶ **Groundwater**, which is located beneath the surface of the earth
- ▶ **Surface water** occurs on the earth's surface in streams, rivers, lakes, and reservoirs
- ▶ **Water in the air**

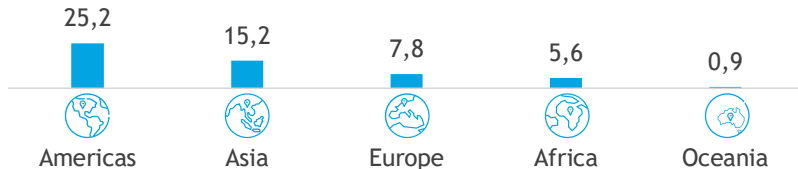
Water on the planet **constantly circulates** and transforms its physical forms between solid, liquid, and gas (water vapour). The ocean ensures global movement of water and **affects weather and climate** by storing solar radiation, distributing heat and moisture around the globe

# Since the freshwater distribution is uneven around the globe, many countries face the risk of water scarcity

## Freshwater recourses worldwide per capita, m<sup>3</sup>



## Global renewable water resources 2017, by region, thousand cubic kilometres

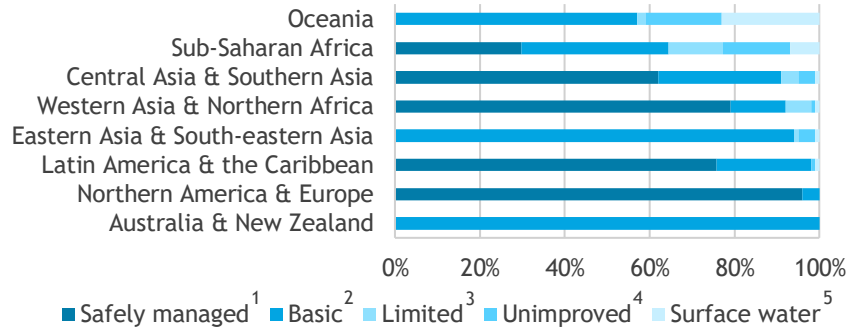


Source: Statista website; Bloomberg website; The World Bank website

Notes: (1) Drinking water from an improved source that is accessible on premises, available when needed and free from contamination; (2) Water source that is located closer than 30 minutes roundtrip; (3) Water source that is located farther than 30 minutes roundtrip; (4) Water from unprotected dug well;

(5) Water directly from a river, lake, canal, streams, pond and dam

## Share of regional populations with access to various water sources worldwide in 2020



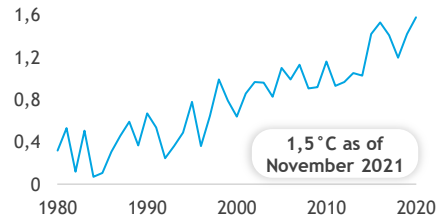
- ▶ Global renewable water resources on Earth **differ from region to region** due to the climate specific and geological characteristics. Meanwhile the access to water sources also depends on the economic development of the each region and country
- ▶ **The Americas has the largest renewable water resources** worldwide, namely 25,2 thousand cubic kilometres. **Brazil, Russia, the USA and Canada** are the countries with the biggest amount of renewable water resources worldwide
- ▶ **The Middle East and Africa experience water scarcity.** Most African countries have high drought risk, which is classified in terms of socioeconomic effects such as agricultural losses

# Global warming leads to the rise of the sea level, increases flooding and causes massive disruptions worldwide

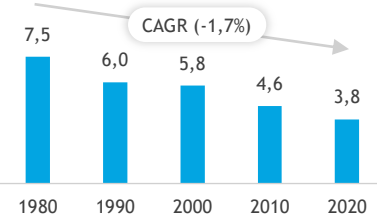
## Climate change as a reason of the global sea level rise

- ▶ Record atmospheric greenhouse gas (GHG) concentrations and associated accumulated heat **caused rapid and intensifying global climate changes**. The GHG trap the heat in the atmosphere and cause the planet to get **hotter, which is called the greenhouse effect**
- ▶ The greenhouse effect is **the main reason for global warming**. Since 1980, the global annual temperature has risen by **0,2 °C**, which has a **negative impact on the water circulation processes**. Europe and Asia are the regions with the biggest temperature changes, which hurts the water cycle
- ▶ **Annual Arctic Sea Ice Area extremely decreased** at a CAGR of **(-1,7%)** for the last 40 years, which was **global warming consequences**. This abnormal reduction leads to the global sea level rise

## Annual anomalies in global land surface temperature<sup>1</sup>, in degrees Celsius



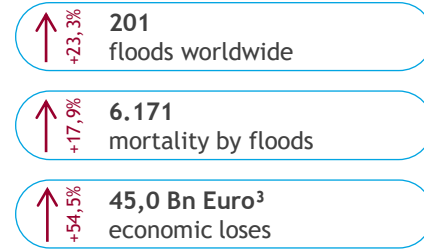
## Annual Arctic Sea Ice Area, in million square kilometres



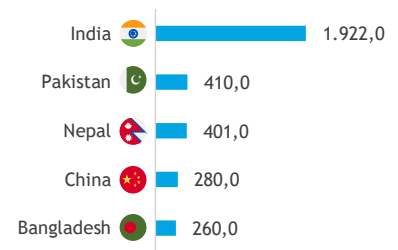
## Floods as consequences of the global sea level rise

- ▶ **Due to climate changes, the risk of floods is increasing worldwide** during the last decades. The **coastal and low-lying, urban, and river areas** with frequent heavy rains are **the most vulnerable to flooding**
- ▶ **In 2020, 201 floods were recorded worldwide, most of which occurred in the Asia region**. The mortality from floods increased globally by **17,9%** in 2020 compared to the 2000-2019 annual average. The most of fatal incidents were recorded in India mainly due to the weak preventing and rescue activities
- ▶ Floods cause a number of **short-term and long-term consequences** for social and economical spheres. **Water supply disruption, property destruction, destroying of land for living and agriculture** are among most frequent consequences of the floods

## Global key figures in 2020<sup>2</sup>



## Top-5 countries by number of mortality from floods in 2020

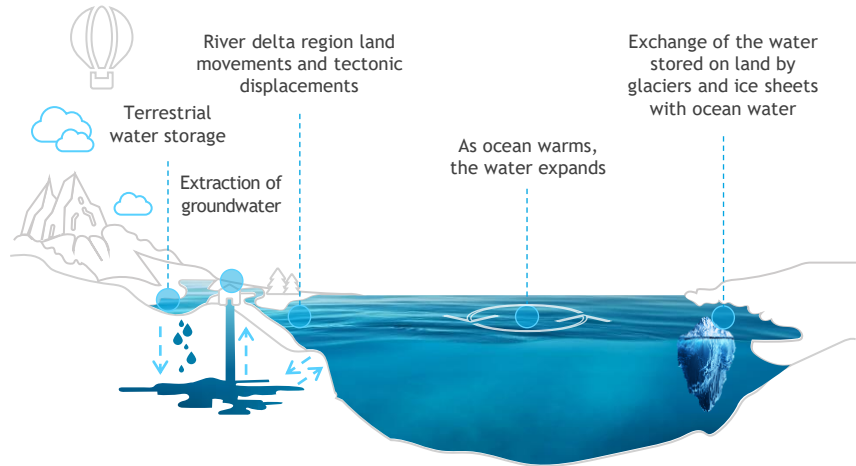


Source: UNDRR PreventionWeb website; NASA website; NRDC – Global warming – [2021]  
 Notes: (1) Compared to the 20<sup>th</sup> century average; (2) Compared to the 2000-2019 annual average;  
 (3) Numbers are converted from USD to Euro due to the exchange rate by ECB

# Without immediate preventive measures the global sea level is projected to rise by around five times until 2050

Global warming accelerates the sea level rise, which provokes coastal erosion, worsen the quality of drinking and irrigation water, damage historical heritage, affect mobility systems in cities, as well as submerge farmland and natural landscapes.

## What causes the sea level to rise?



**Ocean Warming**  
50,0% of sea level rise linked due to thermal expansion of water



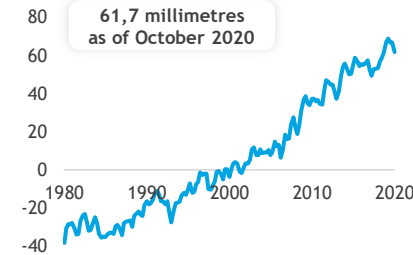
**Ice Melting**  
Polar Ice melting drops 430,0 gigatonnes of fresh-water annually into ocean



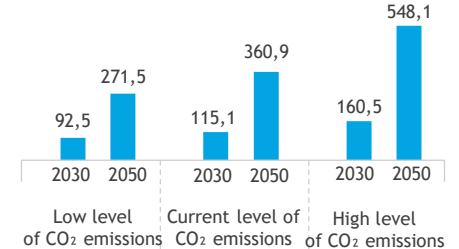
**Deglaciation**  
Global loss of 9,0 billion tonnes of glacial ice since 1961

CO<sub>2</sub> emissions heated up our planet causing glacier recession and Ice melting. Depending on the increase in CO<sub>2</sub> emissions, **scientists are projected three scenarios for sea level rise by 2050.**

## Global sea level rise<sup>2</sup>, millimetres

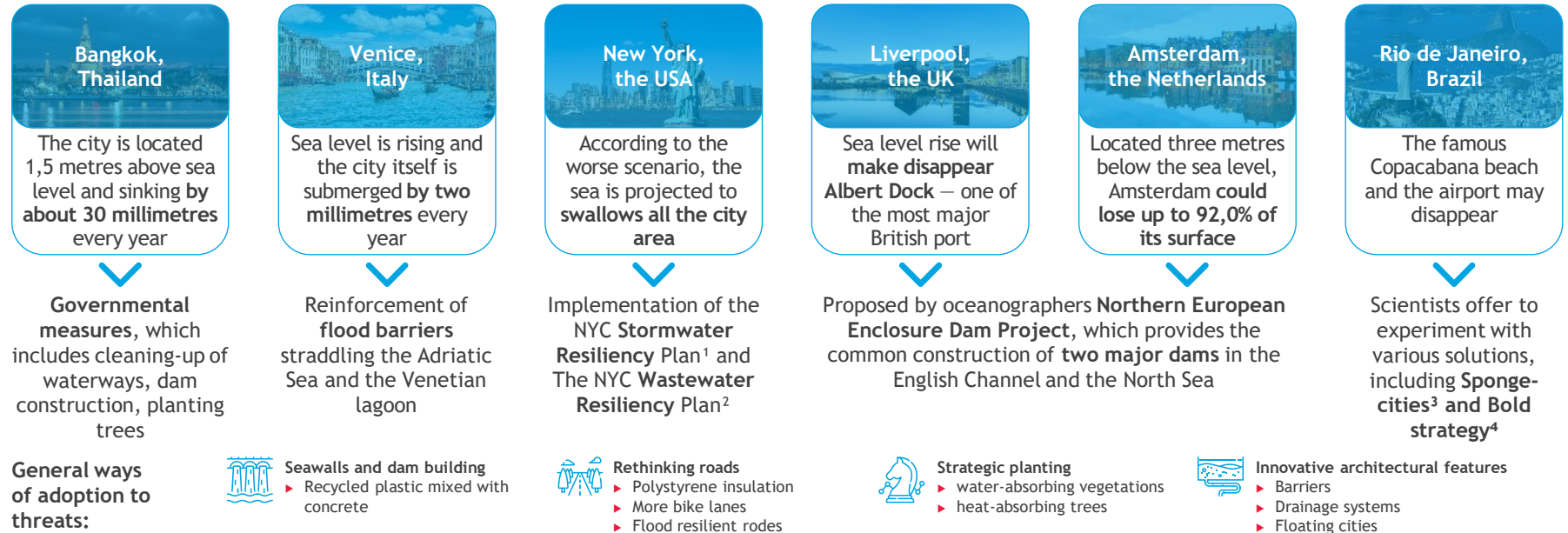


## Forecasted sea level rise by path scenario<sup>3</sup>, millimetres



# Therefore, governments are looking for solutions and measures to protect cities from vanishing under water

The major cities are expected to be affected by sea level rise and measures for prevention



General ways of adoption to threats:



Seawalls and dam building  
 ▶ Recycled plastic mixed with concrete



Rethinking roads  
 ▶ Polystyrene insulation  
 ▶ More bike lanes  
 ▶ Flood resilient roads



Strategic planting  
 ▶ water-absorbing vegetations  
 ▶ heat-absorbing trees



Innovative architectural features  
 ▶ Barriers  
 ▶ Drainage systems  
 ▶ Floating cities

Source: TimeOut – 9 cities that could be underwater by 2030 – [2021]; National Geographic – Sea level rise – [2019]; Media overview

Notes: (1) Includes facilitate green roof deployment, timely public inform, as well as drainage network improvement; (2) Provides the development of pumping stations through static barriers installation, and seal building; (3) Combination of repurposed built space, rain gardens, ponds, and wetlands to store excess water;

(4) Rio de Janeiro's transformation into a sustainable city with green areas protection and recycling promotion

# Northern European Enclosure Dam is one of the joint initiative to address the sea level rise in the North Europe



## Northern European Enclosure Dam (NEED) –

is a potential megaproject about the construction of two major dams in the English Channel and the North Sea proposed by two oceanographers – Sjoerd Groeskamp and Joakim Kjellsson. The project is a possible solution to decrease the sea level rise from the melting Arctic ice in the Arctic Ocean and save millions from losing homes and land. Scientists suggest the dams would be more effective than individual countries taking actions.

However, enclosing the North and Baltic Seas will have a negative effect on wildlife and the environment. Tides would be disrupted, affecting the way sediment, nutrients, and small marine life would circulate.



Estimated cost:  
Around 300,0-400,0 Bn Euro



Estimated timeline:  
50- 100 years



# Despite the global sea level rise, there are ecosystems that are drying up and are at risk of disappearing completely

## Five Drying Rivers

### 1 Colorado River

 The USA, Mexico



**Why:** wide usage for agriculture, industrial and municipal needs. Over last century the rivers flow declined by about 20,0%

**Proposed Fix:** four American states<sup>1</sup> consider a programme to voluntarily reduce agricultural water use in the upper Colorado River basin

### 2 Yellow River

 China



**Why:** extensive usage for agriculture  
**Proposed Fix:** In 1990 was established YECC<sup>2</sup> to manage the river's lower

and mitigate the devastating effects of the destructive droughts and floods

### 3 Rio Grande River

 The USA, Mexico

**Why:** the river is highly depends on the rainfall, which declined in the recent years due to the climate changes

### 4 Teesta River

 India

**Why:** wide usage for irrigation and other uses

### 5 Indus River

 Pakistan

**Why:** agricultural, industrial and household activities

## Five Drying Lakes

### 1 Aral Sea

 Kazakhstan, Uzbekistan



**Why:** Soviet Union's strategic diversion for irrigation purposes

**Proposed Fix:** splitting the sea, dam construction

**Status:** implemented


**Aral Sea is the fastest drying lake in the World with 90% of its surface water gone by 2021, due to combination of Strategic Soviet Union's diversion for irrigation purposes and otherwise dry steppe area of Central Asia. Even though the efforts to preserve the lake have been implemented, the Eastern Basin is completely extinct**

### 2 Lake Urmia

 Iran

**Why:** damming the flow-in rivers

### 3 Dead Sea<sup>3</sup>

 Israel, Jordan

**Why:** diverting Jordan river flow  
**Proposed Fix:** building canals  
**Status:** not implemented, due to Middle East/Jordan/Israel conflict



### 4 Lake Chad



Chad, Cameroon, Nigeria, Niger  
**Why:** catchment area discharge, evaporation

### 5 Lake Eyre

 Australia

**Why:** evaporation

Source: NASA website, Science website Interesting Engineering website; Smithsonian website; China Daily

Notes: (1) Wyoming, Colorado, Utah and New Mexico; (2) Yellow River Conservancy Commission YRCC, a government agency

17 under the Ministry of Water Resources of China; (3) Deepest point on Earth;

# Global droughts are not only affecting rural areas but some cities, potentially leaving inhabitants without water access



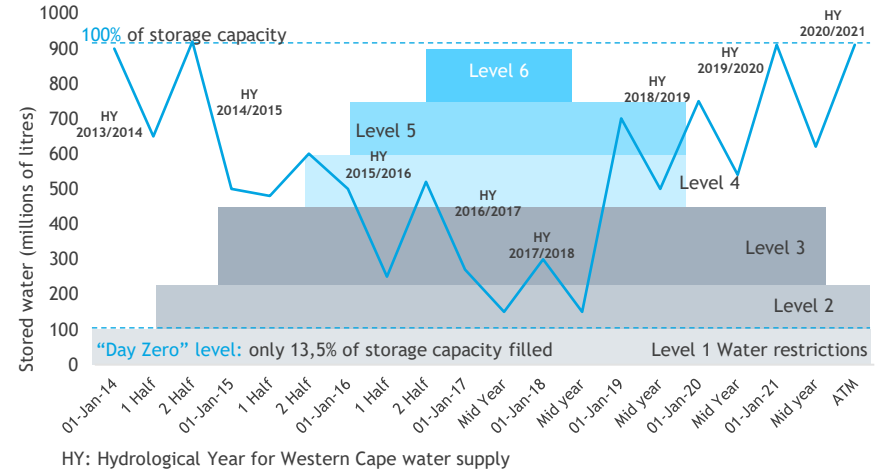
More than 2,0 billion people are living in countries under water stress and 3,6 billion people face inadequate access to water at least one month per year. Meanwhile, water-related hazards have increased in frequency for the past 20 years. Since 2000, the number and duration of droughts also increased by 29,0%

## The worst droughts in 2021 worldwide

- 1 Extreme weather conditions, from massive flooding to severe water shortages, have affected Brazil in May and October. The country faced its worst drought in 91 years, increasing fears of energy rationing, hitting hydroelectric power generation and agriculture while raising the risk of Amazon fires.
- 2 In Madagascar, hundreds of thousands of people were starving as a result of the July drought. WFP<sup>1</sup> reported that in some regions, about 55,0% of people need action to protect livelihoods and reduce food insecurity.
- 3 In Iraq, large swathes of farmland, fisheries, power production and drinking water sources have been depleted of water. In the Ninewa governorate, wheat production is expected to decrease by 70,0% due to the drought, while in the Kurdistan Region of Iraq production is expected to decline by half.

## Cape Town Water Crisis

Cape Town Water Crisis in 2018 has been brought upon the Western Cape due to severe droughts being starting in 2015 and led to the only 13,5% of the region's storage capacity filled. As a response to the crisis, tens of thousands of pines and eucalyptus trees were chopped due to consuming 55 billion litres of water per year



Sources: World Meteorological organisation website; Ecological Threat Register website; Media overview; The UN World Food Program report – 'Hunger Hotspots' – [2021]; United Nations Office for the Coordination of Humanitarian Affairs website;



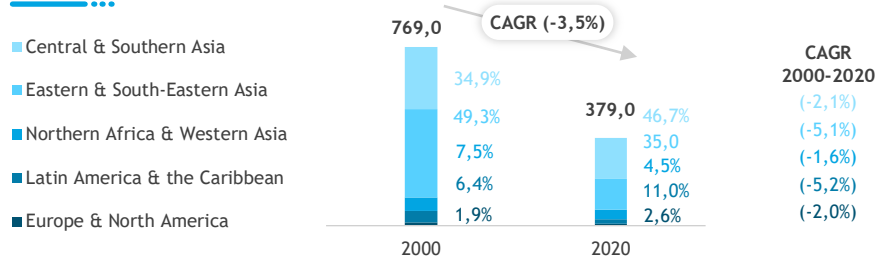
# SOCIAL AND POLITICAL ROLE OF WATER



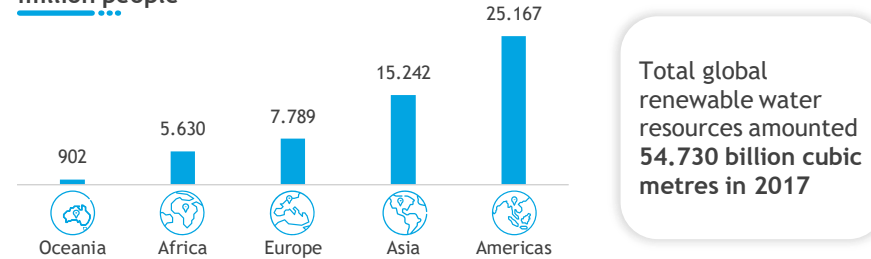
# SOCIAL ROLE OF WATER

# Global availability of drinking water and sanitation services has been actively increasing during the last decades

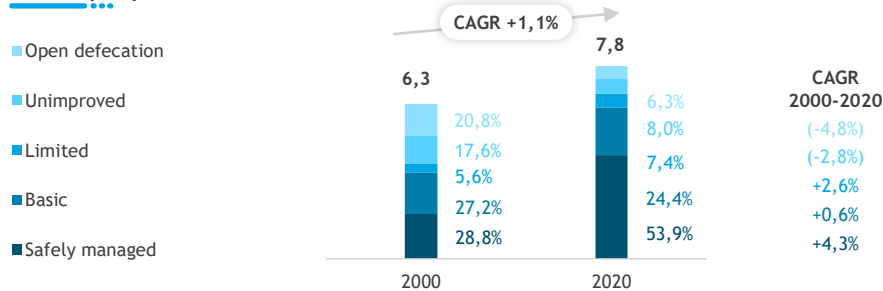
Number of people without basic drinking water services by region, million people



Number of people without basic drinking water services by region, million people



Global population with sanitation facilities supply by facility type<sup>2</sup>, billion people



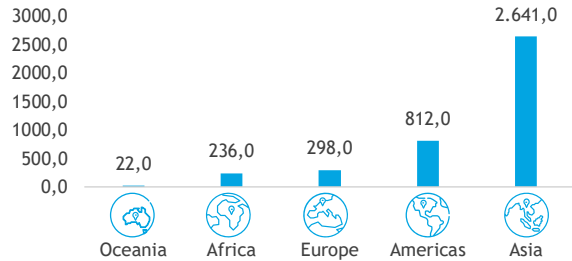
- ▶ Access to drinking water and sanitation are the basic needs for people around the world. Despite the **stable rise of water services accessibility** within the last decades, currently, **4,8% of the global population** still suffer from the **lack of drinking water services**, with almost a half of which in the **Central & Southern Asia**
- ▶ As of 2020, **4,2 billion people worldwide had access to safely managed sanitation services**, which was a 2,3 times increase during the last 20 years. Herewith, **6,3% of the global population still practised open defecation**, and 8,0% experienced unimproved facilities only
- ▶ **The Americas is the richest region worldwide in terms of renewable water resources**. Its share in the global renewable water resources reached **46,0% in 2017**, followed by Asia and Europe, which shares were **27,8% and 14,2% respectively in 2017**

Source: Statista website, Media overview

Notes: (1) Per latest available data; (2) Safely managed – use of improved facilities that are not shared with other households and where excreta are safely disposed; Basic – use of improved facilities that are not shared with other households; Limited – use of improved facilities that are shared with other households; Unimproved – use of pit latrines without a slab or platform, hanging latrines or bucket latrines; Open defecation – Disposal of human feces in fields, forests, bushes etc.

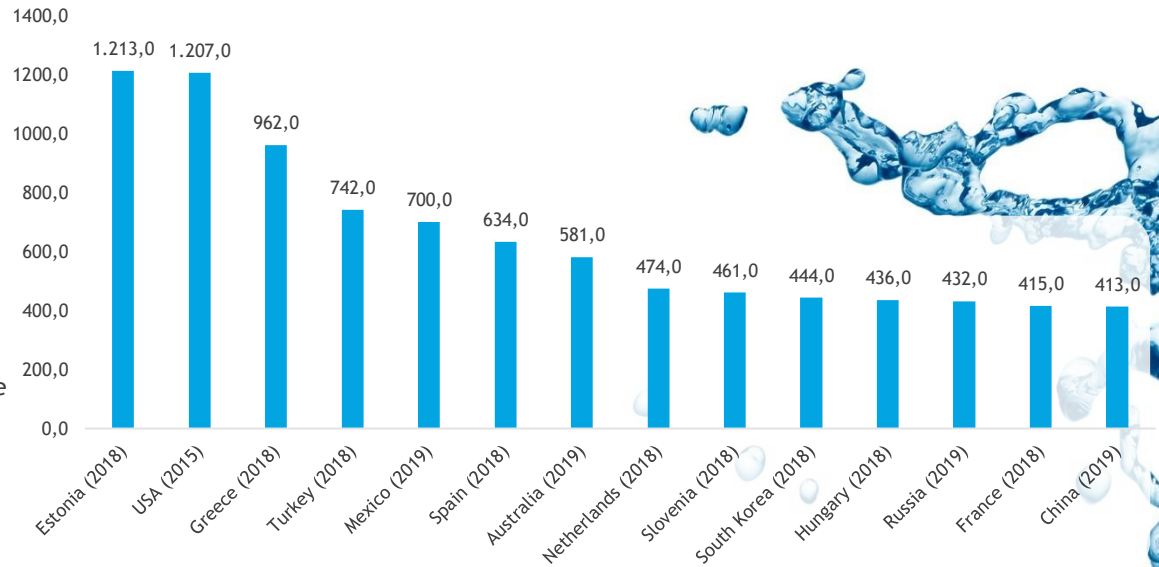
# While Asia has the largest total water consumption, the water use per capita is the highest in the USA and Europe

Annual water withdrawals worldwide as of 2017, by region, in billion cubic kilometres per year



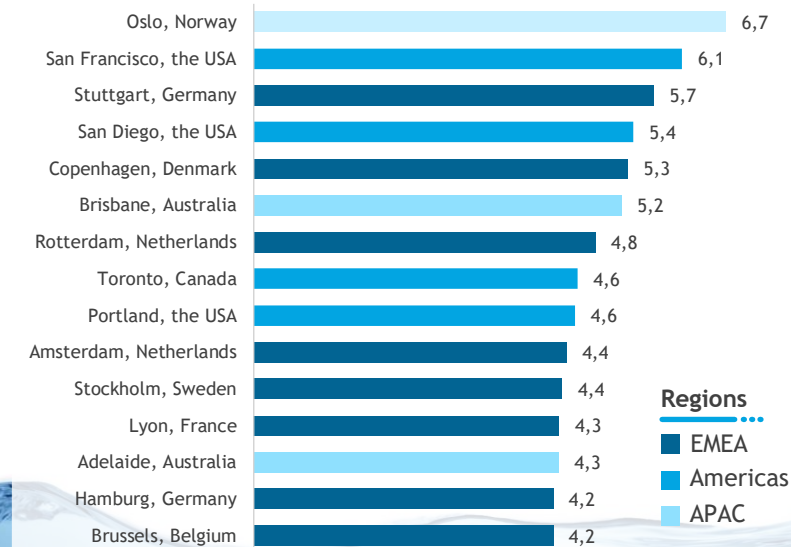
- ▶ Asia is currently home to **4,5 billion people**, who used **around 65,9%** of the world's water supply as of 2017
- ▶ On average, **144,0 litres of water per person per day** was supplied to households in Europe in the last decade
- ▶ **In Africa**, most people get **20,0 litres of water a day** which is the same quantity of water when having a shower for 1,5 minutes. Household water use averages **47,0 litres per person**
- ▶ The average American household uses more than **1.000,0 litres of water per day**

Annual water withdrawals per capita in selected countries, in cubic meters per inhabitant<sup>1</sup>

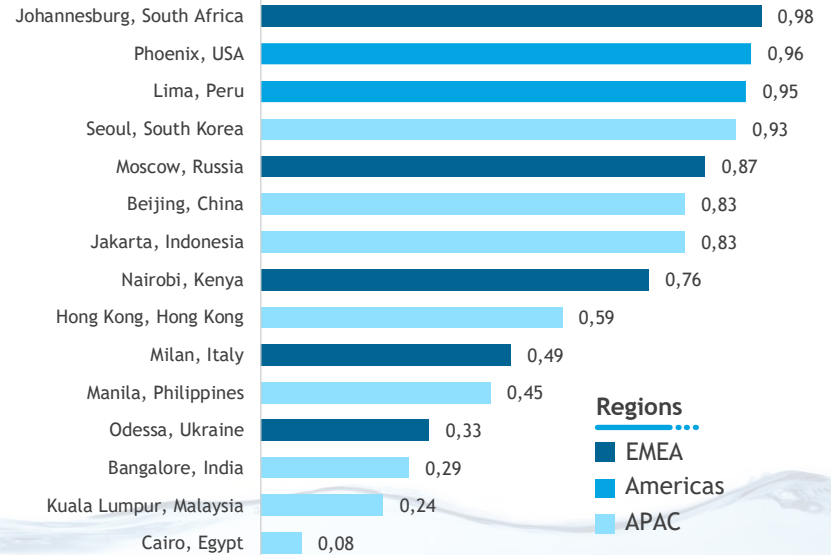


# At the same time, the tap water supply in the US cities is offered at higher rates compared to other countries

Most expensive prices of tap water in selected cities worldwide in 2021, in Euro per cubic metres



Lowest prices of tap water in selected cities worldwide in 2021, in Euro per cubic metres

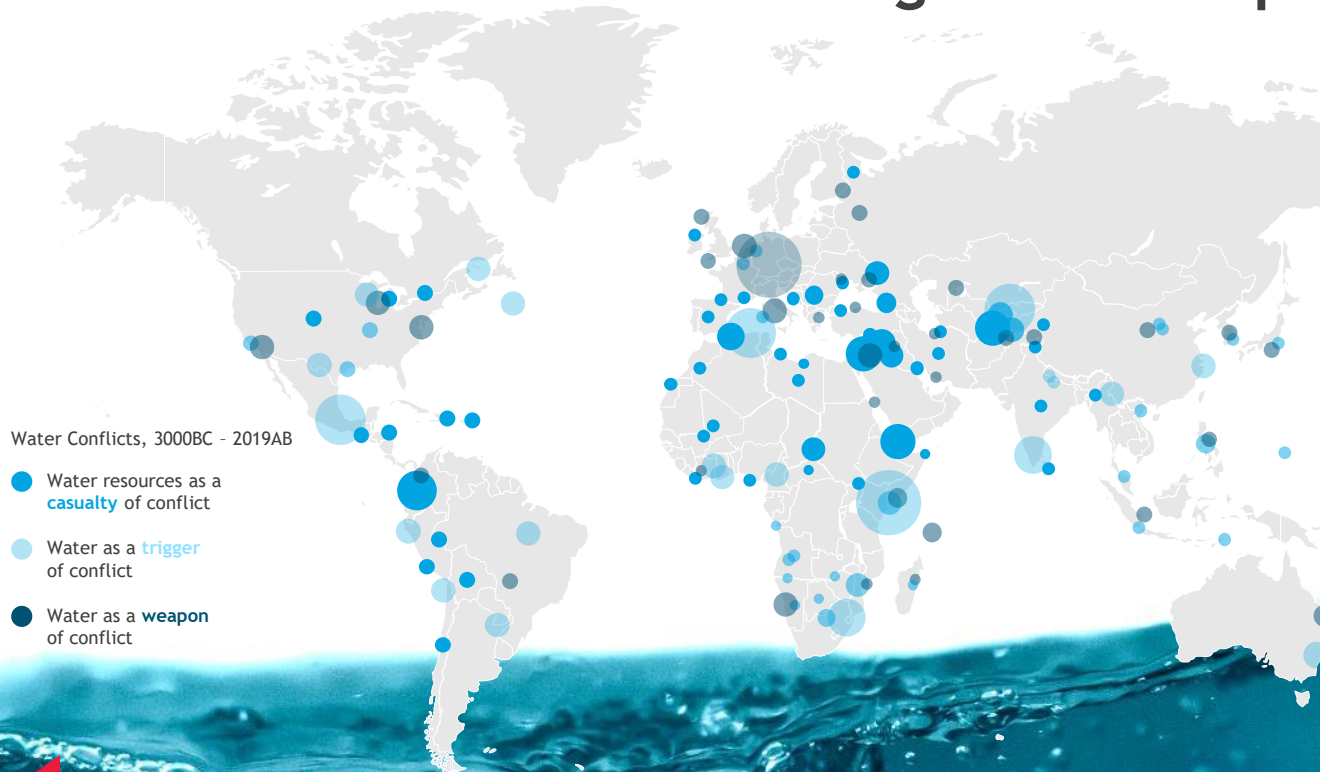




# POLITICAL ROLE OF WATER



# The uneven water distribution on Earth and limited access to water resources in some regions cause political conflicts



- ▶ As water is a vital element for human life, and human activities are closely connected to the availability and quality of water, it always led to various conflicts between countries
- ▶ The potential risk of conflict arising over water resources has become a key topic over the past 20 years. Water is often shared between several administrative sectors, like rivers, groundwater streams flow across boundaries and may lead to transboundary conflict scenarios

# The most recent geopolitical conflicts related to water resources were triggered by the dam-building projects

## Dam building conflicts on Nile river



## Counterparties



## Causes of conflict

- ▶ Since 2011, Ethiopia has been building a Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile, which makes Egypt worried that the dam might affect the overall flow of its biggest water source and waterway, the Nile river
- ▶ Together with the Nile downriver country Sudan, Egypt brought the issue to the United Nations Security Council. Countries' main concern is the risk of drought conditions such as those that occurred in the late 1970s and early 1980s. Thus, they pushed Ethiopia to fill the reservoir over a longer period if needed and guarantee minimum flows

## Dam building conflicts on Mekong river



## Counterparties



## Causes of conflict

- ▶ Mekong river plays an important role as a water and power supplier to a number of Asian countries. Since 2010, hundreds of hydropower dams have been built up and down the river, mostly in China and Laos
- ▶ However, dam-building resulted in environmental destruction as Thailand, Myanmar and Vietnam regularly report unusual flooding and droughts because of damming
- ▶ International organisations warn China and Laos against building new dams and force them to abandon existing ones to stabilise the situation in the region



# ECONOMIC ROLE OF WATER

# Water as an essential resource for key business sectors plays a vital part in the global economic development

Water plays a crucial role in the global economy, as it is an essential input in all sectors. Water scarcity can impact economic performance through metrics such as GDP growth, trade balances, industry structure etc.

## Agricultural and Food Production

For global food production and security in the future, sustainable agricultural growth and efficient water use in the sector is needed.

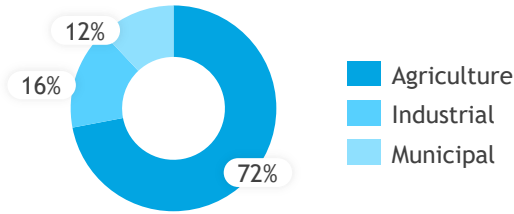
## Industrial Development

For business development and economic growth, adequate access to water is required by many industries for smooth operations.

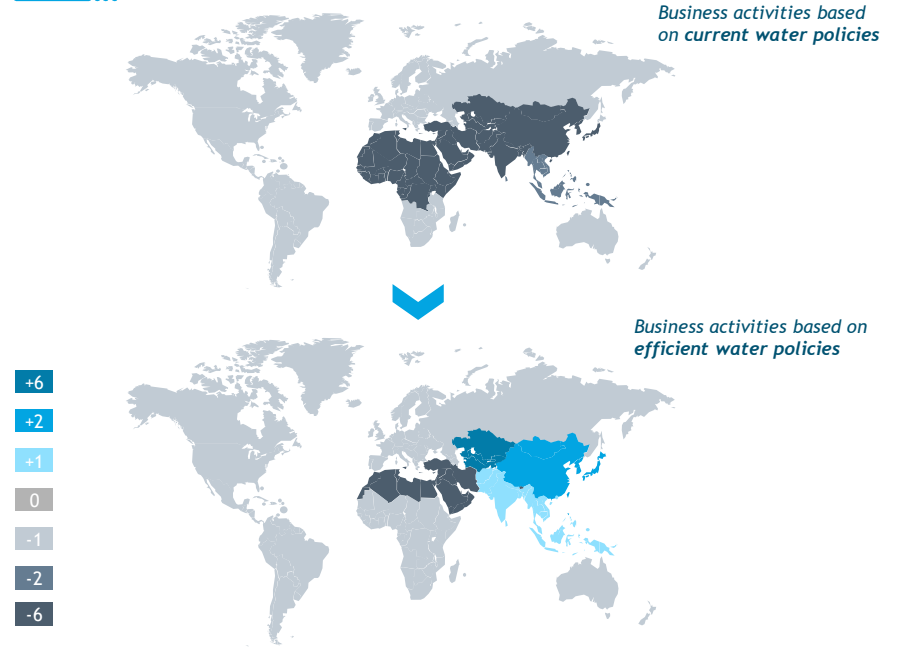
## Water Storage Infrastructure

For secure water supply for households and businesses in the future, improved water storage capacity is a crucial component.

## Global distribution of water withdrawals by sectors, 2017



## Estimated effects of water scarcity on GDP in 2050<sup>1</sup>



# The importance of water use in value chains across different industries cannot be underestimated

Global water use has increased six times over the past 100 years and continues to grow steadily at a rate of about 1% per year with **increasing population, economic development and shifting consumption patterns.**

The OECD projected that water demand will increase by 55% globally by 2050, mainly as a function of **growing demands from manufacturing (+400%), thermal power generation (+140%) and domestic use (+130%).**

## Evident importance of water use in various industries<sup>1</sup>



### Agriculture

Agriculture as the largest using sector of water is **highly dependent on water supplies and increasingly subject to water risks.** Agricultural water is used for **irrigation, pesticide and fertiliser applications, crop cooling, and frost control.**



### Energy

Water remains **fundamental throughout the lifecycle of energy infrastructure and resource development,** from extraction of raw materials, washing and treatment of raw materials to coolants in nuclear or thermal power plants to being a fuel for hydropower plants.



### Industry

The industrial sector **generally uses large amounts of water during their manufacturing processes.** The industries with high water demand produce commodities such as **food, paper, chemicals, refined petroleum, primary metals etc.**

# Agriculture industry remains the largest consumer of water causing a high stress on available water resources globally

Water is a critical input for agricultural production and plays an important role in food security. Irrigated agriculture remains the largest user of water, accounting for **70% of global water withdrawals** and **over 40% in many OECD countries**. Therefore, improving agriculture's water management is essential for addressing water scarcity issues and managing high water stress locations.

## Key actions for sustainable agricultural water management



Improve irrigation management



Use water wisely to grow crops



Manage land sustainably



Use soil conservation techniques

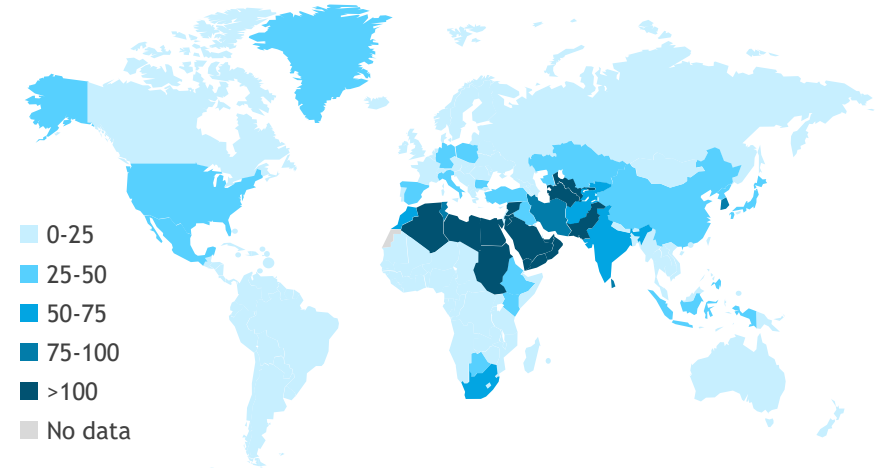


Reduce food loss and waste



Improve livestock management

## Level of water stress by country, 2018



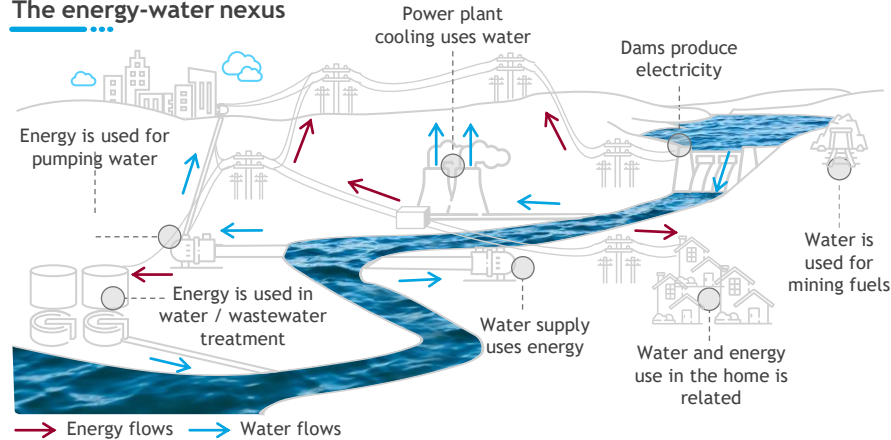
Water stress is the ratio between total freshwater withdrawals by major economic sectors and total renewable freshwater resources, after taking into account environmental water requirements. The higher the number, the more water users are competing for limited supplies.

# The energy industry is exposed to increasing water risks, due to its strong water dependency in generation processes

Water is an integral element of energy-resource development and utilisation, as it is used throughout energy production processes:



## The energy-water nexus



2,5 billion people have unreliable or no access to electricity

2,8 billion people live in areas of high water stress

By 2035, energy consumption will increase **35%**

Water consumption, as a result, will increase by **85%**

The energy sector accounts for more than **10%** of global water consumption, with **projected 60% increase by 2050**. Increasing demand for energy will continue to put significant pressure on global water resources due to **urbanisation, industrialisation and climate change**:

### Water-related risks

- Water availability decrease
- Regulatory uncertainty
- Water quality
- Sea level rise
- Water temperatures increase

### Possible solutions

- Integrate energy-water infrastructure
- Implement renewable energy technologies
- Incorporate water constraints into energy planning

# As water is widely used in different industries, the global action is required to secure future economic benefits

## Water consumption across other industries



### Oil & Gas Industry

The oil and gas industry requires **vast amounts of water across the value chain**, as the result it **negatively impacts water sustainability**. Some of the **most water-stressed regions** are also the **locations of intense oil and gas activity**. Even though, the industry disrupts water sustainability through its operations, it is also well-suited to manage water-related risks, as market players have required **engineering experience, construction capabilities and access to investment funds**.



### Pulp & Paper Industry

The pulp and paper industry is a **large and growing portion of the world's economy**. Moreover, the production of pulp and paper is expected to increase in the near future. As a result, the industry consumes **huge amount of water**, as it is used in **almost every part of manufacturing process**, including **digesting wood chips, making fibre slurries, or washing rollers**. The main challenge for industry players is how to reduce the volume and toxicity of its industrial wastewater.



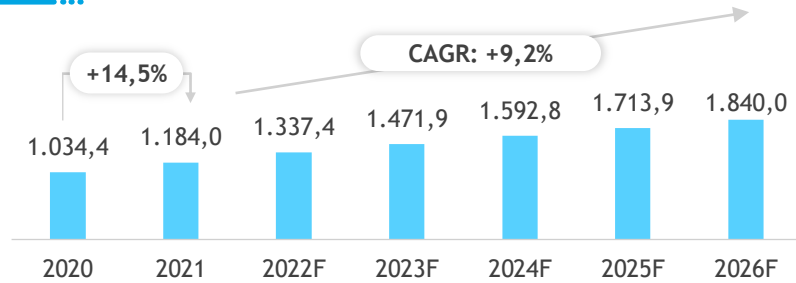
### Food & Beverage Industry

The food and beverage industry is **one of the major contributors to the growth of all economies**. However, the sector has been associated with various environmental issues including **high levels of water consumption and wastewater production**. For example, the **bottled water segment appears to be highly competitive and profitable**. Yet, while it provides an access to clean water especially in the developing countries, it is also accused of being an additional source of waste.

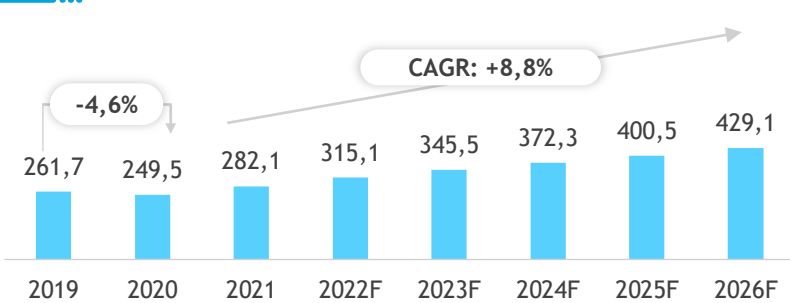


# Water as an industry itself, including bottled water segment, is expected to grow in the coming years

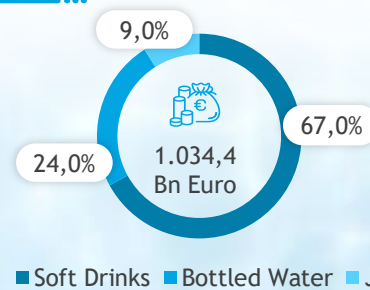
Global revenue of non-alcoholic beverages market, Bn Euro



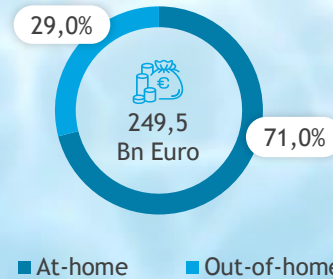
Global revenue of bottled water segment, Bn Euro



Global revenue distribution by type, 2020



Bottled water consumption by type, 2020



► In 2020, the non-alcoholic beverages market generated total revenue of 1.034,4 Bn Euro worldwide. Key players in the non-alcoholic beverages market are PepsiCo, Inc., The Coca-Cola Co., Fomento Economico Mexicano SAB de CV, Coca-Cola Europacific Partners Plc, and Keurig Dr Pepper, Inc.

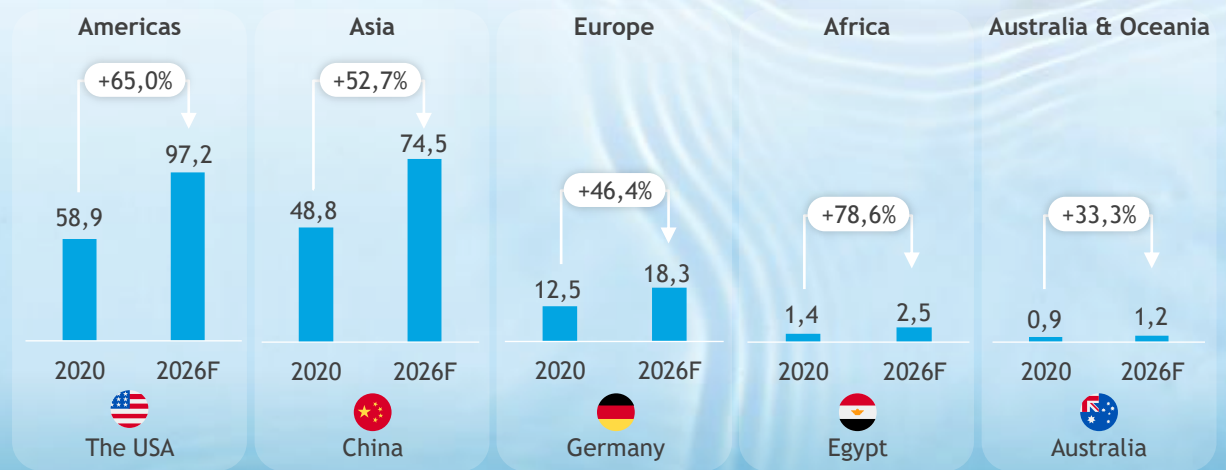
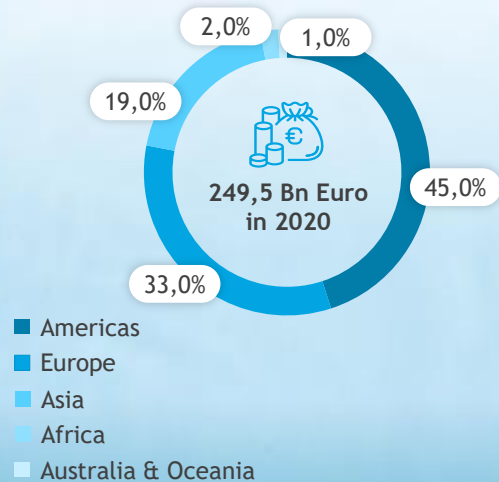
► In 2020, the bottled water segment accounted for 24,0% market share in the total non-alcoholic beverages market and its revenue amounted to 249,5 Bn Euro

► In the bottled water segment, Switzerland and Germany had the highest annual revenue per capita in 2020 (98,1 Euro and 93,9 Euro respectively)

# In 2020, the USA and China were the leading countries in terms of generated revenue in the bottled water segment

Distribution of bottled water revenue by regions

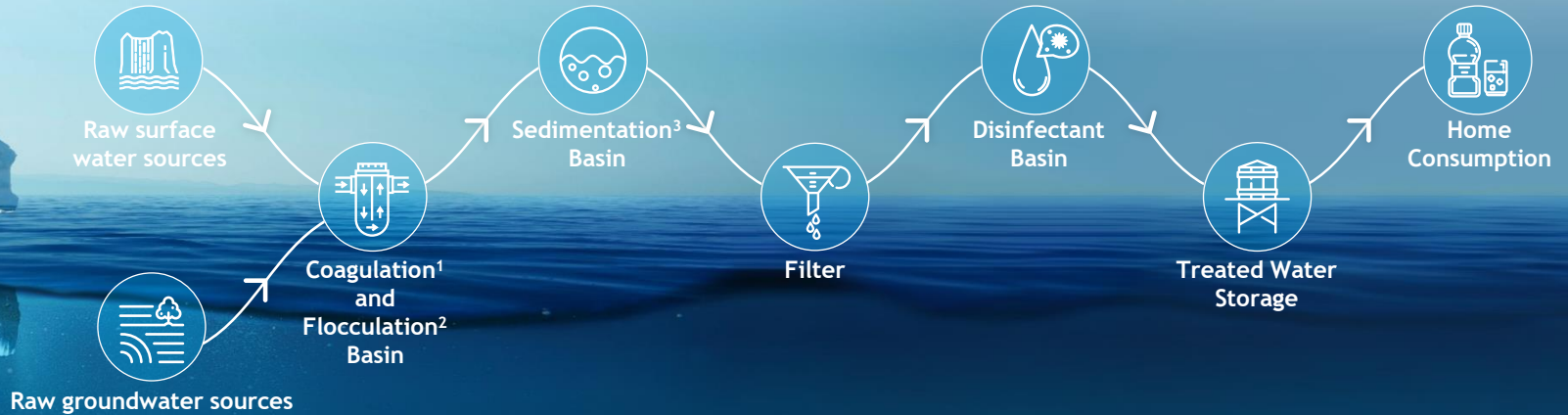
Top countries by revenue in the bottled water segment, Bn Euro



In 2020, the Americas was the leading region in the bottled water segment in terms of revenue. In 2020, the USA and China together accounted for 43,2% of revenue generated in the bottled water segment.

The revenues of the mentioned countries are forecasted to grow by more than 50,0% by 2026. In 2020, Aquafina, Dasani, Nestlé Waters, and Danone Waters were the leading companies in the bottled water market.

# The purification of water in the bottled water production is a complex process that requires various resources



From source to consumption, water is purified during a large number of processes. Coagulation and flocculation are often the first stages of water treatment. During these stages, water becomes purified from such particles as sand, dirt, slime, softeners, lead, mercury iron, etc.

During sedimentation, floc settles to the bottom of the water supply, due to its weight. Once the floc has settled, the clear water on top will pass through filters to remove dust, parasites, bacteria, viruses, and chemicals.

After the water has been filtered, a disinfectant may be added to kill any remaining bacteria and to protect the water from germs when it is piped to homes and businesses. After mentioned stages, water is ready for consumption.

Water can have various flavours. Water's flavour depends on where the water comes from. Water bottled from mountain springs and wells can be packed with minerals that alter its flavour. Calcium makes water taste milky and smooth, magnesium makes it bitter, and sodium makes it salty.

Source: The Water Treatments website; Online Biology Notes website; Media overview

Notes: (1) Coagulation is the chemical water treatment process applied to remove solids from water, manipulating electrostatic charges of particles suspended in water; (2) Flocculation is the operation in which the coagulated water must be gently mixed at a propeller speed to promote the growth of the floc; (3) Sedimentation is a physical water treatment process applying gravity to remove suspended solids from water

# Since the bottled water production causes environmental issues, leading companies develop sustainability initiatives



Aquafina is a brand of purified bottled water products. The company was founded in Wichita, Kansas in 1994. Aquafina is currently owned by PepsiCo, thus it has access to an extremely broad and efficient distribution network. Aquafina recognises the importance of sustainability issues and to lessen the company's environmental footprint, the company has cut the size of their labels almost in half, producing 40% less plastic each year and has reduced the weight of packaging by 15%.



Dasani, as a leading brand in the bottled water segment, applies its sustainability efforts and innovations to contribute to 'World Without Waste' – an industry-first goal by Coca-Cola to collect and recycle the equivalent of every bottle or can it sells globally by 2030. Dasani with its global network of partners aims to achieve the ambitious goal through the renewed focus on the entire packaging lifecycle.



Nestlé Waters is one of the world's leading companies in the bottled water market, which is established in 130 countries. Nestlé Waters supports the sustainable use of water and strictly controls its utilisation in the company's activities for the responsible management of water resources. In 2000, Nestlé Waters first published 'The Nestlé Water Policy' that confirms the company's long-term commitment towards sustainable development.



Danone Waters is a bottled water producer owned by Danone. The company's three biggest-selling bottled water brands are Mizone, Aqua and Evian. The company developed a new water sustainability strategy, which is called 'We Act For Water'. This initiative brings together Danone Waters' brands including Volvic, Aqua, Evian, and Bonafont to focus on responsible packaging, watershed preservation, climate neutrality, and global access to safe drinking water.

# Various alternatives to plastic bottles are being developed by producers to decrease the environmental pollution

## Alternatives to plastic packaging



### Seaweed water bubbles

- ▶ The British startup Ooho has created seaweed-derived capsules. These capsules biodegrade in less than six weeks and are edible. They could be used in place of plastic bottles at events
- ▶ The manufacturing process generates five times fewer CO<sub>2</sub> and uses nine times less energy compared to PET<sup>1</sup> production. In the fourth year of development, the production and delivery method of Ooho capsules are still being finalised



### Paper water bottles

- ▶ Paper Water Bottles are designed to reduce the amount of plastic in the world. This technology is redefining liquid packaging through the innovative use of natural materials
- ▶ A specially blended combination of bamboo and sugar cane provides a rigid outer shell. Paper water bottles are produced from renewable and biodegradable materials that can convert to biogas for clean energy



### Plant-based plastic bottles

- ▶ Bioplastic for plant-based plastic bottles are created from agricultural scraps, often from corn, sugarcane, wheat, or food waste. Plant-based plastic bottles eliminate the need for oil resources while repurposing waste and benefiting from reduced carbon emissions
- ▶ Another benefit is that plant plastics typically do not require pesticides or chemicals to grow but is used bamboo fibre and wheat straw

# Reusable and recyclable water bottles are becoming more popular due to changing consumer preferences globally

## Bottles from recyclable materials



### Polycarbonate water bottles

- ▶ Bottled water companies use **polycarbonate plastic** for their **three- and five-gallon water cooler bottles**. Polycarbonate is transparent, lightweight and highly shatter-resistant
- ▶ Returnable polycarbonate three-and five-gallon bottled water containers are cleaned and sanitised between uses and **are reused 30 to 50 times before being recycled**



### Cans water bottles

- ▶ **Aluminium** is one of the most recycled materials. Aluminium can be recycled **infinitely without losing quality or volume**. Due to recycling, **manufacturers save more than 90,0% of the energy** required to produce new metal
- ▶ There are a few brands of canned water, but **Open Water is the only one that is completely climate-neutral**



### Glass water bottles

- ▶ **Outstanding bottled water companies choose glass** as a packaging option for their premium bottled waters. Among these companies are Evian, Acqua Panna, Voss, and Saratoga Spring Water
- ▶ **Bottles made out of glass are 100% recyclable**. Recycled glass is a part of the recipe for glass, and the more it is used, the less energy is needed to make it

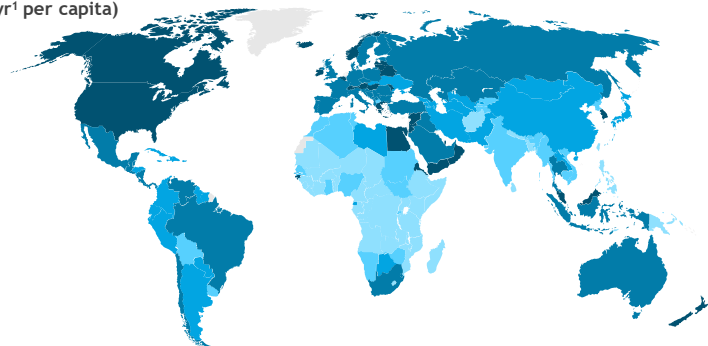
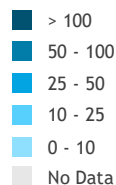


**WATER POLLUTION AND WASTEWATER  
AS A PROBLEM OF HUMANITY**

# Water usage by households and industries produces large volume of wastewater, which becomes a global concern

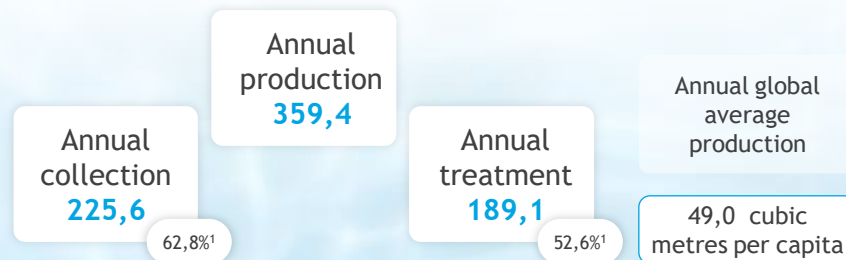
## Annual wastewater production per capita worldwide as of 2020

Production (m<sup>3</sup> yr<sup>-1</sup> per capita)



- ▶ In 2020, the global volume of wastewater production amounted to **359,4 billion cubic metres**, of which only about 62,8% was collected and nearly 52,6% was treated
- ▶ The world average wastewater production per capita was **49,0 cubic meters in 2020**, which varied greatly across regions. In **North America**, the indicator was the highest (209,5 cubic meters), while in **Western Europe** it accounted for 91,7 cubic meters.
- ▶ In **sub-Saharan Africa** the average wastewater production per capita was the lowest among other regions and resulted in 11,0 cubic metres in 2020

## Wastewater global key figures as of 2020, billion cubic metres



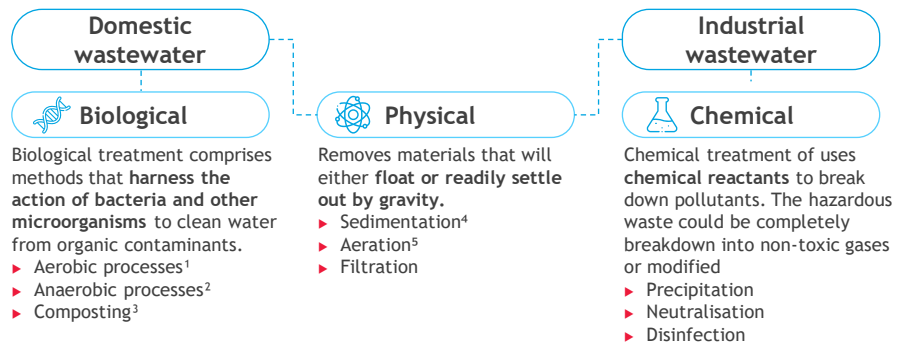
## Types of wastewater or sewage

- 1 **Domestic wastewater** is the used water from households, is also called sanitary sewage
- 2 **Industrial wastewater** is the used water from manufacturing or chemical processes
- 3 **Storm sewage or storm water** is the runoff from precipitation that is collected in the pipe systems or open channels



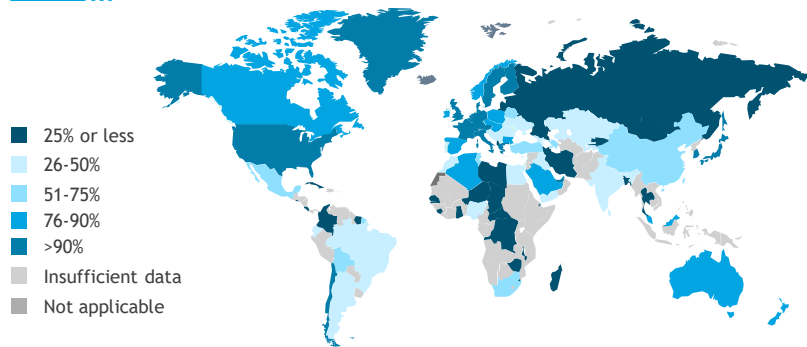
# As a solution, both domestic and industrial wastewater treatment will be increasingly in-demand in the future

## Wastewater treatment methods

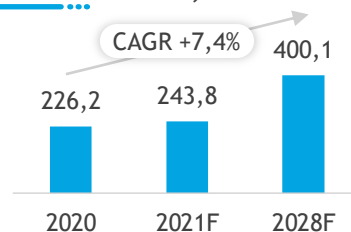


- ▶ Wastewater contains pollutants, which make water unsafe for human use. Pollutants vary depending on wastewater sources and could be treated by biological, physical or chemical methods
- ▶ There are **significant regional differences** in domestic wastewater treatment penetration. Approximately **80,0% of domestic wastewater is safely treated in North America and in the most of the European countries**, while less than 25,0% of wastewaters from households are treated in Central Asia and Africa
- ▶ The global water and wastewater treatment market size **is expected to grow at a CAGR of 7,4% by 2028** reflecting the rising population and its access to water supply and sanitation facilities. The **industrial wastewater treatment market size is forecasted to grow by 44,4% in 2028** compared to 2020

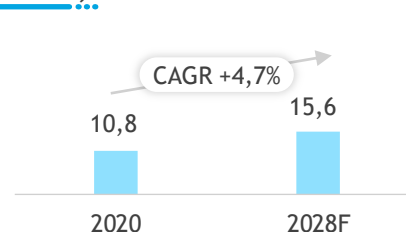
## Proportion of domestic wastewater safely treated worldwide in 2020



## Global water and wastewater treatment market, Bn Euro<sup>4</sup>



## Global industrial wastewater treatment market, Bn Euro<sup>4</sup>



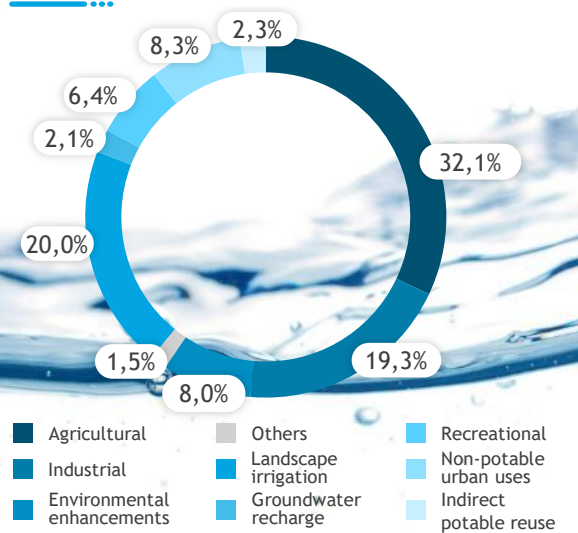
Source: UN Habitat and WHO – Progress on wastewater treatment – [2021]; Statista website; AOS Treatment Solutions website

Notes: (1) Biological process that uses oxygen to break down organic contaminants and other pollutants; (2) Biological process that breaks down organic contaminants in wastewater using microorganisms in the absence of oxygen.; (3) Mixing wastewater with carbon sources to convert into a humus-like product;

(4) The numbers are converted from USD to EURO due to European Central Bank average exchange rate as of 2020

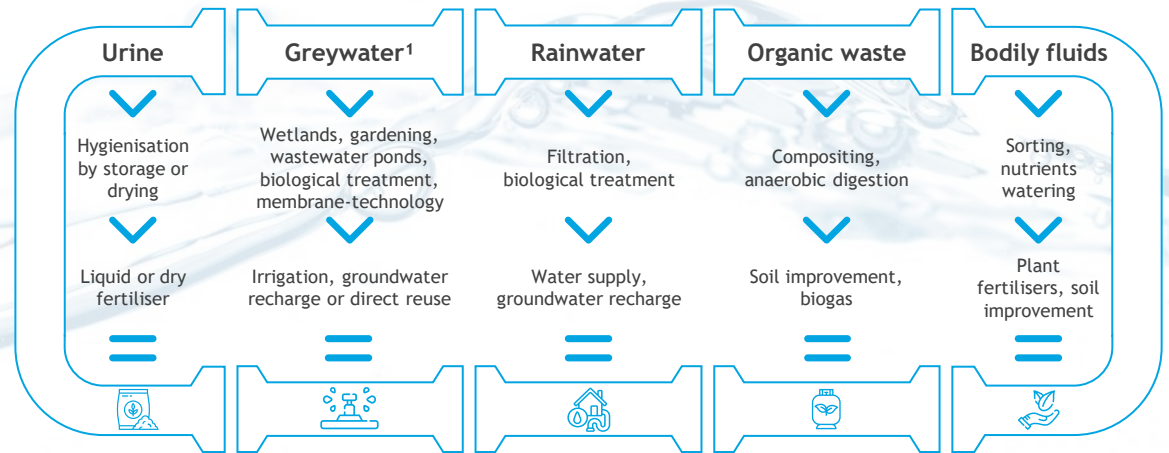
# Reusing wastewater becomes an alternative water source for households and various industries around the world

Global wastewater reusage after advanced treatment, market share by application



Global treated wastewater reusage is estimated at **40,7 billion cubic metres per year**

Waste segregation and possible utilization options



More than **40.000,0 million cubic metres** of wastewater treated in EU every year

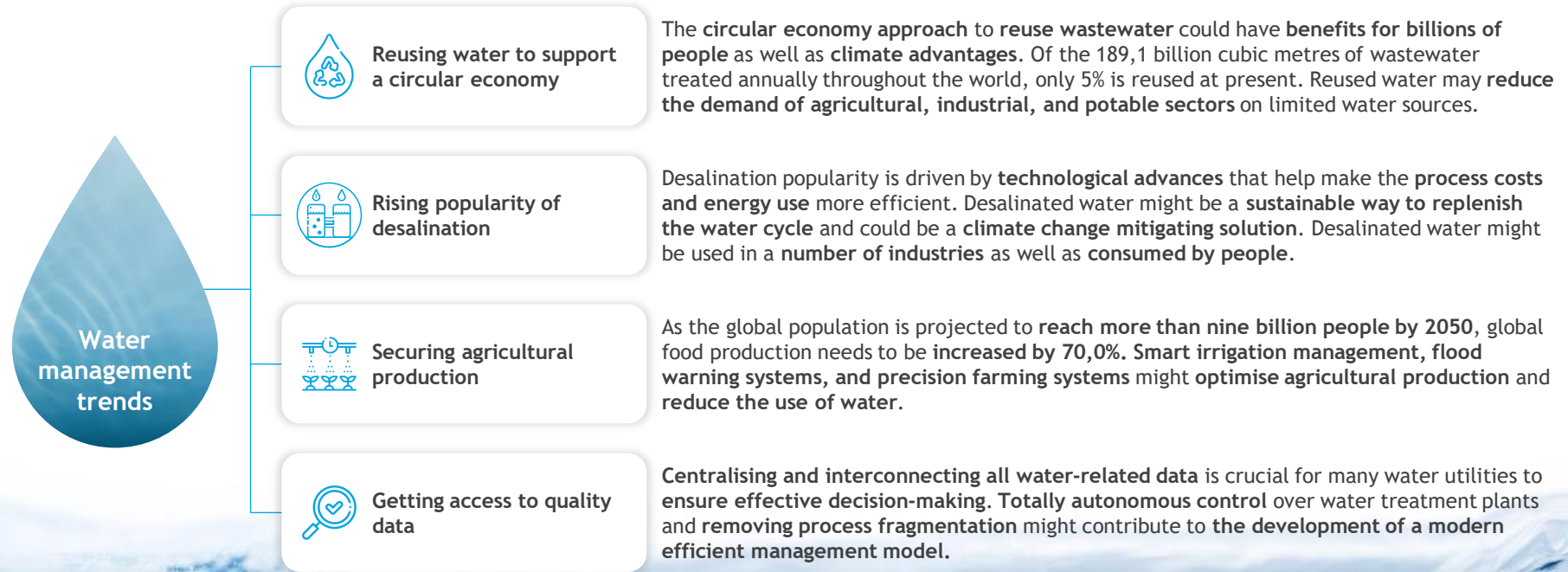


But only **964,0 million cubic metres** of this treated wastewater is reused

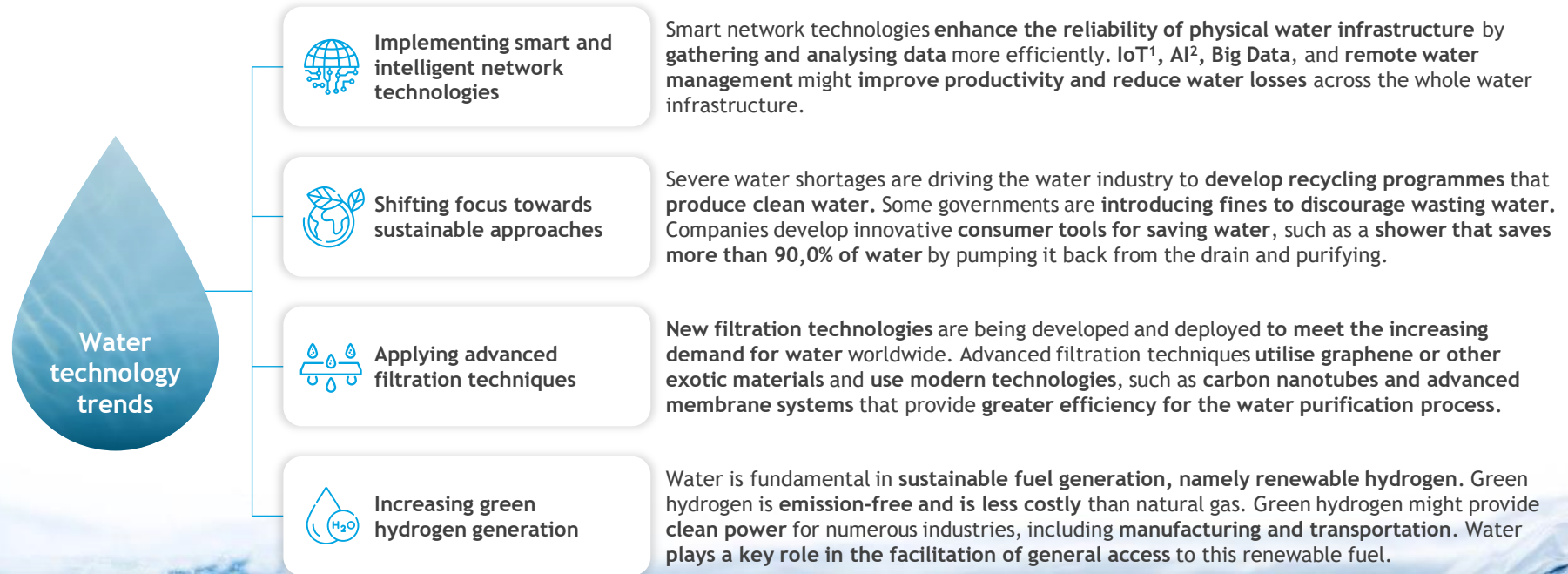


# TRENDS SHAPING THE WATER INDUSTRY

# Current water management trends focus on more efficient water use and mitigation of environmental impact



# Future water availability will be secured by the implementation of innovative technologies and solutions



# Desalination is one of the possible solutions to minimise impacts of water crisis and to ensure clean water access

## What is desalination?



Filters remove suspended solids and other particles that would interfere with the desalting process.

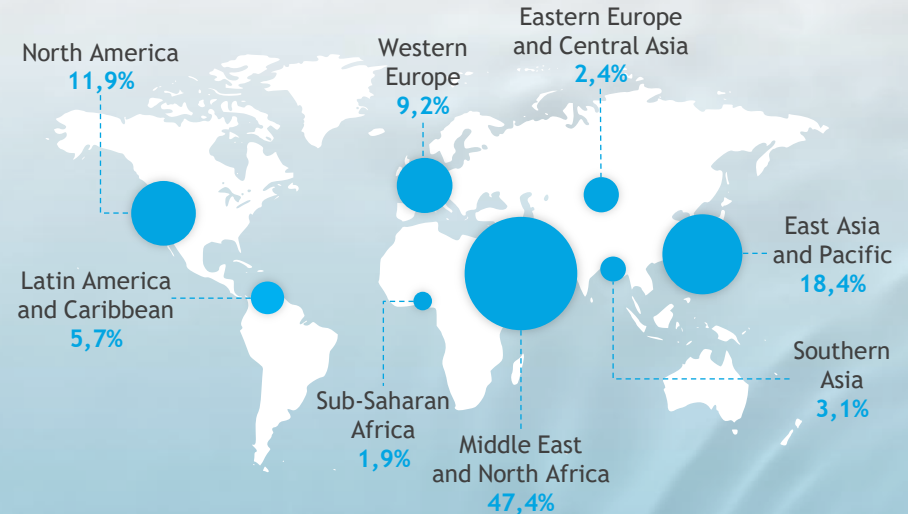
Reverse-osmosis membranes separate dissolved minerals and other impurities from the water.

Minerals and chemicals are added to ensure produced water meets aesthetic and anti-corrosion standards.

Desalination uses **reverse osmosis technology** to separate water molecules from seawater. Water from the ocean is **forced through thousands of tightly-wrapped, semipermeable membranes** under very high pressure. The membranes allow the smaller water molecules to **pass through, leaving salt and other impurities behind.**

## Desalination capacity by region, as of 2020

Worldwide, there are currently around **16.000 desalination plants** in more than **100 countries**. Collectively, they can produce **95,0 million cubic metres of fresh water per day**, which is enough to supply around **300,0 million people**.



# Smart water technologies allow households and industries reduce water usage and minimise water-related risks

Wide-spread usage of innovative technologies allows to improve decision-making, enhance the efficiency of water infrastructure and protect people from the water-related risks. The World Bank, along with water innovation accelerator Imagine H<sub>2</sub>O, supports numerous water technology businesses that help utilities serve customers digitally, solve water challenges globally and provide remote water resources management solutions.

Selected solutions, supported by The World Bank and Imagine H<sub>2</sub>O



## Cloud to Street (United States)



Cloud to Street is a flood mapping platform that detects worldwide floods in real-time through global satellites, machine learning and community intelligence.

The platform combines data on 913 floods across 169 countries to help scientists, governments, and financial institution better prepare to risks of flooding.



## Ignitia (Sweden/Ghana)



Ignitia is a tropical weather forecasting platform with a proprietary forecasting model that predicts weather patterns and delivers highly accurate, hyper-local forecasts to small-scale farmers via SMS.

With Ignitia services, in 2019 farmers reported up to 80,0% increase in income due to decreased risks and losses.



## Wonderkid (Kenya)



Wonderkid is a software solutions company that provides services for African water utilities and aims at improving the quality of their customer care and billing services.

Wonderkid solutions allow to improve operational efficiency of water utilities and result in the revenue growth as well as transformation of water industry sector.



## Smarter Homes (India)



Smarter Homes is smart metresing and automated leakage prevention system for high-rise apartment buildings in urban India.

As of January 2022, Smarter Homes led to 35,3% reduction in water consumption and 12,0% decrease in energy costs of communities with smart metress.

# Businesses in various industries are increasingly implementing advanced technologies to improve efficiency

Innovative technologies such as Internet of Things, Big Data, Artificial Intelligence (AI), and Blockchain, originally embraced by the banking sector to increase the effectiveness of its business, are actively adopted by the environmental and sustainable development sectors to improve resources' usage and management.



## Internet of things (IoT)

Internet-connected devices and sensors, from smartphones to networked manufacturing equipment, are able to **transmit to and receive complex data**. Integrated systems allow to **monitor, control, and regulate the usage and quality** of water resources, as well as **maintain the associated equipment**.



## Big Data

Utilities and water companies are increasingly using **remote sensor technologies** to control and monitor pumping stations and water storage facilities. Collected data are used to **improve performance, detect problems, and optimise plant resource usage**.



## Artificial intelligence (AI)

AI helps the water industry to become **digitalised with smart infrastructure solutions**. AI could **save up to 30,0% of the operational expenditures** by **reducing energy costs, optimising chemical use** for water treatment, and **ensuring proper asset maintenance**. AI might **predict emergency events and prevent water-related risks**.

These three technologies go along a chain from the collection of data right through to its analysis. This is where **Blockchain** comes in.



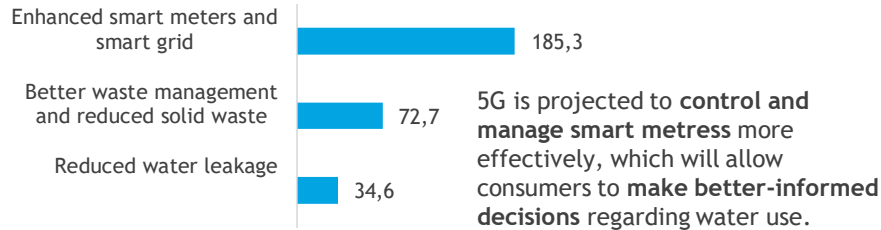
## Blockchain

Increasing usage of **sensors and Big Data technologies** encourage water utilities and water companies to use **secure blockchain systems** that **reduce risks of hacking, data destruction and improve the transparency of processes**.

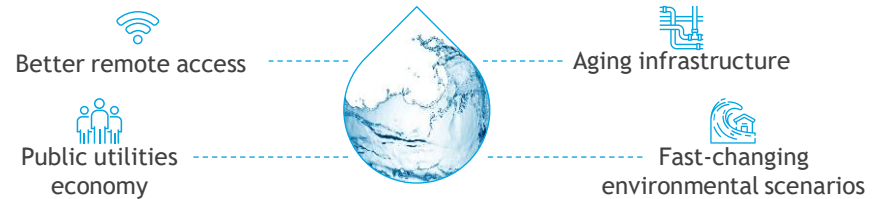


# Moreover, digital solutions allow to transfer and receive data instantly to control water quality and manage leaks

Forecasted 5G applications contribution to productivity in smart utilities' management by 2030, by use case, in Bn Euro



5G technology could help solve main problems that water infrastructure currently faces



How water infrastructure could benefit from implementing 5G?

- ▶ 5G can handle up to millions of sensors per one square kilometre ensuring the connection of smart metres and devices on the streets and homes. Some 5G features might reduce battery consumption that will extend the lifetime of the sensors
- ▶ 5G's improved security protocols could contribute to increased reliability of the water infrastructure and reduce the number of cyberattacks that might interrupt the functioning of infrastructure and cause significant losses
- ▶ In the area of wastewater, sewerage inspections could be conducted by drones driven via 5G in real-time that will enhance visibility in areas with difficult access



By 2025

half of the world population is forecasted to live in water-stressed areas that will need solutions for preventing leaks and maintaining water quality, as contaminated water is linked to transmission of diseases



5G

could deliver information about water quality and leaks more quickly and enable remote monitoring and control opportunities to help struggling communities increase efficiency and lower costs

Source: Statista; Media overview

Notes: (1) The companies in the electric, gas and water sectors that employ connected sensors across their grids in order to deliver services more efficiently and to analyse their operations

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