STOP WATER LOSSES

DANISH LEAKAGE MANAGEMENT SOLUTIONS

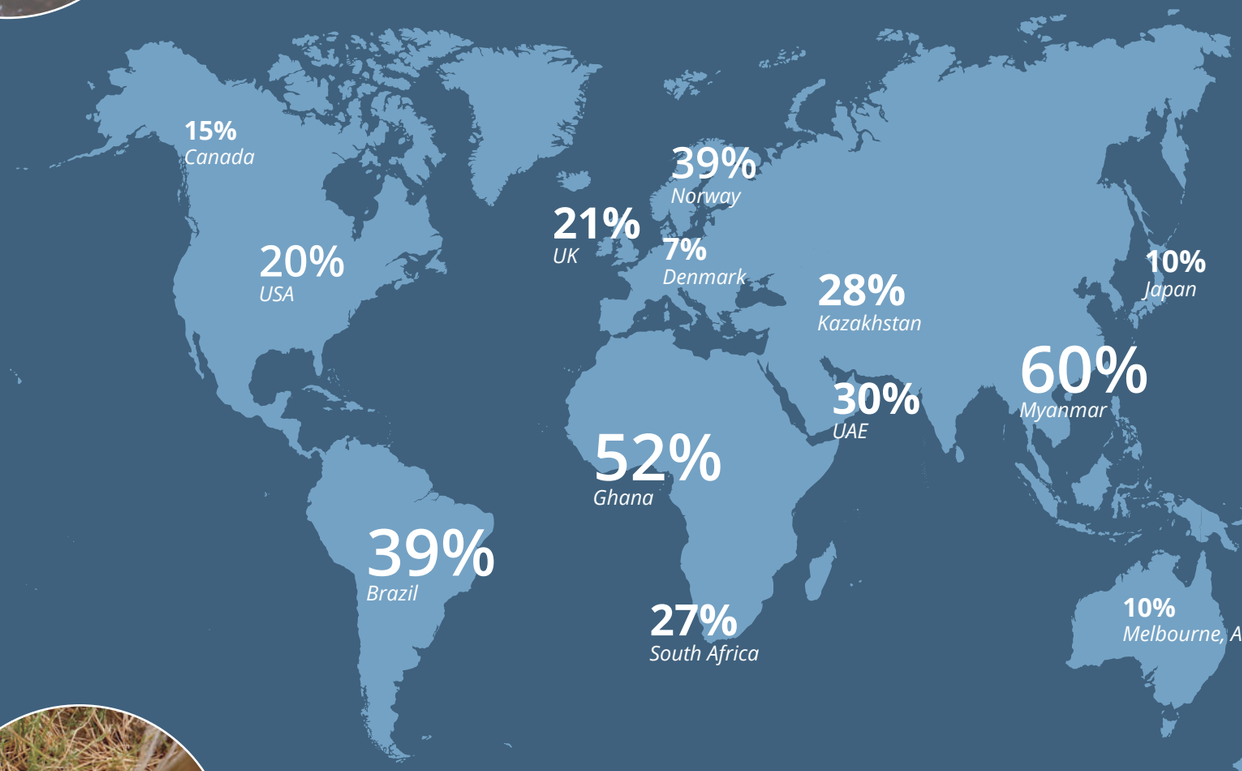
LEAKman

Frontpage picture: Kamstrup

NRW LEVELS AROUND THE WORLD

Leaking valve in valve chamber. Leaking 500 m³/y. Regular valve surveys would minimize the run time of such leaks.

Buried leak that does not surface. Leaking 2,500 m³/y. Active leakage control would lead to shorter run time.



Temporary above-ground installation that has become permanent. It leaks around 3,500 m³/year.

Leaks on pipe in rural area. Serious leakage of 400,000 m³/y. It did not surface but was found when sectioning the network and by manual leak detection.

Source: R. Liemberger, A. Wyatt; Quantifying the global non-revenue water problem. Water Supply 1 May 2019; 19 (3): 831–837

Water lost is money lost

Water loss is a massive challenge world-wide. A devastating amount of valuable and clean drinking water is lost due to leaking pipes and overflows or not accounted for due to metering inaccuracies and illegal connections. In great parts of the world this results in an overextraction of limited water resources to balance what has been lost or not accounted for.

Non-Revenue Water (NRW) is calculated as the difference between the amount of water a utility supplies to the distribution network and the amount of water billed.

According to UN, water consumption is expected to increase with up to 30 percent by 2050, and by 2025 half of the world's population are at risk of living in water scarce areas. The high amount of NRW increases the pressure on an already limited resource, and the result is people suffering from water scarcity and unnecessarily high water tariffs, and in the long run high NRW levels pose a real threat to development, urbanisation and agriculture for many people.

NRW is a waste of money, and water losses from leakage is a waste of the planet's scarce drinking water resources.

At a modern utility complying with internationally recognised standards by institutions such as International Water Association (IWA) and American Water Works Association (AWWA) sustainability goes hand in hand with cost efficiency, energy optimisation and a strong focus on reducing NRW.

A world of difference in NRW levels

Non-Revenue Water levels varies around the world from close to 5 percent to as much as 80 percent, and an average of 40 percent globally. Reducing NRW levels is a pivotal management challenge that requires a committed effort in multiple areas. Sustainable leakage levels are defined by the International Water Association as the Economical Level of Leakage (ELL) – the optimal level where utilities are maximising both economic and resource-related benefits.

Effective Leakage Management is based on four well-known and very important main pillars: Pressure management, active leakage control, speed and quality of repairs and pipeline management and rehabilitation.

Sustainable water management is besides being environmentally viable simply good business. In the long run, a sustainable approach to clean water supply does not cost money – it saves money, for both the utility and the consumers.

Multiple technologies – one solution

As a result of major efforts by Danish authorities and utilities, Denmark has managed to reduce water losses to an average of 7 percent. Denmark is a small country located in Northern Europe, where the conditions for establishing an effective and sustainable water supply have been advantageous because of the thrifty and law-abiding nature of the Danish population, as well as a well-established political system.

Denmark has the know-how and some of the best high-tech solutions for limiting Non-Revenue Water

Since the 1970s, the Danish water utilities have focused on preserving ground- and surface water while creating and maintaining a sustainable, high-quality water supply.

The ambition to create a world-class water supply has also been supported by political incentives e.g. by enforcing extra taxes on NRW and requirements for individual customer water metering established by law.

Thus, Danish water utilities have ensured an ongoing focus on continuous improvements and optimisation.

Today's low NRW levels are the result of a long-term commitment to asset management, strategic rehabilitation processes, good craftsmanship, accurate measurements of production and consumption combined with preventive maintenance and leakage control.

The low NRW levels in Denmark are a solid proof that it is possible to define strategies to achieve and maintain remarkable results by following the right approach.

Pipes, valves, pumps, smart meters, sensors, simulation models, Geographic Information System (GIS), Management Information Systems (MIS) etc. The idea behind the LEAKman initiative is to make all components of the utility and the distribution network operate as an integrated system.

Full-scale Implementation

The LEAKman solution has been developed by an association of nine Danish partners representing technology providers, consultants, water utilities and the Technical University of Denmark. Each of the partners are leaders within their field of expertise, delivering world-class products and knowledge for NRW management and water loss control. The LEAKman solution was fully developed and implemented at two large-scale demonstration sites during 2016-2021, supported by the Eco-Innovation Programme under the Danish Ministry of Environment.

Even though the demonstration sites were completed in 2021, the LEAKman solution will continue to be improved by the initial and potential new partners as new technologies are developed and more effective tools are identified.

Constructing the demonstration facilities
The large-scale demonstration facilities have been established at the Danish water utilities Novafos and HOFOR to showcase the LEAKman concept. The solution has been fully implemented on a total of 107 kilometres of main pipes and covers 5,200 customers supplied with 1.9 M m³ of water each year. At these facilities the LEAKman solution is implemented in full-scale combining all available knowledge and technologies, which creates a unique opportunity to test, verify and optimise each element of the LEAKman solution as well as the interfaces between systems.
The implementation includes installation and use of intelligent valves, pumps, deployed noise loggers, smart meters, smart inspections, SCADA, online hydraulic modelling and a holistic management information system configured for automated calculation, display and reporting of selected performance indicators.

The first step of the full-scale implementation was to plan and prepare the hardware installations and their integration with both the existing infrastructure and the involved IT systems. This was followed by on-site installation of instruments, deployment of noise loggers, smart meters, intelligent valves, valve positioners and intelligent pumps.

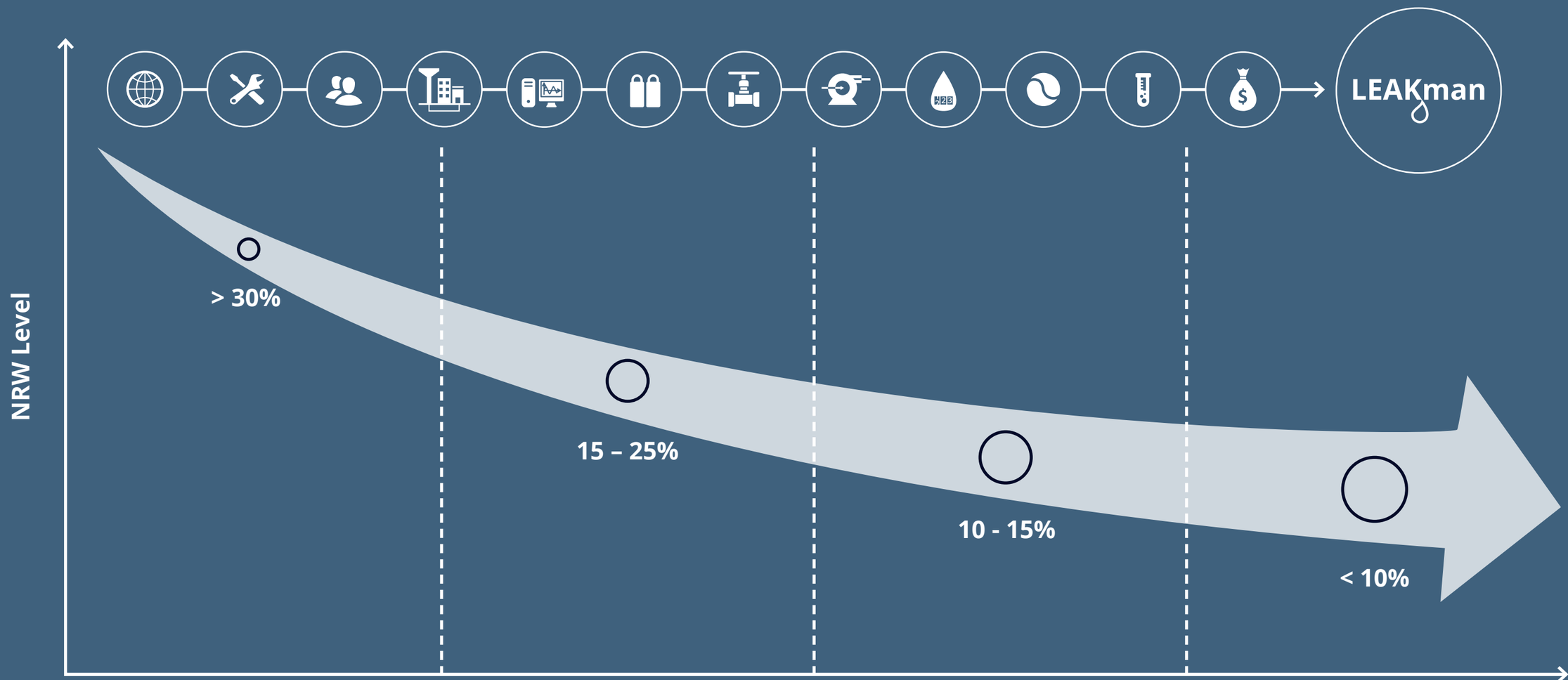
The hardware components installed perform a combination of pressure management and active leakage control. All data is connected to an online real-time hydraulic model (Aquis) and an online holistic management information system (HOMIS), which in combination creates a digital twin of the water supply network that provides an intelligent layer used for reporting, analysis, optimisation and training.

The LEAKman state-of-the-art demonstration facilities are open for site visit. Find contacts at ***www.leakagemanagement.net/contacts***, for inquires for site visits.

Value proposition
For decades, each of the LEAKman partners has delivered solutions and innovations within their specific field of expertise. However, the solutions are often installed as part of separate projects, with only little or inefficient interface between the different components. Consequently, the full potential of the entire system is never reached.

The LEAKman solution is unique in the sense that the partners of this concept have united to deliver a single, holistic solution, which combines several smart systems and seamlessly integrates and monitors them holistically, thereby connecting the entire water distribution network. The result is one solution that facilitates water loss reduction to less than 20 per cent for any system within just a few years – with possible reductions to below 10 percent.

LEAKMAN PROCESS OVERVIEW



Phase 1

NRW master plan
Network & asset registration
Leakage detection
Speed & quality of repairs

Phase 2

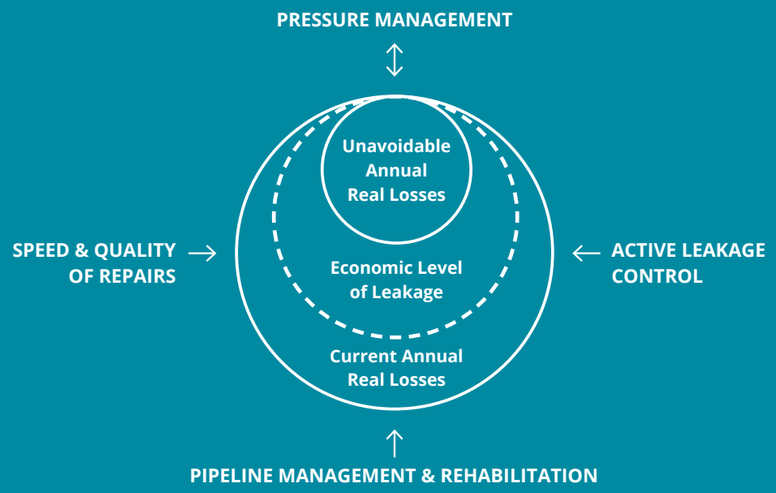
Hydraulic modeling
Instrumentation
Data collection
Online monitoring & reporting

Phase 3

Pressure management
Active leakage control
Water balance reporting
Training & education

Phase 4

Pipeline management & rehabilitation
KPI monitoring & reporting
Performance management
Evaluation & new targets



Effective Leakage Management is based on four well-known and very important main pillars.

How to get started

Effective and lasting leakage management is not accomplished with a quick fix, and since all utility networks are unique the approach to water loss reduction should be tailored to the specific conditions. No matter what your challenges are, we can help you.

1 **Develop a NRW master plan**
The first step is to analyse your water distribution system and develop a master plan for NRW reduction. Performing a water audit with a breakdown of the International Water Association (IWA) water balance will help you quantify the different NRW elements to prioritise activities and investments to reduce leakage.

Always consider the full water cycle from the source to the point of consumption. Do not solely focus on the management components of the utility. Customer awareness is also a vital aspect, and every drop counts.

Establish an overview
You will need to know your water network in detail. Locate all pipelines, production plants, pumps and valves and register the complete network in a Geographic Information System (GIS) to know exactly where all your assets are located.

You need to locate the major leakages first. Luckily, these are also the easiest to find. Start by using standard portable acoustic equipment and a systematic approach before introducing new high-tech equipment.

Assess and register all identified leakage locations, prioritise and repair accordingly, then store the results in your GIS. At this point, you will have reduced your NRW considerably as well as obtained valuable data about your geographical work area. Building of a historical database of bursts and repairs in the network is essential for the later phases where strategic rehabilitation planning is introduced.

The next steps depend on the current situation at the individual company. First establish an overview, then expand with more advanced systems.

2 **Instrumentation and monitoring**
Your master plan may have pinpointed the need to investigate basic instrumentation such as intelligent meters (flow, pressure, consumption), gate valves or information communication systems (ICT) such as GIS, CIS (Customer Information System) and SCADA (Super-visory Control and Data Acquisition).

Quality repairs
Skilled and well-trained staff with access to the right tools and equipment is key to persistent leakage reduction. Improving the speed of repair will reduce the volume of water lost through running leaks.

However, often it is just as important to focus on increasing the quality of repair to prevent the same leaks from re-appearing shortly after being repaired. An ongoing capacity building programme combined with a few Performance Indicators are vital.

3 **Optimising pressure and leakage control**
Intelligent valves and pumps can be utilised to manage the pressure. In combination with hydraulic modelling, pressure management solutions can be designed to operate at the optimal point. The pressure is continuously minimised in the water network on District Metered Area (DMA) level whilst ensuring the minimum required pressure at all customers to maintain a satisfactory service level.

Operating the distribution network at the lowest required pressure reduces not only water losses from existing leaks, but also burst frequency and energy consumption while prolonging the lifetime of the pipes. In other words, it contributes positively to several aspects and thus potentially saves a lot of money.

Using permanently deployed noise loggers reduces the runtime of non-surfacing burst and leaks significantly. Combined with smart meters and short-term water balance reporting on DMAs, it enables the leakage team to react quickly and efficiently and target the weakest areas and pipeline segments.

4 **Pipeline management & rehabilitation**
Continuous management of the pipeline infrastructure is the only way to reduce leakage to an absolute and lasting minimum. This requires preventive maintenance as well as strategic rehabilitation in order to know when and where to repair or renew. Efficient and logged asset management is a necessary precondition to develop and maintain optimised rehabilitation plans.

Data made available and operational
Objectives should be formulated as a set of (Key) Performance Indicators (KPIs or PIs). Access to updated and validated data is essential in order to select and monitor relevant KPIs. Many utilities are large businesses that generate a huge amount of data; the challenge is to make this data available, operational and visible.

Continuous improved performance
It is vital for any efficient utility company to master performance management. Performance management also contributes to reduce NRW and ensures that the utility executes its primary objectives in the most efficient manner.

Utilities in general have a substantial number of objectives they want to achieve. However, we recommend selecting a maximum of 4-5 essential objectives for a given period typically 1-2 years. As work progresses and objectives are met these may be reassessed and new objectives selected.

We can help
It takes considerable work to get this far. But it is worth the effort. Any utility that are compliant with these standards will achieve a significant reduction in expenditures and a network in good conditions.

We can assist you all the way towards that goal.

READ MORE

How water losses were reduced by 75 percent between 1977 and 2021 in Copenhagen, Denmark

By means of innovation, new technologies and thorough leak detection methods, Greater Copenhagen Utility, HOFOR, has brought water losses in the capital of Denmark down to a minimum and sustainable level. HOFOR has succeeded in reducing specific water losses by more than 75 percent since 1977 where the water losses have been reduced from 13.3 m³/day/km mains to 3.1 m³/day/km mains corresponding to an overall reduction in NRW level from 9 to 5 percent.

This result is especially remarkable since 50 percent of the water pipes in Copenhagen are laid before 1945, 22 percent are more than 100 years old, and 55 percent of the pipes are cast iron.

HOFOR is one of the world's leading utilities in reducing leakage. This is thanks to the way they combine multiple technologies and methods, including noise loggers and advanced microphones, water meters installed at every customer, hydraulic models, capacity building programnes as well as sectioning of the network into District Metered Area (DMAs), and online water balance monitoring on DMA level. HOFOR has at present completed the implementations of DMAs in the seven municipalities outside Copenhagen city centre.

Routine area sweeps

First and foremost, in-depth knowledge on system conditions is vital. For instance, HOFOR reviews the entire pipeline network of the capital every third year.

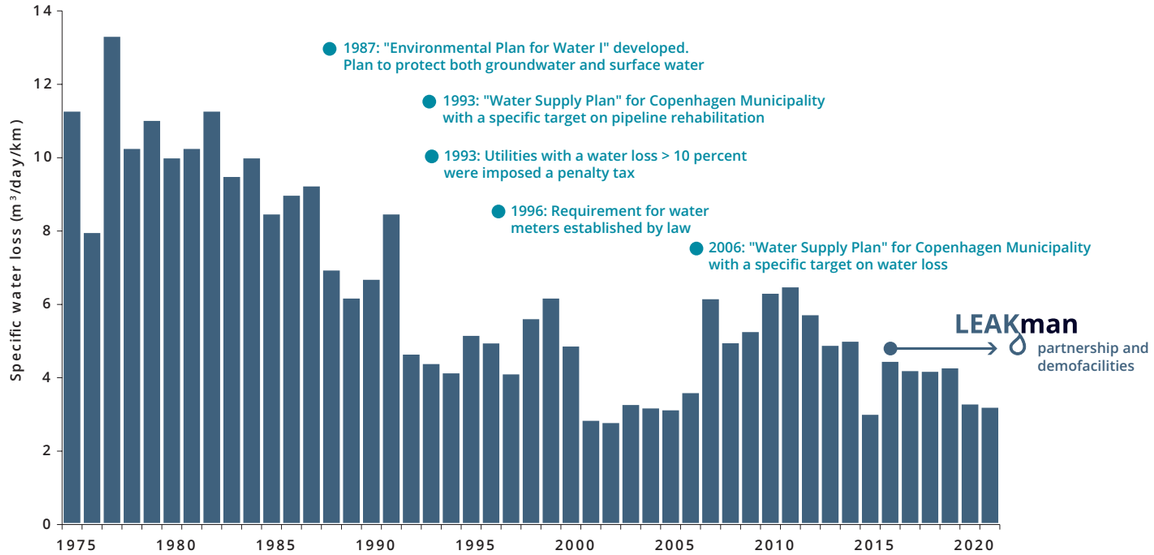
Leaks are identified by listening for leak noise at selected valves at strategic locations using advanced sound detecting equipment.

Furthermore, applying condition assessments from scheduled maintenance is an important part of the renovation strategy. This way Greater Copenhagen Utility is able to initiate repairs in time to prevent failure and thereby avoid massive water losses. This is especially crucial in the older areas of the city, as the 100-years old streets are at risk of collapsing if an underground leak is not identified and repaired in time.

HOFOR has installed permanently deployed noise loggers in such high-risk areas of the city as an important part of the active leakage control strategy. The noise loggers automatically deliver data every day to assist in early identification of potential leaks.

A change in leakage management strategy

During the last decade Greater Copenhagen Utility has changed the leakage management strategy from conducting manual scheduled leakage surveys at regular intervals to active leakage control by combining multiple data sources, SCADA, smart metering, hydraulic models and noise loggers. Data from all systems are integrated in the online management information system, HOMIS. By integrating data from different systems, the utility is able to identify and target the weakest areas and pipeline segments, as well as quickly and automatically locate leaks and prioritise which leaks to be repaired first. This change in strategy optimises both operations, maintenance and the human resource management.



1974: Leak detection with track gas survey

1975: Water meters installed at every costumer

1987: Leak detection with correlator and ground microphone

1987: Water consumption behavioral change information and campaigning

1995: Strategic rehabilitation of 1 percent of pipes per year

2000: Sectioning into District Metered Areas (DMAs)

2000: Area sweeps for leakages every 3. year

2002: Noise loggers on valves (lift and shift)

2005: Deployed noise loggers on valves

2005: Noise logger data online with Almos Leak

2015: HOMIS online leakage management system

2016: Asset Management to improve operation and investment plans

2017: Smart meters installations at consumers

2018: DMA sectioning completed in Greater Copenhagen

2020: Online water balance monitoring

● = Political initiatives
● = Initiated HOFOR actions

Source: DANVA "Water in Figures 2021" and HOFOR.
Data on specific water loss 1975 – 2012 represents Copenhagen.
Data 2013 – 2021 represents HOFOR

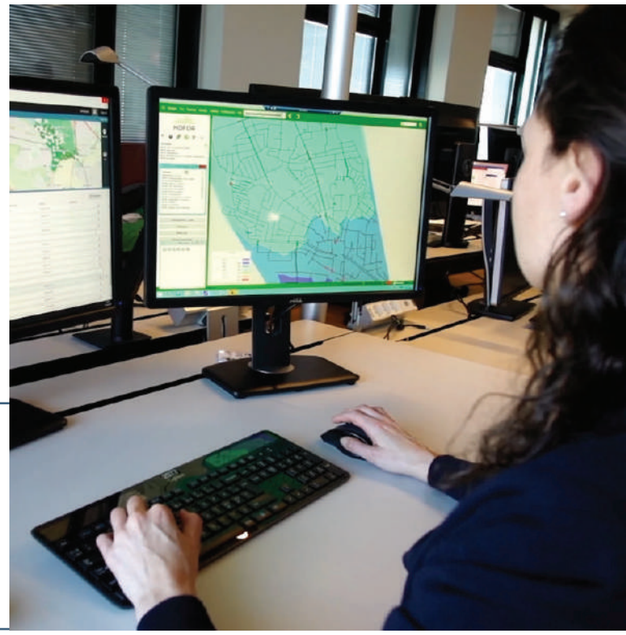
Innovation as a cornerstone

To achieve a "smart" water distribution system, utilities need hardware and software technology, investment programs as well as operational experiences to come together and create a system to manage the utility in an intelligent way.

One of the reasons the NRW level at HOFOR is one of the lowest in the world is that the utility is always looking for new technology and solutions that can support the ongoing leakage management strategy. One of the goals for HOFOR is to strengthen the digital transformation as tool for further optimisation. As a LEAKman partner HOFOR is aiming at connecting knowledge and operation.

"The interaction between data from remotely read smart meters, SCADA, noise loggers and other components in HOMIS enables us to direct our leakage detection activities to the most relevant areas and prioritise our resources"

- Kristiane Østergaard Jensen,
HOFOR Greater Copenhagen Utility



Courtesy: HOFOR

The LEAKman partnership creates valuable academic results

The LEAKman partnership continues to support the reduction of water losses in the Danish water sector through research projects where the partnership formed under LEAKman is a key in the development of competences and talents. To date the partnership has engaged and facilitated one PhD and several MSc projects working with data and cases delivered by the utilities and supervised by NIRAS and The Technical University of Denmark (DTU). The candidates have contributed with valuable results and expertise in data and leakage management of water distribution systems, which in turn has been communicated through academic journals and conferences.

Data from the LEAKman partnership will continue to provide the basis for research and advanced developments within several areas including water loss control, demand forecasting, hydraulic modelling, and water quality monitoring.

"The LEAKman partnership made it possible, during my PhD studies, to work closely together with stakeholders from all areas of the water sector, understand the challenges that they face, and how they may help each other solving them"

- Jonas Kirstein,
PhD fellow at the LEAKman project

Educating the future generation of NRW specialists
The close link between the industrial partners and DTU has created and innovative environment. By bringing challenges, data, and practical knowledge together with academic research LEAKman has generated new competences and continuously contributes to educate a new generation of environmental engineers with expertise in NRW management and optimisation of water distribution systems.

Amongst the results are the introduction of systematic data integrity testing and novel methods to ensure robust decisions-based smart meter data. The vast amount of smart meter data has e.g. been applied for suggesting improved national reference values for diurnal demand profiles and legitimate night consumption.

Courtesy: DTU

Optimising water pressure with advanced smart valves in Klampenborg, Denmark

The DMA in Klampenborg, north of the Danish capital Copenhagen, is located along the coastline of the Oresund strait and is located in a low-lying area. Consequently, the pressure in the water mains is high as the water supply comes from sources located inland at a higher elevation.

Most (almost all) water supply networks are prone to leaks. Some are big and will typically be detected by the utility company staff or reported by customers. Some are minor and will never be spotted or repaired during the entire lifespan of the pipes. The difference in altitude and pressure means, that the DMA in Klampenborg will lose more water through leaks, compared to other areas situated at a higher altitude.

Therefore, advanced pressure control valves have been installed at two of the three inlets to the DMA. They optimise and stabilise the pressure and ensures that the setpoint is at a minimum. At the third entrance, a control valve has been installed and configured as a pressure sustaining control.

The valve is closed during normal supply conditions, and automatically opens in case of unexpected pressure drops or emergencies.

Data from the flow meters at the DMA inlet enable the utility company to compare flow data with consumption data received from the customer smart meters. Thereby the utility can monitor the flow balance on a daily basis and thus calculate water losses at DMA level and reduce the leak run times significantly.

With the new valves and knowledge about the operational and hydraulic behaviour of the DMA, the utility company has successfully reduced average pressure by 29 percent (from 46.7 mwc to 33.3 mwc). As a result, water is saved, as corresponding decreases in leakage level and burst frequencies are expected.

Courtesy: Novafos

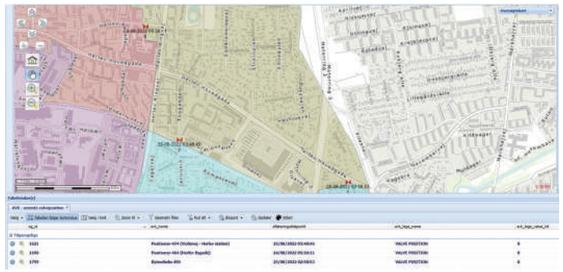
VIDI Positioner, a new innovative device supporting active leakage control in Copenhagen, Denmark

Installing flow meters on DMA inlet pipes and shut-off valves on the pipes connecting DMAs, enables water balance calculations at DMA level. Accurate water balance calculations rely on robust, precise and complete data where all water entering and leaving a DMA is monitored and measured. Such calculations highly depend upon valid information confirming that all boundary valves are closed during the water balance assessment period.

VIDI Positioner increases reliability and usage of data
It is a well-known problem, that if the emergency valves have been opened during maintenance work, they are sometimes not brought back to the closed position following completion of the maintenance works. The VIDI Positioner will register such behaviour and instantly inform the utility when the valve is operated and whether it is open, closed or somewhere in between. It sends a signal when the valve is being operated and continuously transmits updated data on the valve position.

VIDI Positioners contribute to improved overview at Denmark's largest utility
VIDI positioners have been installed as part of the LEAKman demonstration facilities at HOFOR, at three strategically important shut-off valves that are working as emergency valves between DMAs. Data is automatically sent to HOFOR at regular intervals, and if the valve is operated in-between the regular intervals. The data is then further integrated with the GIS so that the entire operation and maintenance staff automatically have direct access to the valve status information.

The valve position data is further integrated with the smart water platform under LEAKman, and directly connected with the hydraulic model where the hydraulic simulations automatically will reflect the change in valve position. HOMIS will also utilise the information coming from the VIDI Positioners to disable water balance calculations during periods where the DMA boundaries are opened. This way, the VIDI Positioners ensure precise information about valve positions and allow for a better overview and automated knowledge sharing.



At the DMAs shown, the VIDI positioners are installed at emergency valves and integrated with the GIS so that the entire operation and maintenance staff automatically have direct access to the valve status information.

The LEAKman partners did at an early stage identify the need for knowing if and when DMA boundary valves (emergency valves) are operated. Open boundary valves are a common influencer on NRW management as it often leads to false results when conducting water balance assessment and minimum night flow monitoring. During the implementation of the LEAKman demonstration facilities, AVK in parallel developed a new IoT device, the VIDI Positioner, which can be mounted on the valve spindle to register any operation of the valve and then transmit the valve position change to the cloud (online) for use by the water utility.

Courtesy: AVK

A state-of-the-art Leakage Management System is key to reduce water losses in the city of Oslo, Norway

Historically, Norway has had almost unlimited access to drinking water at quite low costs. As a result, there has only been little focus on NRW and NRW-levels around 50 percent were not unusual. Over the past 5-10 years, though, this has changed as high NRW also leads to high maintenance and production costs as well as overcapacity. The city of Oslo is growing and urgently needs to secure a sustainable drinking water supply for the future. In 2018 around 35 percent of drinking water was lost in the network on its way to the customer. To bring down this level of water losses several initiatives have been taken, and the utility, Oslo Vann, launched a Non-Revenue Water master plan targeting a 20 percent reduction by 2030.

Real-time hydraulic overview to prioritise efforts
The plan includes the implementation of Aquis, an online hydraulic modelling system, and HOMIS, an online Holistic Management Information System. With the support of these two tools, Oslo Vann has established a real-time hydraulic overview of their 1,550 kilometres of main pipeline network, divided into 7 regions, 43 pressure management areas and 69 District Metered Areas (DMAs).

The Aquis model provides real-time hydraulic simulations where selected results are connected to HOMIS, and combined with other data from CIS (Customer Information System), GIS (Geographical Information System) and SCADA (Supervisory Control And Data Acquisition) to automatically calculate and maintain a set of Performance Indicators monitoring the performance on DMA level. This overview is used to identify problematic areas and prioritise leakage management activities. The leakage management system is dynamic, and designed with open interfaces allowing new technologies to be added to improve the utility's NRW management. Oslo Vann is currently planning to expand the system by pressure management, noise loggers, and smart meters.

Innovation and new developments
Another aspect of major importance for the utility to reach their NRW reduction target, is the introduction of a capacity building program targeted for operators and engineers, which provides the participants with a variety of knowledge and tools for improved NRW management and water loss control from monitoring and prioritisation to leak detection and repair.

Courtesy: NIRAS and Municipality of Oslo

Reversing water loss in a rural municipality in Oneida, Tennessee

In 2019, the town of Oneida, Tennessee was experiencing an impossible situation. With increasing state regulations and massive water loss, the water department was taken over by the local government. Oneida produces 1,500 million liters of water a year and saw a 51 percent total water loss, meaning that over 750 million liters a year were being lost, mainly to leaks. The loss cost the city $186,000 annually and caused the water treatment plant to operate on 12- to 14-hour days to keep up with demand.

Oneida faces a complex set of conditions to provide quality water on tap. The diverse and rugged topography creates an obstacle course for water distribution and maintenance. The water system consists of one water treatment plant feeding two water supply reservoirs which again supplies the customers with drinking water through an aging water distribution system. Routine droughts are also impacting the water supply.

23% loss
Water loss reduced 23 percent in three months

3 hours
Water treatment plant operation reduced by three hours a day

They installed 4,600 Kamstrup meters with built-in acoustic leak detection and erected 12 collectors within five weeks. During the initial three-month period after the Kamstrup meters were installed, Oneida uncovered and repaired a single leak that had been running for five months at an estimated cost of $21,000 per year and Oneida's water loss was reduced by 23 percent.

Overall, the city's 51 percent total water loss was reduced to 38 percent, and the water treatment plant operation was reduced by three hours per day. With leak detection on its side, they have transitioned to recovery and are steadily upgrading their infrastructure, utilising a two-man crew to fix an average of five to six leaks per day. The water department is methodically addressing leaks and repairing their infra-structure. The city aims to replace two miles of pipe per year and reduce their water loss to below 15 percent. With leaks and losses under control, the Oneida water treatment plant continues to improve its operating time and Oneida is now a showcase for municipal water management in Tennessee.

Courtesy: Kamstrup

Intelligent management of pumping systems in San Giovanni in Persiceto, Italy

The water supply plant at Via Bassa, San Giovanni in Persiceto, is managed by Gruppo HERA and feeds two aqueduct branches, serving two different parts of the city, including a high water demand hospital. The existing pumping system was made by four end-suction Grundfos pumps normalised-axial-suction Grundfos pumps controlled to guarantee a discharge pressure of 2.6 bar.

HERA is focused on innovation and new solutions and has a strong partnership with Grundfos not only for new pumps, but also for the design and deployment of tailormade control systems and solutions in the water networks applications.

HERA's target in San Giovanni in Persiceto was to stabilise water network pressure and to supply the right pressure 24/7 at the critical points.

To reach their targets HERA initiated a pump upgrade project handled by Grundfos including several steps; audit on the existing pumping system, pressure monitoring at the network's critical points, data analysis and reporting to obtain a clear picture of the network and to reveal the potential benefits of different solutions for pressure management.

HERA proceeded as suggested by Grundfos by upgrading to a new and more efficient pumping system and by introducing Demand Driven Distribution (DDD) control logic. Demand Driven Distribution (DDD) is a solution patented by Grundfos for intelligent management of pumping systems, capable of adapting to the actual requirements and service level of the water networks.

Thanks to the DDD control, HERA has been able to stabilise and reduce the pressure at the most critical points guaranteeing a higher comfort to the customers and a lower stress to the entire supply area resulting in reduction of water losses, water hammer and pipe bursts.

Numbers to highlight, due to the DDD control and upgraded pumping system:
- 2.3 bar at the critical points (instead of previous 2.7 - 3 bar)
- 110,000 kWh/y estimated energy saving
- 58,000 m³/y of water loss avoided
- 36 t/y of CO_2 saved
- 0.09 kWh/m³ specific energy (instead of previous 0.13 kWh/m³)
- 1 year and 5 months of payback time

Courtesy: Grundfos

LEAKman

AVK is a world-leading Danish supplier of valves for all purposes and for all types of utility companies. AVK has 4,500 employees worldwide, and their product portfolio of intelligent valves is especially relevant for their participation in the present consortium. *www.avkvalves.com*

DTU Sustain at the Technical University of Denmark is one of the largest university departments specialising in environmental and resource engineering in Europe. We are working to develop new environmentally friendly and sustainable technologies, methods, and solutions, and to disseminate this knowledge to society and future generations of engineers. *https://sustain.dtu.dk/en*

Grundfos develops intelligent pumps and solutions for the world. While touching millions and millions of people every day, we set the standard in terms of innovation, efficiency, reliability and sustainability. Our products and solutions help our partners and customers move water to where it is supposed to go. Today we employ around 20,000 people and we are directly accessible in 56 countries. *www.grundfos.com*

HOFOR stands for Greater Copenhagen Utility. HOFOR handles wastewater and delivers water to more than a million customers in the capital region of Denmark. HOFOR protects the groundwater against pollution and overuse – and implements climate adaptation projects to protect urban areas from flooding. HOFOR also supplies Copenhagen with district heating, city gas, and district cooling. We focus on sustainable supply and state-of-the-art utility solutions. *www.hofor.dk*

Kamstrup is a leading supplier of intelligent metering solutions and services. We help utilities all over the world reduce waste and optimise their production and distribution of clean water and energy, and we enable sustainable management of energy and water buildings. For 75 years, Kamstrup has been dedicated to delivering the actionable insights water and energy professionals need when managing their network and supply. Because we believe better data enables better decisions. Our solutions are sold in more than 90 countries, and we are headquartered in Denmark with production facilities here and in Georgia, USA.

Leif Koch is a leading Danish provider of leak detection services with international experience. Leif Koch conducts surveying and control of pipeline networks, pressure and valve testing as well as leakage detection. We sell instruments for leakage detection and offer a range of training seminars and workshops in leak detection using our test fields in Denmark and abroad. Leif Koch remains up to date on the latest instruments and technologies, and the staff is continuously trained and equipped. *www.leifkoch.dk*

NIRAS is an international, multidisciplinary consultancy company with more than 2,400 employees located across of Europe, Africa, Asia, North and South America. Our trademark is the cross-cutting approach – we always strive to achieve the optimal solutions across disciplines with a focus on sustainability and digitalisation. We have profound knowledge of the entire water cycle, and we believe water to be one of the world's biggest challenges and the anchor of any sustainable society. *www.niras.com*

Novafos is a utility company covering a total of 425,000 inhabitants in the capital region of Copenhagen, Denmark. We operate 16 waterworks which supply 19M m^3 of drinking water per year and 18 wastewater treatment plants which clean 22M m^3 of wastewater per year. Novafos operates and maintains 1,600 kilometres of water lines and 3,500 kilometres of sewer pipes. Novafos employs 318 staff.

Schneider Electric is the global specialist in energy management and automation. With revenues of ~€34 billion in FY21, our 150,000 employees serve customers in over 100 countries, helping them to manage their energy and process in ways that are safe, reliable, efficient and sustainable. Our technology, software and services improve the way our customers manage and automate their operations.

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