LESSON 6
INNOVATION FOR FIXING LEAKS IS A HIGH PRIORITY

Leakage has environmental, reputational and economic implications for utilities and customers.

Leakage is a long-standing problem in the water industry. The division of responsibility for rectifying leaks between utility and homeowner, from the street to the property boundary and within, respectively, has perpetuated a less than proactive approach. Historically, water companies have been little incentivized to carry out costly maintenance work to remedy leaking water, potentially causing widespread disruption to customers and communities, in return for reduced income. But with rising pressure on global water resources, turning a blind eye to the vast volumes of treated water 'lost' worldwide every day is no longer an option.

Accurate, consistent data

One of the biggest challenges is quantifying the scale of the problem. Leakage is estimated, not calculated. Further complicating the issue is that leakages – or 'real losses' – are commonly part of what is referred to as non-revenue water (NRW), which also includes 'apparent losses', namely unauthorized consumption or metering inaccuracies, and other unbilled authorized consumption (for example consumption linked to a fixed charge based on average or expected usage) or systematic data handling error. Globally NRW has been estimated at 30% of the total, equivalent to 346 million cubic meters per day, and cost value of US$39 billion per year.

Globally almost 350 million cubic metres of water are lost through distribution networks each day.

Regardless of which definitions are used, leakage and NRW both imply inefficiencies with environmental and commercial ramifications for utilities and clients, in terms of wasted resources, increased operational costs and water tariffs, and implications for future demand shortfalls.

As the effects of climate change intensify, the increasing frequency of drought and flood events and temperature extremes will only further stress already aging infrastructure. The industry needs to embrace a technologically driven approach to addressing NRW and reducing leakage. Pressure for improvement will come notably from customers, not least when they are repeatedly being asked to reduce consumption and cut wastage during drought conditions. Questions were asked in the UK House of Commons in summer 2023 about proposals to invest in a major water transfer scheme in the Thames Valley. Opponents argued that cutting leaks by 10% would be much less disruptive for residents and customers.

Eliminating all leakage is virtually impossible and economically unrealistic. Nevertheless, new technologies are delivering exciting results, by highlighting and isolating previously invisible leaks, enabling utilities and consumers to take action on both sides of the boundary. Technology must play a larger role in solving leakage in the future.

Water utilities in England and Wales have been reporting leakage under a consistent industry-wide methodology since 2017/18, and the results reported annually by the UK government's economic regulator for the water and sewerage sectors, Ofwat.

The **European Union** also is looking to establish measures to reduce water leakage and increase transparency in the sector through the Drinking Water Directive. Water suppliers within the block producing over 10,000m^3 of water per day (or supplying over 50,000 consumers) will be required to quantify and inform the European Commission of their leakage rates by 2026.

Consumer-side leaks

Household leaks are often smaller and less obviously require immediate attention compared to a burst water main, but combined they add up to a significant volume of wasted water. According to the US EPA, household leaks waste "nearly 1 trillion gallons of water annually" across the US. Through its WaterSense program, the EPA encourages consumers to "Detect and Chase Down Leaks" with a checklist of tips to help householders establish if they are leaking water and if so, the source.

In addition to highlighting consumption and encouraging conservation practices, water meters are invaluable in identifying leaks. Nevertheless, household metering varies significantly across countries, regions, utilities, rural and urban settings and customer types. Fixed rate tariffs remain commonplace, notably in regions where water scarcity has not historically been a concern. For example, 61% of household connections in the UK are now metered, according to Consumer Council for Water (CCW), while 39% remain on fixed rate tariffs. Fixed rates undervalue the real cost of providing a clean water supply, making moving to universal metering a priority. In areas where fixed rates are still used, mandating metering in newbuild homes is a minimum first step, as has been the case in some countries for decades.

The newest Advanced Metering Infrastructure (AMI) systems, or 'smart meters', provide real time insights by automatically transmitting data from meters back to utilities for storage and analysis. The integrated two-way communication system between meter endpoints and the water companies also enables them to alert consumers to potential leaks if the flow data signals excessive or prolonged water use.

Wellington Water in New Zealand recently undertook a technical feasibility study and business case to examine the strategic, economic and technical case for implementing residential water metering. Having explored three types of universal metering, namely Manual Meter Reading (MMR), Automatic Meter Reading (AMR) and AMI, the last option was judged to offer the greatest benefits in terms of leak detection and consumer engagement.

Many utilities are now embarking on multi-year smart meter rollout programs, some of them compulsory. Such initiatives have however raised concerns around the impact of metering on large families and low-income households. When transitioning from fixed tariffs, these concerns must be addressed by communicating the advantages for the majority of households in terms of reduced consumption and hence billing.

There are other simple leak detection technologies that consumers can be encouraged to deploy themselves. Portsmouth Water, in the UK, has been trialing an existing IoT solution widely used within the insurance industry to mitigate claims linked to water damage (which are the single biggest cause of home insurance claims). The LeakBot water leak detector, which is clipped directly onto the mains water pipe by the consumer, is generating impressive results by alerting the utility's customers to even the smallest leaks within their properties. Such has been the success, that neighbouring water companies, Southern Water and South West Water, have since launched their own LeakBot trials.

Utility-side leaks

On the utility-side, leak detection has progressed significantly since the days of periodically walking the entire network and simply looking for evidence of leakage. Acoustic listening methods have been widely used for decades. The emergence of remote monitoring systems which transmit data back to the utility has removed the need for local 'listening' teams on the ground but still relies on skilled operatives in the control room to manually analyze the recordings to pick out likely leaks.

The most innovative advances in acoustic leak detection are using AI and machine learning algorithms to analyze the volumes of data. These technologies can eliminate false positives more accurately and provide details on the characteristics and location of the suspected leaks which helps utilities to prioritize physical maintenance schedules to the biggest leaks.

More 'remote' still is the emergence of satellite leak detection, which has adapted technology used to look for water on other planets. It involves the use of radar sensors to penetrate the earth – through all ground coverings, including tarmac, concrete and brick – in search of the unique signature of underground drinking water, highlighting possible leaks. South Staffs Water in the UK has been trialing the technology with impressive results in terms of leak detection across its network. Anglian Water reports saving two million litres a day from the use of satellites to detect hard to find leaks faster. Drones equipped with thermal imaging cameras also are proving effective by detecting temperature changes in the soil around a leak, particularly in rural and inaccessible areas. In drought events, drones can similarly pick out unusual flora growth, indicating possible leakage.

Anglian Water in the UK reports saving 2m litres per day from the use of satellites to detect leaks.

Another emerging leak detection technology is the use of helium, an inert gas, which is injected into the flow of water in the pipe. Helium is lighter than air and also found in only very small concentrations, hence any helium detected at ground level indicates a leak.

‘Prevention better than cure’: predicting leaks

Digital technologies are helping utilities not just to identify but even to predict where and when the leaks are most likely to occur, enabling them to plan for what-if scenarios and act proactively before they happen.

Hunter Water in Australia has been using machine learning technologies to reduce leakage by 20%.

In Australia, Hunter Water has been using machine learning to leverage the extensive bank of historical data it has built up to ascertain which pipes are at highest risk of leaking and breakage. Analysis of a range of data including pressure, pipe material, age and location, together with other factors that might influence pipe lifecycles, such as acute weather events and soil moisture, is helping Hunter to prioritize survey schedules, leading to a 20% reduction in leakage. It’s also providing valuable insights into the cost of maintaining those assets long-term versus the cost of renewing them.

To address leakage, utilities will need to be much more innovative and open to innovation than they have been to date. They must also address the investments needed to be able to adopt these technologies, not just in terms of hardware and software but also in developing the digital skills to be able to leverage them across their organizations.