# RETHINKING RESILIENCE

## How a new era of extremes is changing how utilities invest

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GWi GLOBAL WATER INTELLIGENCE | xylem

# Foreword

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*The roles and responsibilities of water utilities are at a moment of transition. Once tasked with the steady delivery of water and wastewater services, utilities now stand on the front lines of a far more complex mandate: managing urban risk and resilience.*

*This transformation is driven by a convergence of forces: rapid population growth and concentration, decades of underinvestment in critical infrastructure, and increasing climate volatility.*

Across the water cycle, events expected to occur once in a hundred years are now arriving with unsettling regularity. The result is that a system engineered for predictability must now operate in a world of unexpected extremes.

The data contained in this report confirms what global utility leaders are experiencing firsthand: a shift from means to variances. In other words, we are not only planning for gradual increases within known boundaries; we must now be deeply curious about how bad things could get. In mathematical terms, we have to become obsessed with kurtosis (the shape of tail risks) because understanding statistical extremes is becoming a matter of human urgency.

For water infrastructure planning and investment, the implications are profound. Traditional funding models are built for steady use and long-term amortization. They are not fit to support expensive infrastructure projects that may only be used occasionally, even if these are indispensable in the moments of greatest need.

This paper presents a clear challenge: how do we adapt water systems to serve profoundly greater demand and deliver resilience to more frequent, severe, and costly disruptions? Just as importantly, how do we do it affordably?

The answer isn't simply to spend more but to spend smarter. Our path forward leads us toward strategic modernization and investments prioritizing resilience, flexibility, and long-term value over reactive fixes.

To succeed, our sector must drive innovation across three fronts: new financial models to support resilience; accelerated adoption of existing technologies that enhance resilience; and institutional innovation to stitch together the fragmented web of accountabilities for resilience.

Resilience is not a cost center or a revenue line. It's a strategic investment in the continuity of services essential to healthy and prosperous communities. The challenges are significant, but the human and economic case for action is even stronger. The choice is clear: invest strategically today or pay exponentially more tomorrow.

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# Executive summary

## Key findings

- Resilience is becoming **the most significant driver of investment among utilities.** Our study of over 1,000 investment projects proposed by utilities around the world suggest the proportion of capital spending aligned with the resilience theme is expected to grow from 41% in 2025 to 46% in 2030.
- Resilience investment is about reducing the risk of system failure. This risk has been growing with the challenge of meeting the needs of **growing populations** and adhering to ever more **complex regulations** while depending on **ageing networks**. Climate change is adding a significant new dimension to this challenge.
- New data from NASA's GRACE programme shows that higher temperatures are bringing a **significant increase in the intensity of extreme wet and dry events.** This "kurtosis" - or skewing of the probabilistic distribution of events towards the extremes - demands **new thinking** on resilience, otherwise the costs of adaptation will be an insurmountable obstacle.

### What are the solutions?

#### Institutional

Resilience cannot be the burden of utilities alone. As they become the default agency for climate change adaptation, they require support from a range of stakeholders if they are to deliver the resilience that is being asked of them.

From regulatory support and political decisions about risk and funding to innovations from the supply chain and financial sectors, the entire industry must pull together.

#### Financial

Utilities cannot deliver resilience by following their current spending patterns: the capital required is too great.

As well as finding new sources of capital and new revenue streams, they must optimise. This means rethinking their business models, improving procurement and delivery models and choosing smart systems to squeeze the most resilience out of every dollar invested.

#### Infrastructural

The infrastructure of the past is not suited to the challenges of the future.

Resilience is not just about adding more infrastructure, but about redesigning systems to make them adaptable and smart; future-proofing them to meet the unpredictable impacts of climate change.

#### Planning

Capital planning and budgeting models that fail to look far enough ahead limit a utility's ability to build resilience.

Utilities need the autonomy and the financial visibility to create long-term, multiyear strategies that will secure their resilience for generations.

# Understanding the challenge

## Key questions and methodology

*Intensifying climate change impacts are shifting water utility investment requirements on top of existing pressures including population growth, ageing infrastructure and regulatory compliance.*

This white paper reveals new data on climate impacts and resilience-specific spending in utility capital expenditure plans. It aims to frame the resilience challenge and highlight how utilities are responding and how they can shift thinking on their investment strategy.

## Methodology

### Climate change data and capex forecasting

GWI leveraged newly released satellite observations from NASA's GRACE program, which reveal clear correlations between rising global temperatures and the frequency and severity of extreme wet and dry events (see p. 7–8). These insights were combined with our existing global dataset on capital employed and capital expenditure in the water sector. This integrated dataset formed the foundation for a model estimating future capital needs for water security by 2040, under increasingly volatile climate conditions.

### Infrastructure requirement analysis

To understand how water infrastructure must evolve, we used the new climate data to estimate the additional infrastructure design capacity required to maintain today's levels of water security in the face of intensifying climate extremes (see p.7) .

### Qualitative insights from utility leaders

To complement our quantitative analysis, GWI conducted structured interviews with senior leaders at major water utilities around the world. These conversations provided invaluable, on-the-ground insights into how utilities are evolving their planning, engineering, and operational frameworks to meet the growing demands of climate resilience. We captured case studies, strategic shifts, and common challenges that utilities face—enriching our model with human context and forward-looking industry intelligence.

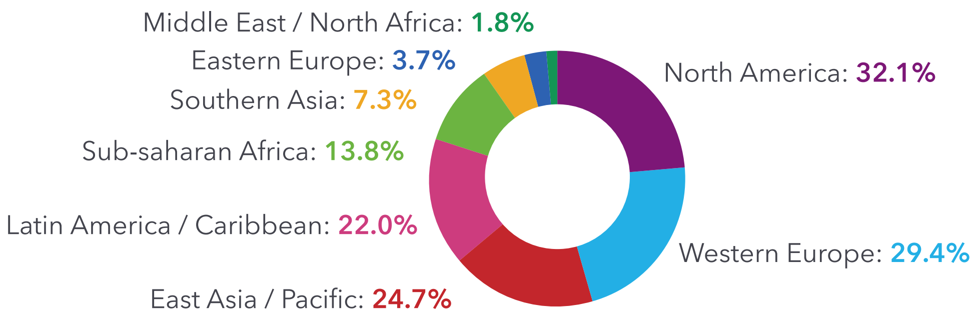
### Utility capex deep dive

We assembled a global database of capital expenditure (capex) plans from water utilities spanning every continent (see chart below). Using a custom-built text mining model, we combed thousands of individual project descriptions to identify resilience-related investments. This involved a systematic keyword search across categories tied to climate adaptation, infrastructure hardening, green-blue infrastructure, redundancy systems, and emergency preparedness (see p. 9–10).

### Total effort at a glance:

- 1,000+ utility projects scanned
- 40+ climate resilience keywords tracked
- 5+ data sources merged
- Interviews conducted across 5 continents

**Utilities surveyed by region**



# The meaning of resilience

## The water cycle is becoming more violent. Cities must adapt.

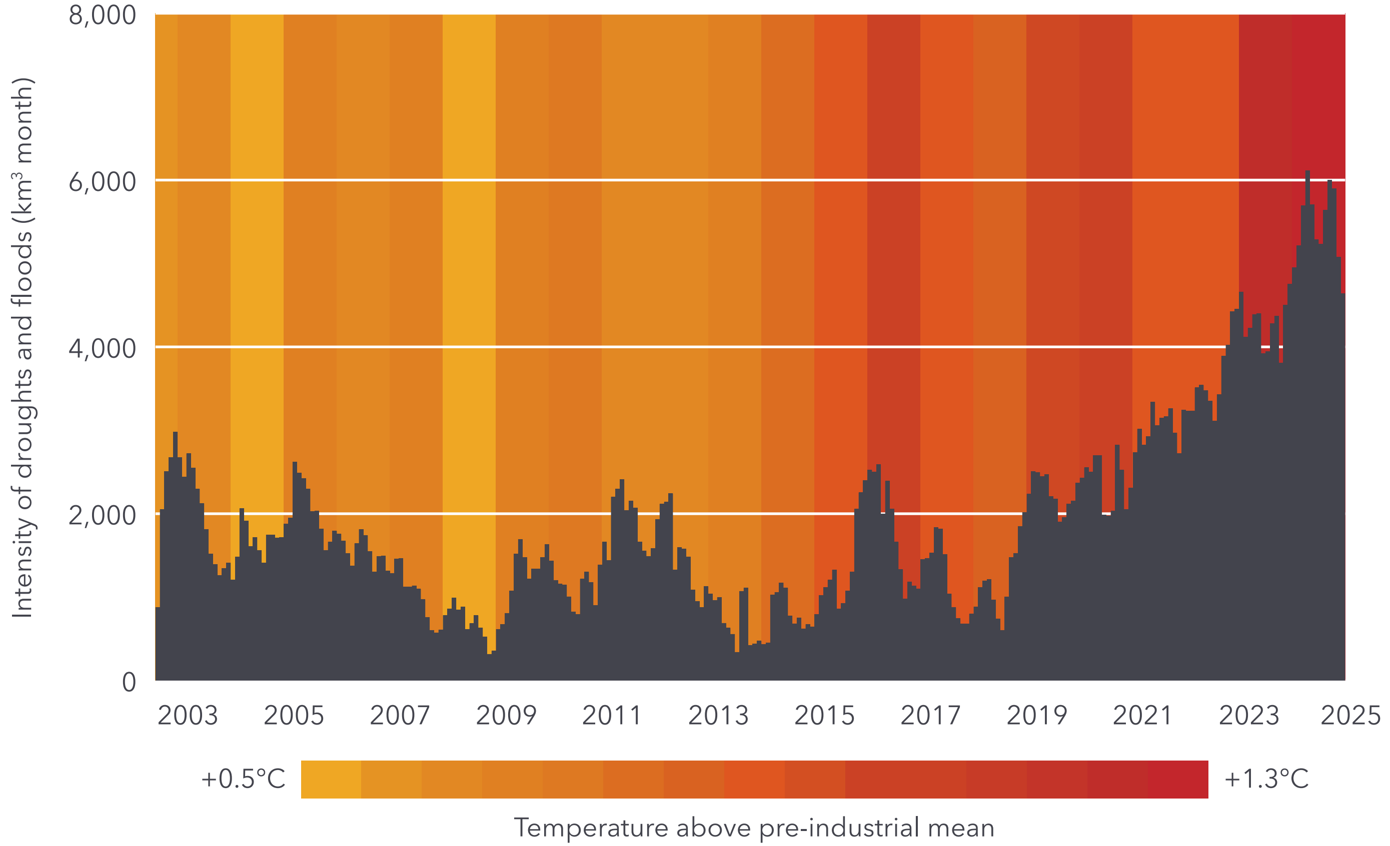
***Droughts and floods are becoming more extreme. Crises will become more frequent unless we respond.** A new analysis from NASA's GRACE programme, published here for the first time, confirms the correlation between rising global temperatures and the increased intensity of floods and droughts. It is a wakeup call to all those responsible for urban water resilience.*

### What higher global temperatures mean for water.

The best measure of the impact of rising global temperatures on the water cycle comes from NASA's GRACE programme. It uses fluctuations in Earth's gravitational field to measure terrestrial water storage. By clustering continuous rises and falls in water stored in aquifers and in soil moisture, the project has been able to track the growing intensity of extreme wet and dry events since 2003. In a seminal paper published in *Nature Water* in 2023 researchers Rodell and Li showed a "significant correlation" between the growing extremity of these events and rising global temperatures. That study's cut-off was December 2021, when the average annual global temperature was +0.89°C. By 2024 global temperatures had risen to 1.28°C. The impact of this continued rise in temperatures on the intensity of wet and dry events is shown in the chart opposite, based on data exclusively provided to GWI by Li.

**It defines the water resilient challenge that the world is now facing.**

**The intensity of droughts and floods is rising as global temperatures increase**




*Source: NASA GRACE / GWI*

The dark bars represent the total intensity of extreme dry and wet events (beyond one standard deviation of the mean). A dry event is measured as a reduction in water stored in an area, while a wet event is an increase. Added together they give total intensity.

1. Changing intensity of hydroclimactic extreme events revealed by GRACe and GRACE-FO, by Matthew Rodell and Bailing Li, Nature Water January 3 2023 doi.org/10.1038/s44221-023-00040-5

# Infrastructure for extremes

## Does infrastructure investment have to grow in line with global temperatures?

***Cities now have a fat tail problem to manage.*** *Statisticians call it kurtosis: where the distribution of events is no longer clustered around the mean, because there is a greater-than-expected chance of extreme outcomes. This has huge implications for water management because the infrastructure cities build - the water resources they develop, the storm water systems they rely on - are designed based on historic assumptions about the severity of extreme events. These assumptions no longer hold good.*

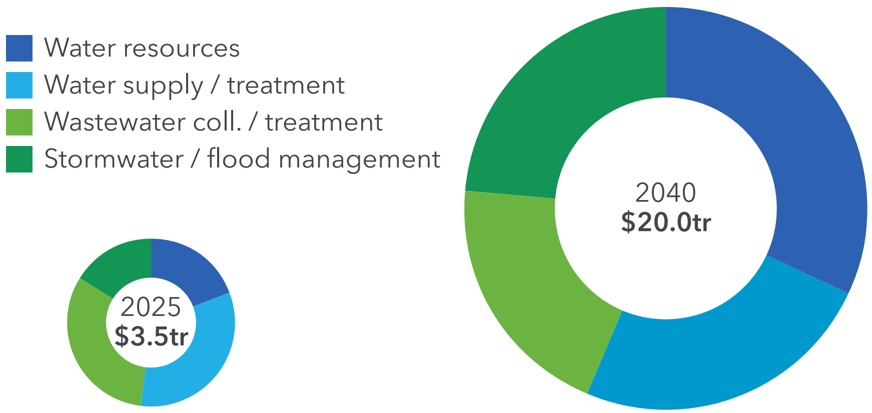
### Rethinking water risk

Global temperatures are likely to exceed +2.0°C by the mid 2040s. This might mean that the total intensity of wet and dry events will reach 8,000 km$^3$/month by 2040 (see chart). Urban water infrastructure built before 2015 is estimated to have been designed to manage extreme events with an intensity of no more than 1,300 km$^3$/month.

This could imply that in order to deliver the same level of water security that cities have enjoyed in the past, it might be necessary to increase by as much as six fold the capital employed in water resources and flood management systems. GWI estimates that delivering historic levels of water security, as well as meeting existing investment objectives, would entail a $16.5 trillion increase in the capital employed in the municipal water sector.

**This is simply unrealistic. We need to rethink the way we manage the new extremes of the water cycle.**

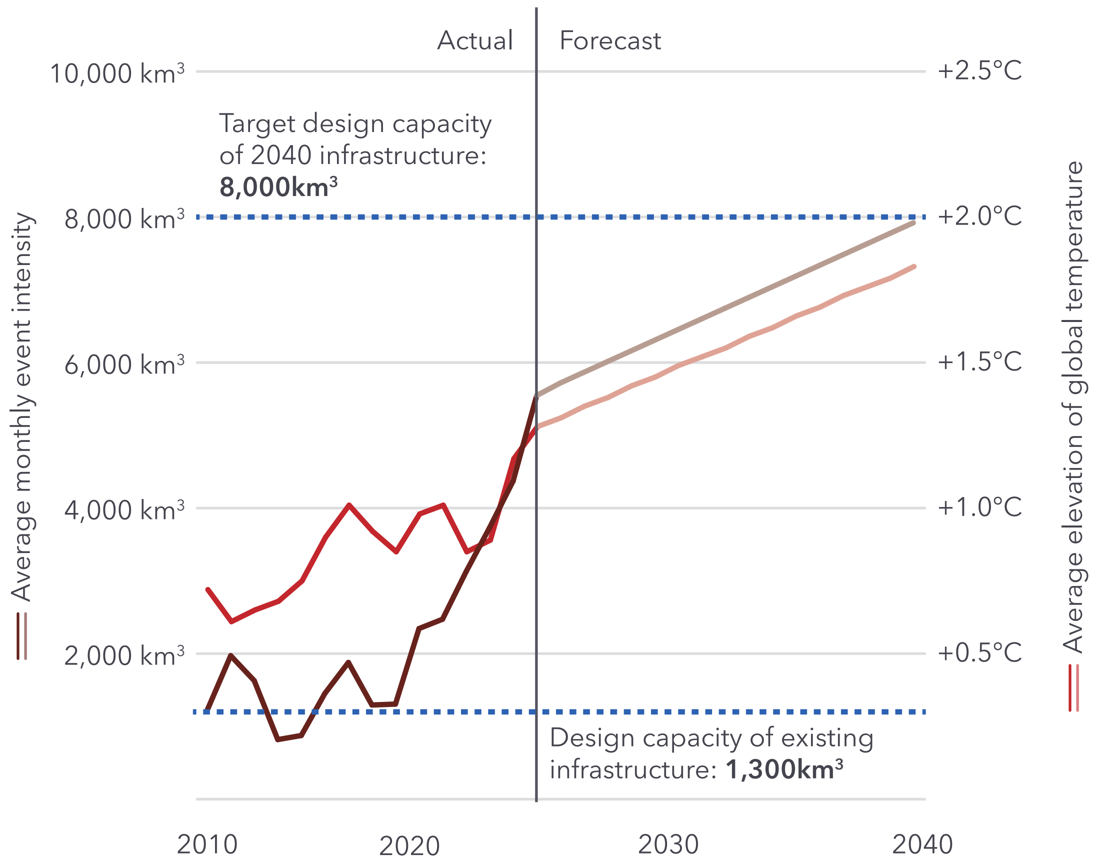
### The cost of water security in 2040 without rethinking risk




Current capital employed

Required capital employed

### The new infrastructure challenge: managing extremes




Source: GWI

# Rethinking resilience

## How do we make the future affordable and secure?

***Urban water resilience is about so much more than protection against floods and droughts.** It is also about ensuring that ageing infrastructure networks meet the needs of growing populations and guaranteeing the health of the population and the environment. Getting resilience right is going to be about optimising investment across all categories.*

### New thinking on infrastructure

Our capital expenditure survey shows that resilience spending by cities is already rising fast. It also points to some of the approaches to infrastructure that will deliver water security at a lower cost.

**1) Smart:** intelligent systems enable intelligent responses to extreme events, ensuring that existing infrastructure is used to its maximum benefit. For example, by optimising the storage capacity of the sewer and storm water network in an extreme wet weather event. Smart systems could reduce the cost of flood resilience by 40% and drought resilience by 20%.

**2) Dual purpose:** assets that are used the least are the most difficult to finance. They add to bills without customers seeing an immediate benefit. Ensuring investments have more than just an insurance value is important. For example, planning the stormwater systems to turn rainwater into a resource for dry periods or reduce combined sewer overflow problems, building green infrastructure that has recreational uses, or water reuse projects that also improve environmental water quality. Multipurposing could reduce the total investment requirement by 20%.

**3) Soft:** it will not be possible for cities to protect themselves from the most extreme events. However the impact of those events can be reduced if the public is engaged and informed about how to respond in the event of a crisis. Educating the public on the new realities of urban water risk could reduce the required investment in water resource development and flood management by as much as 50%.

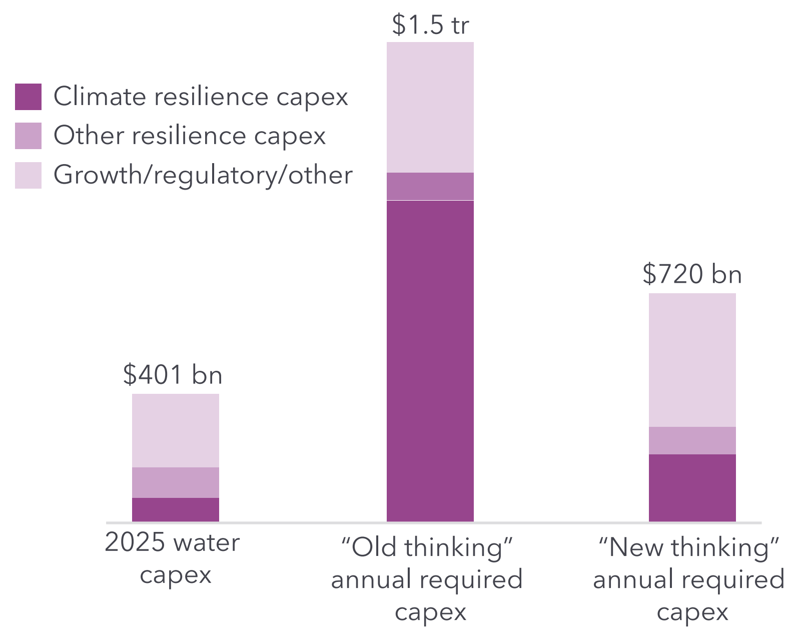
**4) Slow:** the intensity of wet and dry weather events is exacerbated by the speed with which water moves through the environment. The greater the natural storage of water in the landscape, and the longer flood water is held upstream, the smaller the impact of extreme wet and dry events. Slowing the water cycle in this way means investing in green infrastructure rather than grey infrastructure. Nature-based solutions could cut 20% from the cost of managing the intensity of extreme weather events.

### Ultimately the cheapest alternative is net zero emissions

Climate change adaptation is going to be expensive. Not investing in adaptation will cost significantly more than investing, because it would expose cities to catastrophic losses in the event of extreme events. New thinking on resilience can reduce the cost of adaptation, but holding global temperatures below +2°C would be more cost effective.

### The future need not cost $1 trillion

Cities are expected to invest $401 billion in water-related infrastructure in 2025. Already this is insufficient to meet demands from population growth, regulatory requirements, and asset renewal ambitions. The annual total required to meet those objectives following historic investment strategies and objectives could be $1.5 trillion. With new thinking, this total could be halved to $720 billion. This would entail a 63% increase average tariffs on the basis of current investment models.



# Resilience in practice

## The projects utilities invest in to manage climate and system risks

*To estimate resilience spending, GWI used keywords related to climate resilience to identify investments considered to be earmarked for resilience. These keywords were informed by interviews where utility leaders identified their priorities for managing climate-related risks (yellow and blue boxes, left). While many of these projects support resilience, they may also address other objectives such as ageing infrastructure, population growth or efficiency improvements (grey box, right).*

### Resilience to droughts and water scarcity

**Alternative water sources**

- Building or connecting reservoirs
- Rehabilitation of water main lines
- New groundwater sources
- Desalination and water reuse
- Rain and stormwater harvesting
- Aquifer recharge (reuse or rainwater)

**Water conservation**

- Network leak detection
- Maintaining and fixing pipes to avoid water losses
- Water conservation incentives
- Drought-resistant landscaping
- Fixing domestic leaks

### Resilience to stormwater and floods

**Grey infrastructure**

- Stormwater diversion tunnels
- Stormwater retention tanks
- Sewer separation projects
- Pump stations

**Green infrastructure**

- River and stream rehabilitation
- Constructed wetlands
- Permeable pavements
- Urban green infrastructure (e.g. bioswales)

**Homeowner incentives**

- Replacement of impermeable driveways and courtyards with permeable surfaces

### Ongoing operational resilience

**Public health protection**

- Water quality assurance
- Network integrity
- Continuity of supply in natural disasters

**Environmental health protection**

- Combined sewer overflow correction
- Watershed stewardship
- Effluent quality assurance

**Disaster recovery**

- Cyber security
- Emergency planning

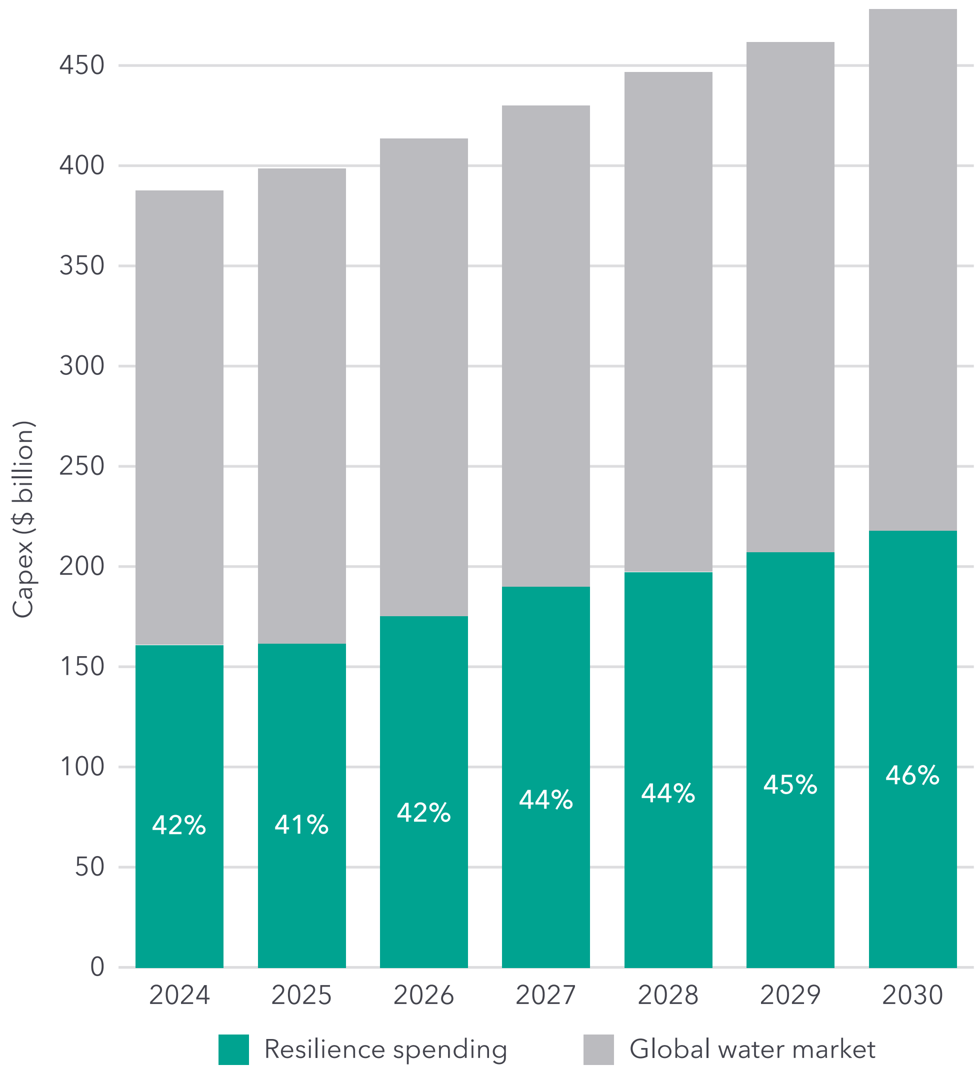
**Managing growth**

- Supply planning

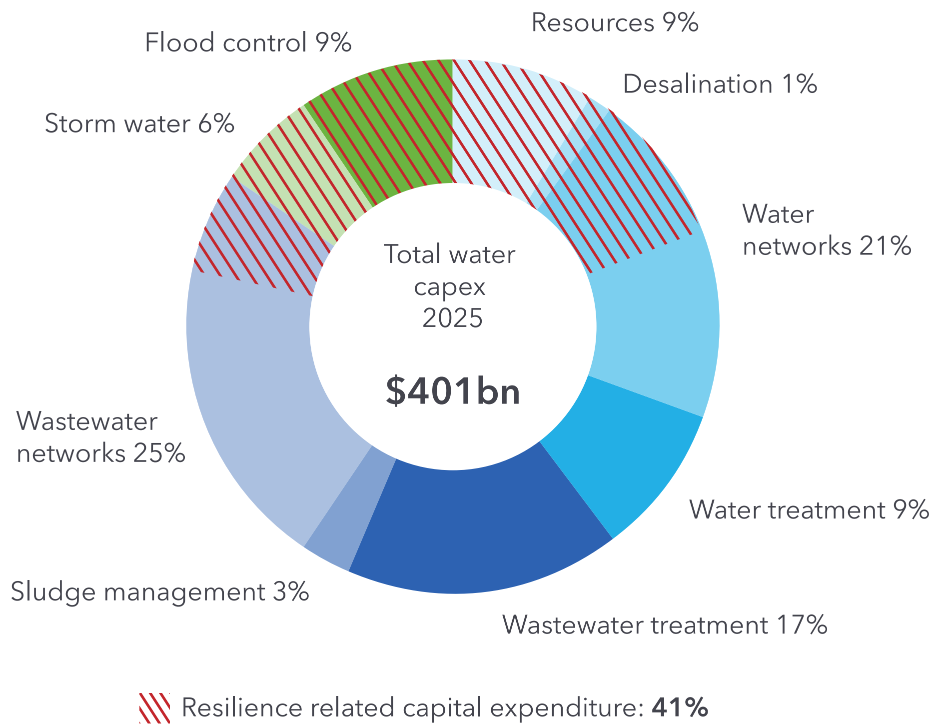
# Utility climate-resilient spending

## How much are water utilities spending to achieve climate resilience?

*By analysing resilience spending in utility capex plans from large urban utilities and mapping it onto utility capex forecast data, GWI has estimated how much capital utilities worldwide are spending, and planning to spend, on resilience. This data clearly demonstrates that utilities are already investing heavily in resilience: they are not waiting for any official mandate or specific funding.*




### 2025 capital expenditure breakdown



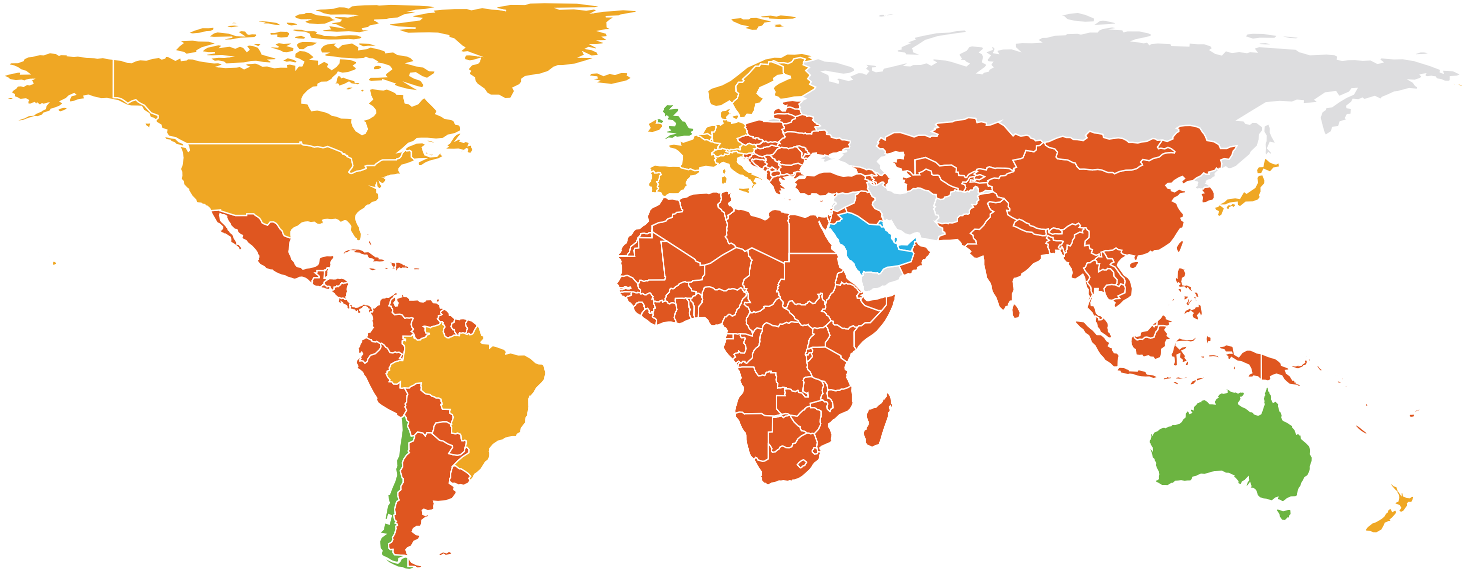

Under the "new thinking" scenario, total capital expenditure would need to increase by 80%. This would enable utilities to meet all of their investment objectives while ensuring that the proportion of spending going towards resilience goals were maintained at 41% of total capital spending.

*Source: GWI WaterData*

# How do utilities plan their capital expenditure?

## Mapping how utilities plan for and budget their capex across the world

*Utility capital expenditure planning varies significantly. Some utilities, often under strong regulatory oversight, can develop and fund long-term, multiyear plans that build resilience. However, most utilities lack control over their capital budgets, relying instead on decisions at the national level or on annual budgeting. This limited autonomy hampers their ability to invest adequately in resilience, leaving them underprepared for escalating water crises.*



**Low utility autonomy, capex funded through national budgets and DFIs**

Utilities can struggle to cover operational costs through tariffs, capex investments mostly planned and funded at the national level, sometimes through development finance loans. Utilities rarely receive these loans directly.

Communist legacy of central planning in Eastern and Central Europe, EU funding for large projects.

**China:** a few large utilities have planning autonomy, elsewhere local governments determine capital budget.

**High utility autonomy and visibility of long-term capex plans, funded through tariffs**

Utilities submit detailed multiyear long term capital investments and proposed tariff increases to their regulator. Tariff increases are tied to capital plans: both are approved together by the regulator.

**Utilities mostly autonomous in planning capex investments, mostly financed through tariffs with some external funding**

Fragmented utility landscape, high diversity of planning and funding models, from multiyear plans to year-on-year budgets. Operational expenditure mostly funded from tariffs, with some external funding for capex.

**North America:** large utilities have multi-year plans, smaller utilities are municipal departments.

**Brazil:** municipalities leverage private capital through concession contracts which lay out capital spending.

**Gulf countries**

A high proportion of water projects are large desalination projects which are financed through PPPs. Capex planning is managed by national agencies who then tender projects out to the private sector.

# Case study: Sydney, Australia

## A record-breaking capex plan for resilience

*Sydney Water is significantly ramping up its capital expenditure in the next two decades to transform a water system that is no longer fit for purpose.*

**Planned spending:**

**AUD 85 billion ($55 billion)**

### Infrastructural

Sydney's water system, that has served it for over a century, is simple: water supplied from reservoirs in the west is distributed through the city and effluent is discharged to the ocean in the east. But this brittle system leaves the city's supply vulnerable, heavily reliant a single rainfall-dependant water source which can run low or become contaminated by storm surges, bushfires or human incidents. The utility also needs to expand its supply to service a population set to almost double by 2050.

To future-proof its water system, Sydney Water has ambitious plans to decentralise and diversify its supply through water reuse, desalination and stormwater capture.

The utility aims to make 65% of its supply rainwater independent by producing up to 163 million $m^3$ of recycled water per year by 2050.

### Planning

Sydney Water has significant autonomy in planning its spending over a long period of time, and must submit its plans to the state regulator which approves increases to customer charges in conjunction with expenditure forecasts.

This system makes the plan both stable and predictable, reassuring investors and lenders that the plan is supported by regulators and will go ahead. A robust multiyear pipeline helps secure cheaper loans and stagger tariff rises.

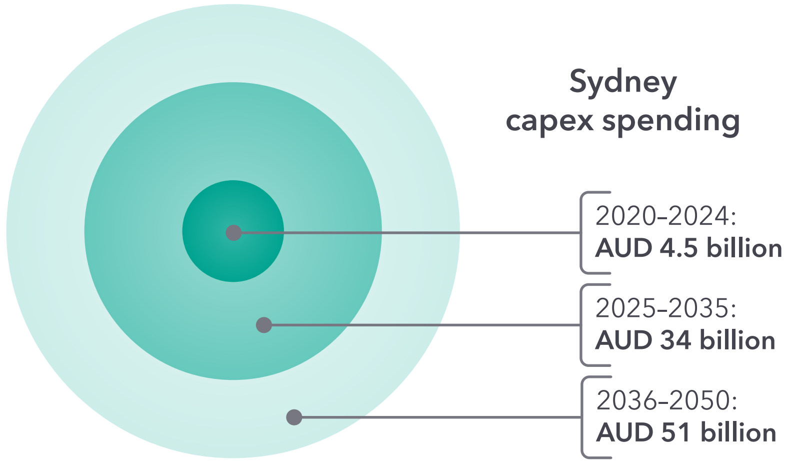
### Financial

To restructure and expand the city's entire system, Sydney Water has tripled its capex plan over the next ten years, compared to their previous plan. The utility will spend AUD 34 billion ($21 billion) to 2035, and forecasts it will need to spend another AUD 51 billion ($32 billion) to 2050.

This includes $12 billion earmarked specifically for new accountabilities for resilience, both on the water supply and stormwater sides.

Funding for the first 10 years of this plan is aligned with the utility's submissions to the regulator and can be delivered through tariff increases, bonds and loans.

The reintroduction of 'infrastructure contributions' whereby developers fund water infrastructure for new developments upfront, will enable the utility to pass on some of its costs for growth.

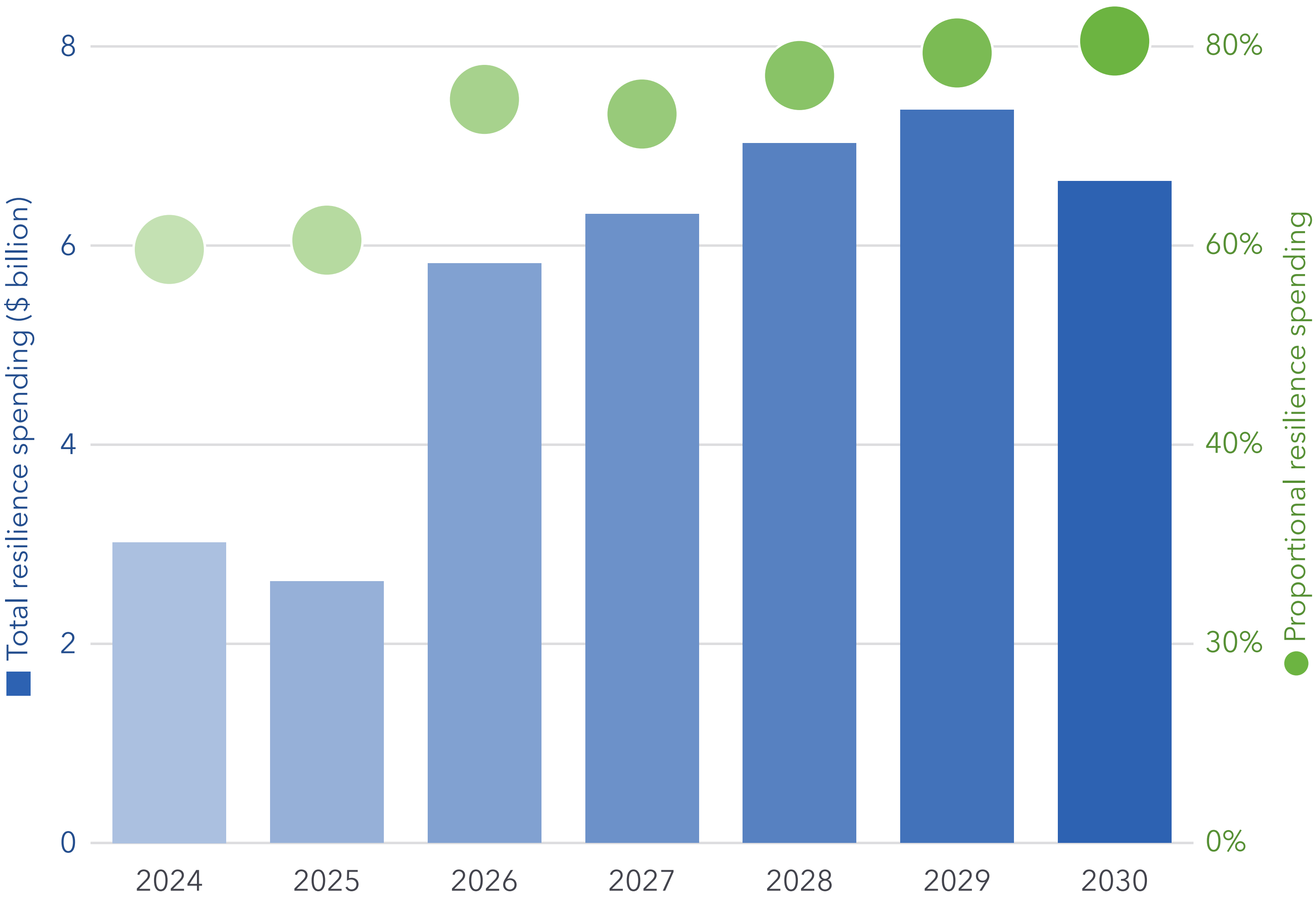


# Utility spending deep-dive: UK

## Resilience spending by highly-regulated, investor-owned utilities

*The UK's privately-owned water utilities must submit their business plans, including capital expenditure, to the national regulator Ofwat every five years. The most recent plans - "PR24" - which run from 2026 to 2030 give a uniquely clear snapshot of utility spending in a country plagued by sewer overflows, floods and underinvestment in water supply.*

**Capex spent on resilience**




Capex spending in the newest 5-year plans is significantly higher than the previous plans, with utilities doubling their planned spending, and the proportion for resilience also rising sharply to represent the majority of spending the 2026–2030 plans.

Although total spending in UK 5-year plans tends to peak around the third or fourth years and taper off in the final year, the proportion of resilience is sustained and even increases.

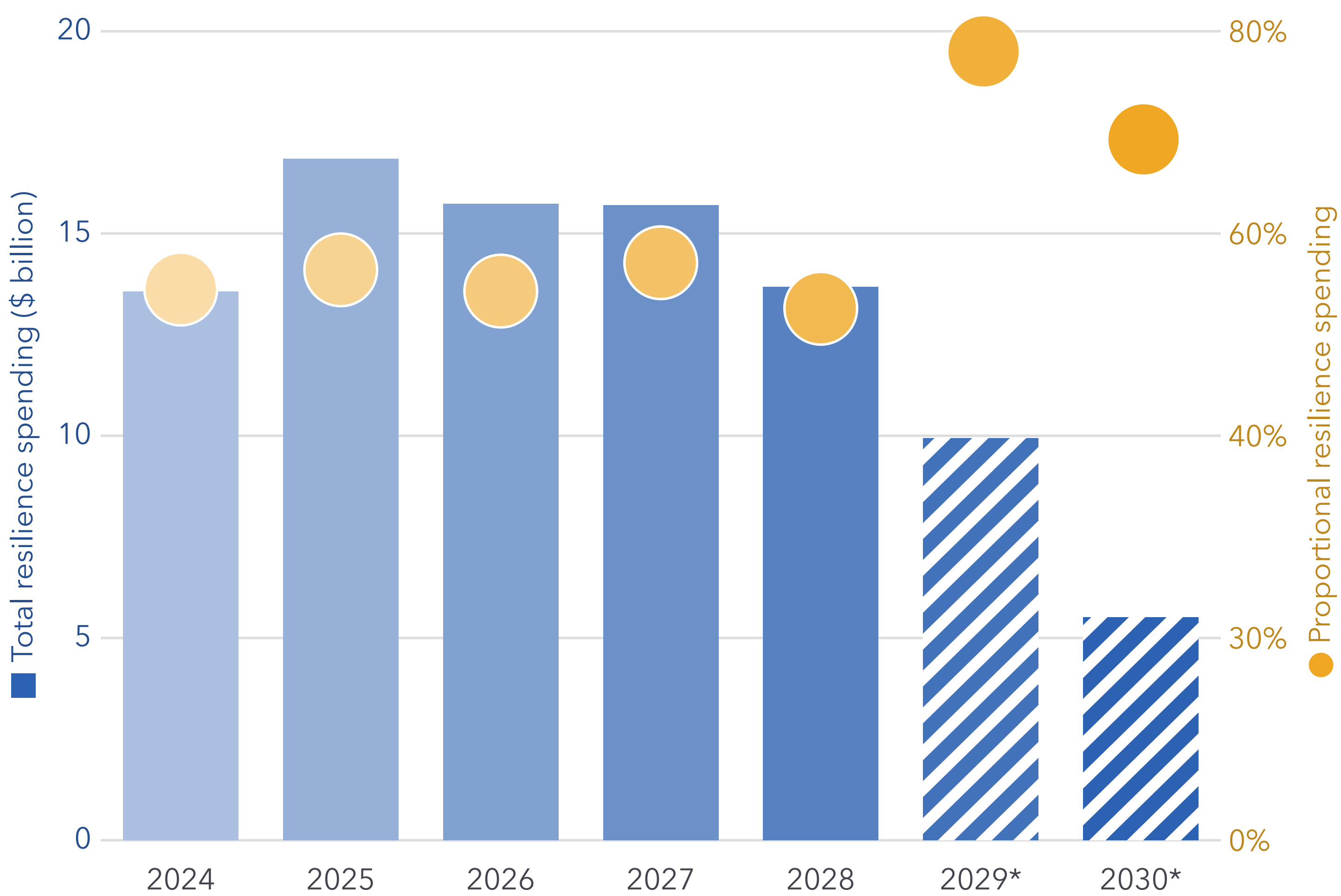
From 2026 onwards, there is a notable uptick in spending earmarked for stormwater projects, a clear canary in the coal mine demonstrating the utilities' move towards increased resilience spending.

# Utility spending deep-dive: USA

## A snapshot of capital spending by large urban American utilities

*The United States has over 60,000 utilities, but only handful have multiyear spending plans. However, even a minority of utilities out of thousands can give an interesting sample of utility spending in a country as diverse as the climate impacts that it is facing, from extreme storms and flooding to severe water scarcity, often in the same regions.*

**Capex spent on resilience**




** only a limited number of utilities have declared spending for 2029–2030*

These charts show estimated spending on resilience for 74 large American utilities with multiyear capital improvement plans (CIPs) from 2024 to 2028.

Although large American utilities plan to spend half of their capex on resilience, stormwater features little in their plans. There is a strong focus on combatting water scarcity, and stormwater is often the purview of municipal council rather than the water utility.

The sample from 2029 and 2030 is smaller as only 32 utilities have plans that extend that far. However, this small sample clearly shows that utilities with longer-term plans have a stronger focus on resilience, as plans further in the future include a much higher proportion of spending on resilience projects.

# Case study: New York, NY

## Tackling an expanding utility mandate among climate whiplash

*New York is a city on the front lines of climate whiplash: it sits both surrounded by water and on top of water and, after experiencing devastating floods in 2023, faced its first drought in over 20 years in 2024. And now, its mandate has significantly expanded.*

**Planned spending:**
**$30 billion over 10 years**

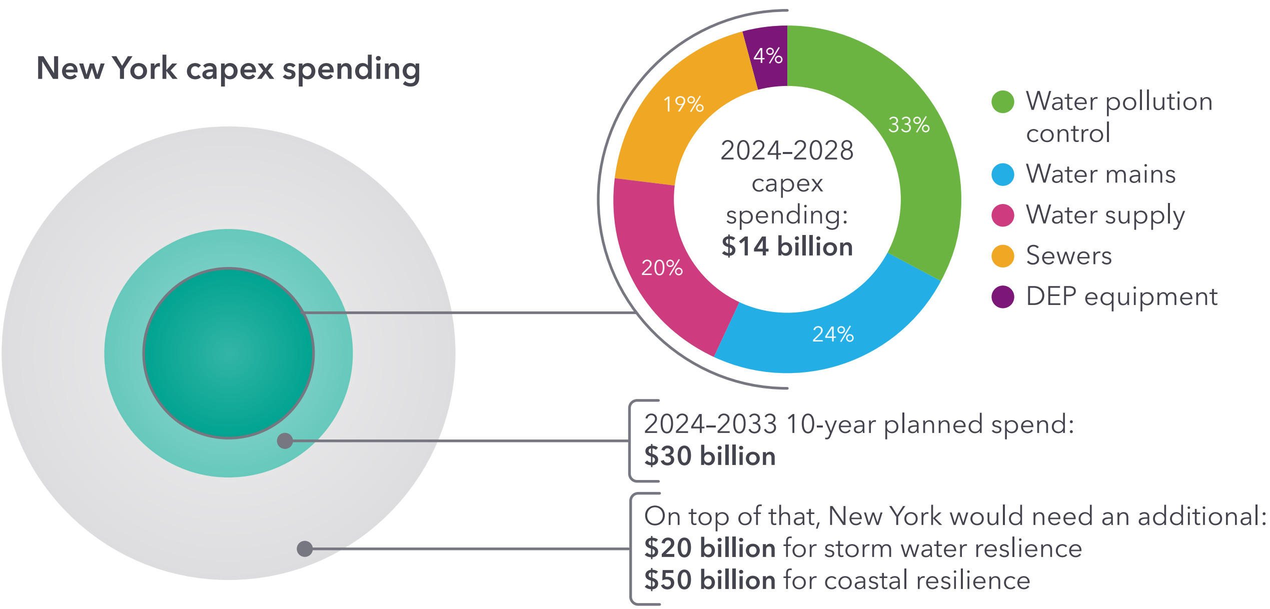
### Institutional

The primary mandate of NYC's Department of Environmental Protection (DEP) is to manage water supply and wastewater treatment in and around New York. After multiple devastating floods in the city, DEP has taken upon itself to significantly expand its focus to stormwater resilience, because in the perception of New Yorkers, water in the wrong place is DEP's responsibility.

After decades of investment into sewers to reduce CSOs, DEP is now pivoting its sewer investment to focus on stormwater resilience where possible.

What's more, two years ago DEP was given the additional mandate of coastal resilience by the city, meaning it must now also protect the city against sea level rise, tidal flooding and storm surges. In January 2025, DEP took delivery of twelve swing gates for the East Side Coastal Resiliency project, officially making it a coastal resilience utility.

### New York capex spending




### Financial

Despite NYC DEP's widened mandate, no significant additional funding has yet been allocated to the utility to fulfil this mandate. Under the legislation establishing DEP's revenue system, coastal flooding is not an eligible expense, meaning coastal defence expenditure must come out of the city's general fund, where it is in competition with housing, the police, education and other city budget priorities. DEP estimates it would need an additional $50 billion investment to achieve coastal resilience.

NYC DEP's current 10-year plan lays out $30 billion of capital spending, mostly on water supply lines to secure supply infrastructure and storm sewers to reduce CSOs. Roughly 1/3 of the budget covers stormwater, but NYC DEP's Commissioner estimates another $20 billion would be needed to truly achieve stormwater resilience.

With such a huge capital requirement, NYC DEP is focused on making the most of its budget. It has been investigating which projects can 'double up': fulfilling both the function of reducing overflows and improving stormwater resilience for example.

The utility is also streamlining its procurement and delivery processes to ensure it is able to actually spend as much as it has planned.

# Case study: Austin, Texas

## The 100-year plan for water resilience

*The current increase in water capex is only the tip of a massive investment iceberg to come. Some cities, like Austin, Texas, already know that in the face of an uncertain climate and increasing population, spending on resilience will need to be sustained for a century to truly secure water supply.*

**Planned spending:**
**$6.5 billion**

### Infrastructural

Austin, in Texas, gets most of its water supply from the Colorado River, an increasingly unreliable source. With the city's population expected to triple to 3.2 million by 2120, most modelled climate scenarios show the city will experience water shortages by 2070 if no action is taken to remodel the city's current supply system.

Reducing Austin's reliance on the Colorado River, as well as augmenting its supply, requires an extremely ambitious set of alternative supply projects. This includes significant demand management and leak detection initiatives, aquifer storage, indirect potable reuse and brackish groundwater desalination.

These projects cannot be planned and financed in a 10-year timeframe, hence Austin Water's formulation of a 100-year plan to enable it to lay longer term ambitions on the table and present a roadmap to achieve them.

### Planning

Austin formulated its "Water Forward" plan which maps out spending over 100 years to secure the city's water supply. This timeframe is completely unique: the gold standard, most forward-looking utilities have a timeframe up to 2050. Austin's bold approach is enabling it to explore options for water security to be delivered far into the future and that would only be achievable in that longer timeframe.

This very long-term plan also gives its customers and stakeholders visibility. Although Austin will rely on external funding, both state and federal, as well as manage debt service costs though debt defeasance, funding this plan will inevitably lead to tariff increases. The century-long visibility enables the utility to avoid price shocks by increasing tariffs gradually.

Although the plan is not fully funded to 2125, it provides an objective and a roadmap that all stakeholders can follow.

**Implementation timeline:**

**From 2030:**
**Customer water efficiency and leak detection**
- Augmenting supply by tackling losses on utility and customer side

**From 2040:**
**Large-scale aquifer storage**
- Storing Colorado River allocations to be used during periods of drought

**From 2050:**
**Indirect potable reuse**
- Deep drought emergency measure to be used if lake levels drop below 20%

**From 2070:**
**Groundwater brackish desalination**
- Water supply diversification strategy

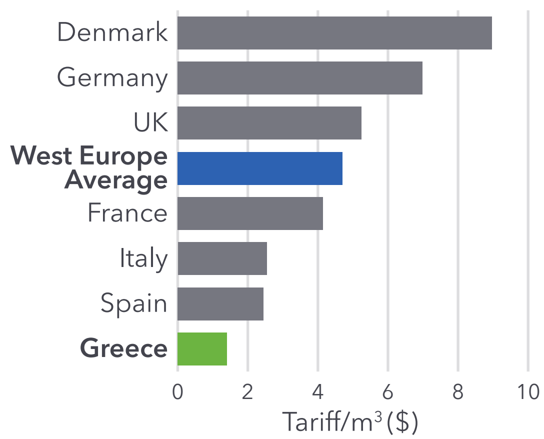
# Case study: Athens, Greece

## Exploring all the options to avert water scarcity

*Athens is having to urgently find new water sources amid institutional difficulties and low tariffs.*

**Planned spending:**

**EUR 2.1 billion ($2.3 billion)**




### Infrastructural

Athens is one of driest cities in Europe, and has historically relied on reservoirs in the surrounding mountains for its water supply. In recent years, levels in those reservoirs have dropped dramatically and are not recovering, leaving the city scrambling for new sources that it must secure in a matter of years, not decades.

EYDAP, Athens' water utility, has formulated a plan with a myriad of options to secure the city's water supply. Some options would mean rethinking the city's infrastructure, such as turning to water reuse and or desalination, or expanding the reach of the city's supply line to find reservoirs further afield (see map on next page).

### Financial

Although almost half of EYDAP's €2.1 billion will be funded by the EU, the utility must raise tariffs to finance its ambitions. Greece has the lowest tariffs in Europe, impairing utilities' ability to maintain existing infrastructure which is in need of repair, and to ramp up spending. Some polls now suggest customers would accept an increase in bills to fund water resilience.

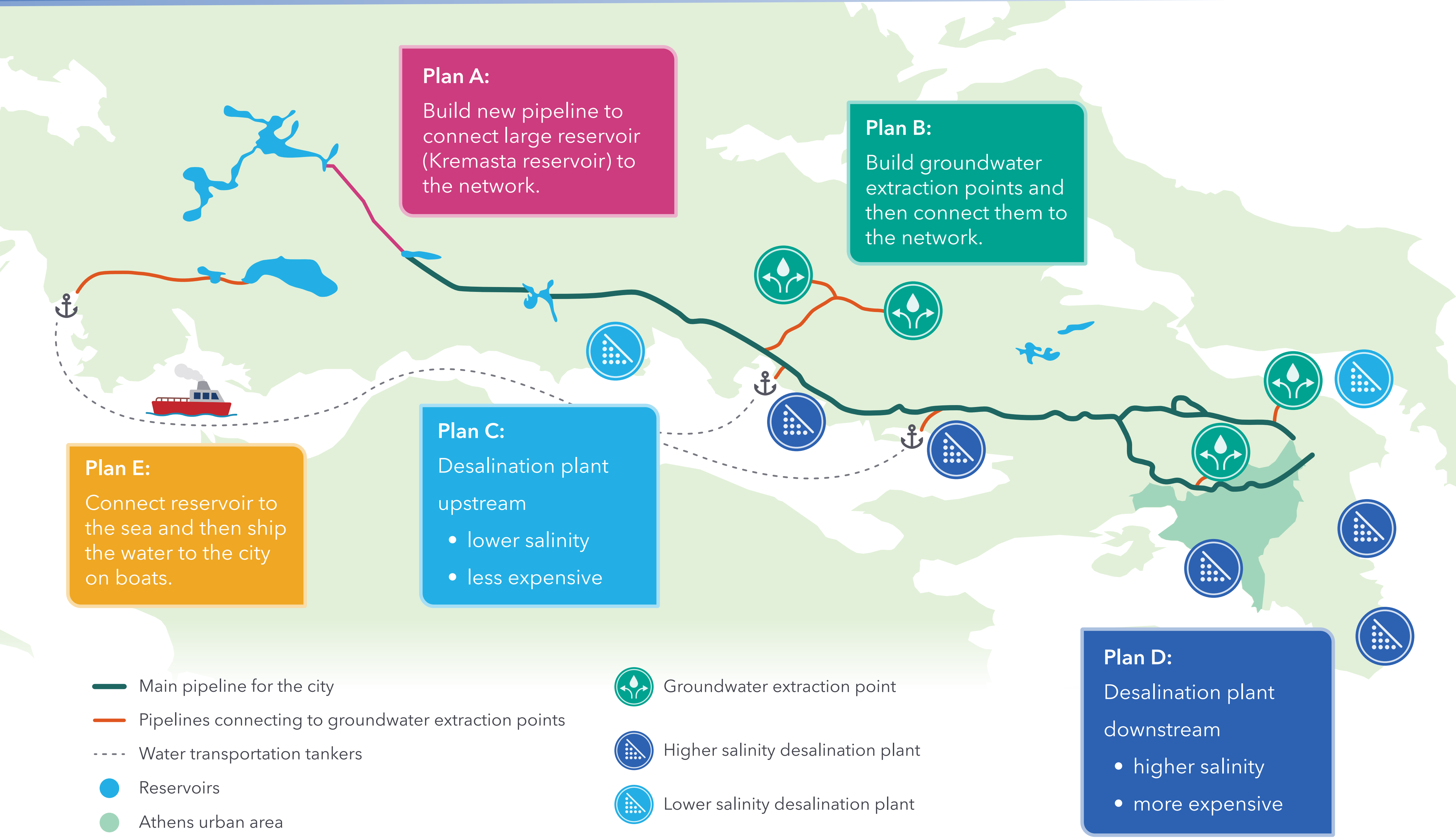
### Institutional

EYDAP has benefited from some legislative support to enable it to fulfil its ambitions. In 2024 Greece passed a bill authorising EYDAP to operate water supply services in other regions, and removed barriers to producing recycled water for non-potable use. Greece also issued a record number of desalination permits in 2024.

Institutional inefficiencies remain however, and EYDAP's plan contains multiple alternative options because it may not receive authorisation for its preferred plan to go ahead.

# Mapping Athens' path to resilience

## What different drought resilience options is Athens exploring?




- Main pipeline for the city
- Pipelines connecting to groundwater extraction points
- Water transportation tankers
- Reservoirs
- Athens urban area
- Groundwater extraction point
- Higher salinity desalination plant
- Lower salinity desalination plant

# Case study: Dubai, UAE

## Making a desert city resilient to floods

*A city that sits in the middle of the desert is the last place one expects to find massive stormwater investments. But now, after decades of bringing water into the desert, Dubai is re-thinking its whole infrastructure to be able to keep excess water out.*

**Planned spending:**

**AED30 billion ($8.2 billion)**

### Infrastructural

Since its inception in the 1960s and throughout its meteoric rise to a global financial centre today, Dubai's water investments have always focused on water scarcity. Thanks to massive investment in desalination, the city's water supply is more secure than in many cities less arid than itself.

But after dramatic floods brought the city to a standstill in 2024, the city was forced to rethink its priorities. A $350 million stormwater project completed in 2021 in the south of the city did little to stop the floods, so Dubai's ruler greenlit a massive stormwater resilience endeavour.

Once completed, the stormwater drainage system will have an overall capacity of 20,000,000 $m^3$/day, with a flow capacity of 230 $m^3$/second, enhancing the city's drainage capacity by 700%.

### Financial

The planned expenditure on stormwater is equivalent to the municipality's entire existing ten-year capex budget for sewerage, meaning Dubai has doubled its wastewater expenditure.

Due to centralised decision making and the availability of substantial financial resources, the Dubai municipality can proceed with this plan without the budgetary constraints that often affect other public institutions.

However, for stormwater infrastructure, there is no clear way to regenerate costs through operation unlike, water production investment such as desalination. Dubai may therefore build this infrastructure through an EPC model rather than through a PPP, which Gulf countries usually rely on for their large water projects.

# Innovation gap

## What technologies do utilities really need to tackle resilience?

*The water industry is constantly innovating to find solutions to utility challenges. Here are some innovations that utilities need more of, and to be more accessible, as they strive for long term resilience to climate change. Increased innovation in these areas would enable utilities to optimise their capital expenditure.*

Reuse is a high-priority solution to augment supply, but there is no standard procurement process which pushes its cost up.

**Innovation:**

- **Affordable reuse** through the standardisation of procurement, along a similar model to desalination.

Leak detection technology is advanced, but fixing leaks once they are found is costly.

**Innovation:**

- **Trenchless leak repair technologies** that enable utilities to repair leaks and conduct proactive maintenance without the high expense of roadworks.

High energy costs threaten utility resilience due to fluctuating energy prices. Efficient pumps lower energy costs for networks, but aeration still uses a lot of energy.

**Innovation:**

- **Wastewater treatment optimisation** through sensors can enable utilities to avoid over-aeration, lowering energy use from blowers.

*"It's not necessarily about the innovation gap, it's about how quickly and efficiently you can bring those innovations into action and how effective they are. Collaborating with other utilities, finding out best practice and discussing solutions is the best way to find out about the best innovations."*

*– Harry Sachinis, EYDAP (Athens Water)*

Utilities are collecting more data and AI is being made more accessible but it is not always clear how to use these tools effectively.

**Innovation:**

- **Advanced network monitoring and modelling technologies** for networks to plan maintenance, run disaster scenarios and anticipate extreme events using meteorological data.

Flood resilience can be a choice between expensive grey infrastructure or high-tailored and high maintenance nature-based solutions.

**Innovation:**

- **'Off the shelf' green infrastructure** solutions which retain the cost effectiveness and environmental benefits of NBS but are easier to put in place at scale.

# Key takeaways

## KEY LESSONS

Utilities are already spending significantly on resilience, but to deliver on their expanding mandates they must rethink their investment strategies.

### LESSON ONE

Resilience is a priority for utility leaders because of their public health and environmental responsibilities. Climate change adds a new layer of systemic risk.

### LESSON TWO

Rising global temperatures are disrupting the "kurtosis" of the water cycle: extreme droughts and floods are becoming more frequent.

### LESSON THREE

Resilience cannot be the burden of utilities alone. They require support from stakeholders to deliver on expanding mandates.

### LESSON FOUR

Utilities cannot spend their way out of this. They must optimise investments and rethink business models.

### LESSON FIVE

The infrastructure of the past is not suited to the future: it needs to be redesigned to be smart and future-proof.

### LESSON SIX

Capital planning and budgeting models that do not project far enough into the future cannot enable utilities to deliver resilience.

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