

WHITE PAPER

The future of leakage

An Ovarro deep dive report



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The future of leakage

An Ovarro deep dive report

Across most parts of the world, water utilities have been tackling chronic water losses over recent decades – globally, around one-third of the treated water put into networks is lost before it reaches customers. But the world population is increasing and with this, demand for water – all while we are experiencing more severe drought. Widespread loss through leaking pipes is no longer acceptable in the eyes of the public and regulators.

Ideally, in the future, the water sector should aim for near zero leakage from water networks. As such, UK Water Industry Research (UKWIR) is undertaking extensive research, some in collaboration with Ovarro, to answer the question, how will we achieve zero leakage in a sustainable way by 2050? If we are to achieve such an ambitious goal, water utilities need to continue to invest in innovation, support new ideas and share findings.

Of course, when it comes to leakage reduction, the sector has not always got it right. Around 70 years ago, it was thought one solution was to replace corroding metal water mains with new plastic pipes, which would never leak. We now know this is not the case. Plastic pipes do leak and the noise the escaping water generates is quieter, lower frequency and harder to detect than that from a metal pipe. This created a new challenge but, in response, technology adapted to focus on internal pipe sensors to listen for noise.



One example is Ovarro's market-leading Enigma lift-and-shift logger, which was designed 18 years ago, but remains a go-to device for leakage technicians, providing reliable overnight correlation results to pinpoint precise leak locations.

The technology is continually advancing - the more recent Enigma3m range uses patented time-synchronisation technology. The Enigma3-BB is a further update, which allows the device to be installed directly into an operational meter box chamber. In 2022, LeakNavigator launched as the UK's first fully-managed, fixed network leakage service, moving us further forward.

Globally, more and more utilities are adopting data-powered tools, which are transforming network management. Products that apply artificial intelligence and machine learning, as well as cloud-based, as-a-service models, are recent additions to the Ovarro portfolio, developed in collaboration with the sector to address their current and future challenges.

The last two years have been an incredibly challenging time for industries that rely on electronics, with supply chain shortages impacting many technology companies, including Ovarro.

Thankfully, these problems are starting to ease and we can renew focus on researching and developing next generation products for leakage reduction. But it is not a solo mission - we all have a shared interest in securing water for future generations. Liaison between utilities, suppliers, innovators, academics and governments will be the only way to drive through new ideas at the rate we need.

Now is an exciting time for water technology. The water crisis is forcing us to answer new questions urgently. Technology, used in the right way, has never been more critical.

- Barbara Hathaway, Technology Leader (Leakage Solutions).

Global water crisis



Rapid growth and industrialisation of the world's towns and cities, along with increased water use by customers in the shadow of the climate crisis means there is much less water available than in the past.

Europe has been in drought since 2018, according to a study from the Graz University of Technology, Austria. In spring 2023, multiple European governments were warning of critical water shortages as summer heatwaves and an unusually dry winter left freshwater sources depleted.

In northern Italy, France and Spain, emerging drought impacts "*raise concerns for water supply for human use, agriculture and energy production*", according to the European Drought Observatory's drought report from March 2023. There were also widespread concerns in Ireland, UK, Switzerland, most Mediterranean islands, Romania, Bulgaria and Greece.

In 2018, Cape Town was the first major city in the modern era to face the threat of running out of drinking water. In 2019, Chennai reached its own day zero – a population of some 11 million without enough water. Other cities looking down the barrel of water scarcity include Sao Paulo, Bangalore, Beijing, Cairo, Jakarta, Moscow, Istanbul, Mexico City and London.

The UN 2023 Water Conference, the first to be held in a generation, heard two billion people still lack access to safe drinking water and 40% of the world's population is affected by water scarcity. More than 90% of disasters are water-related, with climate change hitting hardest through water. The gathering was said to be a "watershed moment" to mobilise member states to take action and bring successful solutions on a global scale.

New infrastructure and technologies have a key role to play in helping countries conserve more water, reduce waste and reach more people. Shifts in policy, investment and behaviour are also key.

In terms of climate change, we cannot reach net zero on carbon emissions without considering water - and we need to get there as soon as possible.



60%

Bulgaria had the highest water leakage rate, at more than 60 per cent.



Leakage a worldwide challenge

The global volume of non-revenue water (NRW) - water that has been treated and is lost before it reaches the customer - has been calculated at nearly 350 million cubic metres per day or 126 billion cubic metres per year. It represents 30% of the volume of water put into piped systems across the world.

While there are significant regional differences, leakage levels worldwide are too high. Up to 60% in parts of South America, anything up to 50% in the US and an average of 35% in Asian cities.

Water losses in Brazil reach more than 40%, which, over a year, is enough water to supply about 66 million Brazilians. This is twice the number of people who do not have access to water in the country, according to the Instituto Trata Brasil, which seeks to protect the country's water resources.

Leakage rates across Europe vary but on average, a quarter of water is non-revenue water - based on EurEau data from 2018. Bulgaria had the highest water leakage rate, at more than 60%. The Netherlands had the lowest rate, at around 5%.

The lowest NRW levels - 36 litres per capita per day - can be found in Australia and New Zealand. This is due to the big water loss reduction efforts made during the last 10 to 15 years in the attempt to better cope with long droughts.

European Drinking Water Directive

A revised European Drinking Water Directive came into force in January 2021, which states that with the improvement of monitoring techniques, leakage rates have become increasingly apparent. Water leakage levels now have to be assessed by all member states and reduced if they are above a certain threshold.

The directive notes there is a general lack of awareness of water leakage rates, and that high levels are the result of underinvestment in the maintenance and renewal of water infrastructure. Member states are now required to assess leakage levels from all suppliers that produce more than 10,000 cubic meters of drinking water per day or supply more than 50,000 people. They must inform the European Commission of those levels by 2026.





5%

The Netherlands had the lowest water leakage rate, at around 5 per cent.



Barriers to progress

Given the size and complexities of underground water networks, finding leaks is a major challenge. Historically, methods of leak detection relied on local teams and contractors working on the ground, using acoustic equipment such as listening sticks, ground microphones and leak noise correlators.

These methods can be time and labour intensive and rely on skilled technicians to use them. Now, thanks to the development of remote acoustic loggers which can be permanently fitted underground, leakage data can be gathered through fixed network systems. These systems enable water company control rooms to remotely monitor networks continuously— that is a gamechanger for water utilities.

There are many more examples of leak detection innovation, including the use of satellites and drones, but despite technological progress, there remain many barriers to global, widespread adoption.

The International Water Association has summarised the barriers, which include:

- Absence of strategy
Every leakage reduction strategy should answer the following questions: how much water is lost? Where is the water lost? Why is it lost? What needs to be done? How to make water loss reduction sustainable?
- Human resources
Water loss reduction is a full-time job requiring a substantial number of staff. In most utilities, this means recruiting and training new staff.
- Unrealistic budgets
Financial requirements for water loss reduction are frequently underestimated. Comprehensive reduction programmes in low-and middle-income countries have payback times of between five and ten years and provide significant long-term financial benefits, but require upfront funding.
- Technical knowhow
Utilities need to choose, install, operate and maintain the most suitable equipment in the most efficient way.
- Reluctance to outsource
Research shows that for water utilities with high water losses, performance-based contracts deliver better, faster and more cost-effective results. Water loss reduction is labour-intensive, and a private contractor can hire more staff and may have expertise that a utility does not have.



Thanks to the development of remote acoustic loggers which can be permanently fitted underground, **leakage data can be gathered through fixed network systems.**





Challenge: Pinpoint leaks on plastic pipes over long distances

Technology: Enigma3hyQ leak detector and LeakVision cloud-based analytics solution

Partner: Anglian Water

Ovarro partnered with Anglian Water to develop a revolutionary remote leak detection device, Enigma3hyQ and a cloud-based data platform, LeakVision.

The UK utility approached Ovarro in 2017 with an idea to adapt existing technology by combining two products – a correlating noise logger and a site-based hydrophone.

A collaborative development team was established to create the Enigma3hyQ system's hardware and software elements. Enigma3hyQ loggers use immersed acoustic hydrophone sensors that listen to sound waves inside the pipe to pinpoint leaks. The fixed devices return data, via 3G or GPRS, to the cloud platform to be analysed by utility leakage teams.

A UK-patented mathematical correlation technique is fundamental to operation of Enigma3hyQ. In event of a leak between two loggers, the noise emitted takes a measurable amount of time to reach each logger. A set of digital signal processing algorithms correlates the two recordings to determine the time difference between the sounds.

Along with the speed of sound in the pipe and the distance between the loggers, this is used to compute the leak location. The system synchronises daily to ensure precision. The sensors are also effective in finding leaks over long distances and inside plastic pipes.

Between April 2018 and January 2021, the system found 6,783 leaks, making it three times more efficient than traditional detection techniques. Anglian Water, on average, saw a 1:1 ratio of leaks found to points of interest issued.

An example of best practice in collaboration between utilities and suppliers, the project was recognised at the Water Industry Awards in May 2021, where it was named Alliances & Partnership Initiative of the Year.



Challenge: Make remote leak logger installation easier

Technology: Enigma3-BB – installed into meter-box chamber

Partner: UK water utility

In leakage reduction, there are huge gains to be made by embracing joint working. The vast local network knowledge within water companies, combined with the research and development capabilities of the supply chain, can deliver transformative results.

Enigma3-BB, launched in April 2021, was developed as a direct result of feedback from one UK utility customer. The device is an update of the Enigma3HyQ remote leak logger and is installed directly into an operational meter box chamber.

This gives utilities an alternative means of connecting to the water mains network with more access points. Previous installation methods were limited to either via a fire hydrant or by digging a new pit, which requires full civils work - a labour-intensive process that can cost thousands of pounds and involve liaison with local authorities, contractor hire and road closures.

Installing the devices onto a water meter box, normally positioned under a pathway or pavement rather than in a highway, saves money and leakage detection hours with far fewer health and safety implications – and, crucially, having the ability to install loggers in more strategic positions on the network significantly enhances coverage potential and increases the chance of finding leaks.



Challenge: Improve data analysis to meet leakage targets

Technology: LeakNavigator - UK's first fully-managed fixed network leakage service

Partner: UK water utilities

LeakNavigator, an end-to-end leakage reduction service, launched as the water sector moves forward with wider implementation of as-a-service models. Launched in 2022, LeakNavigator was the UK's first fully-managed, fixed network leakage service.

The leak-locating model comprises advanced acoustic dataloggers, cutting-edge cloud-based software and Ovarro's inhouse leakage expertise. With all elements combined, the service can accurately identify points of interest (POIs) on behalf of water companies, alerting field technicians directly, so they can head straight to site with high confidence that a leak will be found, reducing the need for inhouse data analysis.

LeakNavigator has undergone successful trials with UK water companies, recording a combined performance increase of 20-25% in total leaks

found, plus a 30% reduction in lost field time through false positives and a POI-to-leak conversion rate of over 85%.

As-a-service models are subscription-based applications, with infrastructure that is entirely managed and maintained by an external supplier.

The LeakNavigator package uses acoustic loggers from the Enigma range, which are installed following an assessment of a water company's district metered area (DMA), undertaken by Ovarro's leakage analysts. This process establishes the most suitable equipment to install, the unit numbers required and the best locations for optimum efficiency.

Once the loggers are in operation, Ovarro's teams undertake ongoing data analysis, sending POIs directly to water company field technicians via a mobile app. The captured data, which also supports maintenance targeting, is processed and presented to customers in a dashboard.

This consultative service allow companies to focus on their core responsibility of water system management and leave the data analysis to external specialists.



Challenge: Enhancing workforce efficiency

Technology: Eureka5 - a transition to tablet-based leak detection

Partner: UK water utilities

The ability to access network information on tablets and smartphones is another step forward in the digitalisation of the water sector. Eureka5 is a tablet-based leakage detection system which will become the basis for Ovarro's leak detection platform. It displays information on an android tablet and does not require a dedicated processor or laptop, cutting down the number of devices field teams need to have in their vans.

In terms of hardware, Eureka5 comprises two radio transmitters: a radio receiver with signal-

processing electronics which interconnects with the bespoke Eureka Go app, as well as Ovarro's existing cloud-based portal, Atrium.

GPS technology enables precise pinpointing of leaks, including in difficult conditions, such as where there is substantial background noise, where only the quietest of leak noise is present, and on a variety of pipe materials, including plastic. Eureka5 enables users to listen to noise on the pipe, upload this data directly to Eureka Go and view the data instantly on a tablet, rather than the bespoke processing unit used previously.

As well as simpler functionality for operators, the solution reduces capex costs. Why have multiple different versions of a PC in the back of a van when operators can work off one tablet?

Considerable research is underway into prioritising leak noise, allowing operators to understand which noises picked up by acoustic loggers are most likely to be large leaks.

Ovarro's LeakHub system has already been updated to filter electrical interference generated noise and other man-made sounds such as pressure reducing valves, mechanical water meters and air conditioning units.

Other advances being made by the sector, within touching distance, include:



Smart water meters

- Smart water meters, which will have the potential to eliminate customer-side leakage by ensuring that any water used customer side of a meter is billed, and therefore accounted for - and no longer considered leakage. As with energy meters, customers can use the output of a smart water meter to reduce their own usage and ensure they get that leaking toilet fixed before it significantly increases their water bill.



Sensors embedded in meters or pipes

- Sensors embedded in meters or pipes will allow easy detection of leaks. As the cost of sensing technology lowers and connectivity becomes easier, the options for where and how sensors are placed can grow. Why not fit a listening sensor into every joint in a water pipe, or into every smart meter to continuously listen for the sound of a leak?



Rapid detection of potential pollution events

- Ability to discover bursts earlier, reducing the number and severity of pollution events and the cost of clean up operations



User alerts to keep you informed

- Incident notification emails ensuring you are informed and able to make decisions to quickly manage pollution events
- Minimising the opportunity of negative publicity following a burst



Predicting when leaks will occur

- A fixed network setup allows us to gather more data around leaks and look for patterns in the data before a leak happens, eventually leading to the ability to predict which pipes are most likely to burst next. In addition to fixed networks, a wealth of data is being captured by a range of network monitoring systems. Brought together in the right way, this data also has the potential to indicate the location of the next leak.

Water utilities investing in new leakage technology

- Considering all available options and business cases, rather than take the default view that lower cost or higher volume is best. A few strategically placed devices in problem areas could provide a better return than flooding an area with a single product and expecting it to solve every problem. Each technology has its place, and it is worth keeping an open mind about what would provide the most effective overall solution for a particular network.



One-stop-shop for leakage reduction

Ovarro's specialists are ready to help water utilities plan and implement their leakage strategies. Our unique range of products and services means we can offer a one-stop-shop for leakage reduction, detection and prevention, providing end-to-end support throughout the process.

LEAKAGE SOLUTIONS

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ONE OF THE BIGGEST CHALLENGES ACROSS THE WATER INDUSTRY IS **THE ABILITY TO DETECT LEAKS EFFECTIVELY** ON PLASTIC PIPES AS THEY DON'T TRANSMIT NOISE WHEN THEY LEAK. CRITICALLY, UNLIKE MORE WIDELY USED METHODS, THIS NEW TECHNOLOGY CAN BE USED ON PLASTIC PIPES, WHICH MAKE UP 60% OF OUR WATERS MAINS. **IT WILL REVOLUTIONISE WHAT WE DO IN TERMS OF LEAKAGE.**

| Tony Gwynne
| Leakage Solutions Sales Director

Support

We have supported water companies across the world with our industry-leading technology. From protecting approximately 5 million people with flood risk telemetry systems for The Environment Agency – to delivering Malaysia's largest water network support system.

Collaboration

We work collaboratively with our clients, creating turnkey solutions for specific needs. Our technology is reliable and robust and we work closely with your engineers to ensure project rollout is as quick and easy as possible.

Strength

The strength and length of our client relationships are a testament to our way of working. The fact that we've been working with clients such as Wessex Water for over 30 years is a source of great pride for everyone at Ovarro.



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FOR A BETTER TODAY AND A
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