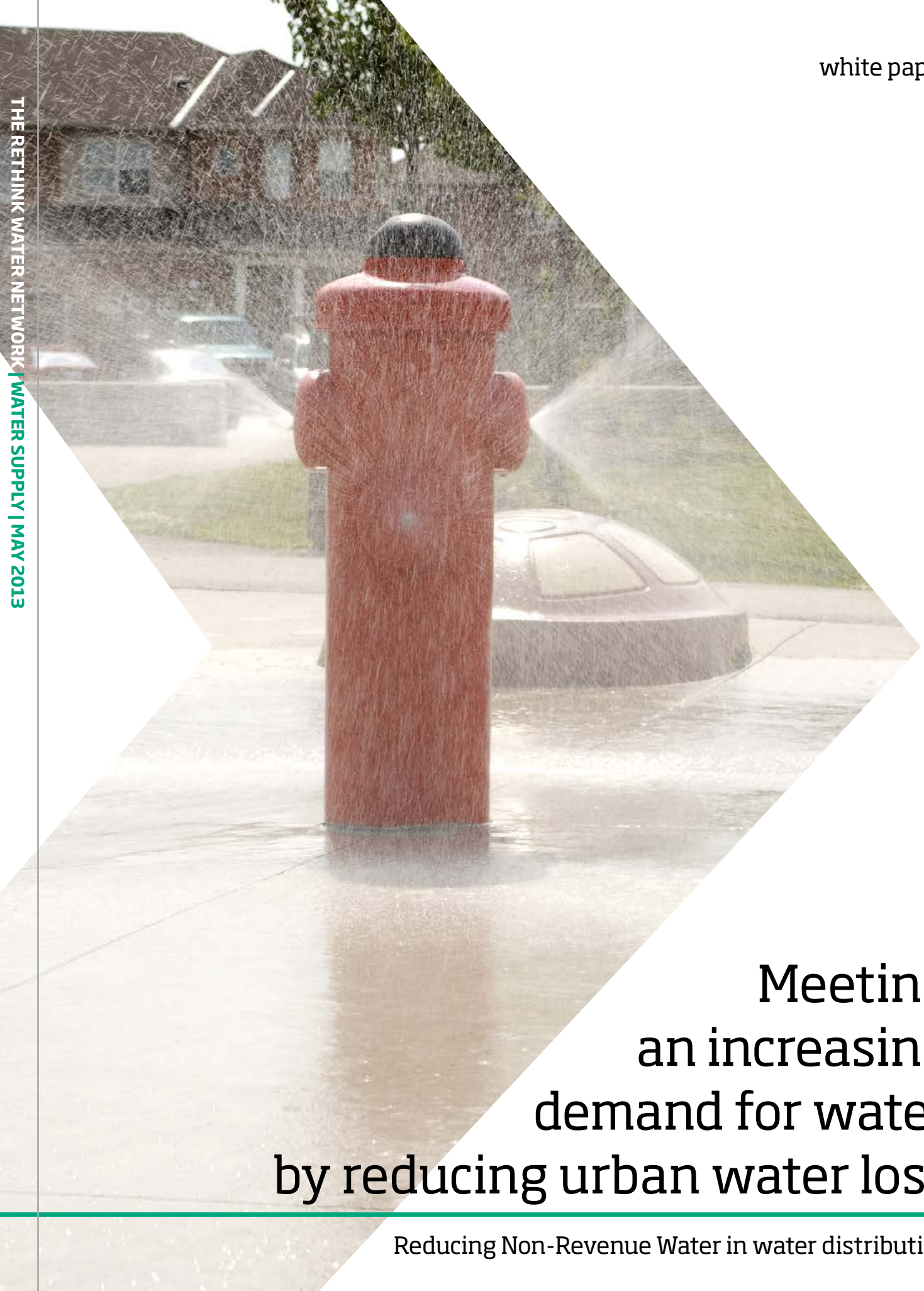
white paper



THE RETHINK WATER NETWORK | WATER SUPPLY | MAY 2013

Meeting an increasing demand for water by reducing urban water loss

Reducing Non-Revenue Water in water distribution

Meeting an increasing demand for water by reducing urban water loss
Reducing Non-Revenue Water in water distribution
Version 1.1

About this white paper
This white paper is developed by the Rethink Water network in Denmark. The work is coordinated by the Danish Water Forum. The Rethink Water network consists of more than 60 technology and consulting companies, water utilities, water organisations and public authorities. It was established to support our partners internationally in developing the highest quality water solutions.

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Executive summary

Water resources will come under great stress in most countries in coming decades due to climate change and growing populations. Our message from Copenhagen is that leaders should take action to prevent water loss and give citizens incentives to save water. It pays!

FRANK JENSEN
Lord Mayor of
COPENHAGEN

Urbanisation and the impact of global climate change are accelerating water scarcity for cities around the world. Securing enough water for a growing population requires more efficient management of freshwater supply.

25 to 50 percent of water frequently lost

For many water utilities it is important to close the considerable gap between the volume of water they supply and that which is billed to the customers. This difference is known as Non-Revenue Water (NRW), or urban water loss, and it amounts to between 25 and 50 percent of the total water distributed globally. It is caused by inaccurate billing and metering systems, leakage from deteriorating distribution infrastructures, excessive water pressure in distribution systems, reservoir overflow, unnecessary flushing and illegal connections to the water network.

Best performers have under 10 percent

As well as rising to the challenge of ensuring enough water resources and avoiding wasted energy on producing and distributing Non-Revenue Water, a few decades ago the Danish government created a strong incentive for water utilities in Denmark to reduce urban water loss and to plan, manage and operate the utilities efficiently to the benefit of the consumers and the environment. Today, urban water loss in Denmark is only 7 percent on average, with some of the biggest cities down to as little as 5 percent. Supported by technology suppliers and consulting companies, most utilities have implemented a wide range of cost efficient leakage monitoring technologies and leakage management systems.

Financial arguments for taking action

With this expertise to draw on, Danish companies have successfully helped cities and water utilities around the world to reduce NRW. Although water loss is a well-understood challenge by most utilities, few are successful at reducing it to a financially feasible level and keeping it low. However, reducing NRW by half is generally a very realistic target within one to two years. Such a reduction can generate a boost in annual income from increased revenues and reduced costs, while at the same time servicing more people without new investment.

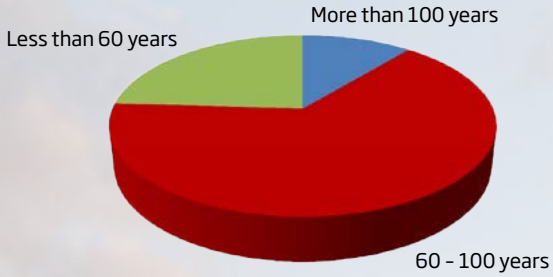
A successful NRW reduction programme

NRW reduction must be an agreed strategy for the whole organization, based on a holistic master plan, so that results can be achieved by the implementation of an ambitious programme. The 'Smart NRW Management' concept works on the principle of breaking the distribution system down into smaller more manageable units. A hydraulic model is used to calculate the optimal number and design of these areas, enabling the utility to focus on conducting the most economically advantageous activities. Furthermore, advanced management support systems secure overview and full control of the water distribution.

Teplice, Czech Republic *Supported by Danish water experts, the level of urban water loss in Teplice has been reduced from 34 to 23 percent in six months, with a return on investment of just one year. Famous for its spas, water is one of the main attractions of the city, but the water supply system suffered from leaks of up to 40 percent of total water distributed and unbalanced flow and pressure distribution. The city was supported in identifying the water losses and in separating the distribution network into District Metering Areas (DMA), enabling accurate flow balancing and pressure management to be carried out within each and making it easy to identify priority DMAs for leakage repair works. (Courtesy: DHI).*

Photo: Aarhus Water

Age of pipelines



Copenhagen, Denmark *In the capital of Denmark, water usage has dropped from 171 to 104 litres per capita per day over the last twenty years, producing an annual saving of 12 billion litres of water. In addition, the average level of urban water loss in Copenhagen is down to only 7 percent. Copenhagen is an example of how a very old pipe network, if well maintained and managed, can still perform well. Around 11 percent of the pipes in Copenhagen are over 100 years old and 76 percent are over 60 years old. (Courtesy: Greater Copenhagen Utility)*

Photo: Kontraframe/City of Copenhagen

1. Urban water losses might be a symptom of inefficiency

It is common to see cities where 25-50 percent of the water distributed never reaches the customer. For growing cities this is particularly problematic; expanding water distribution networks without a programme for reducing urban water losses means expanding a cycle of inefficiency

PER JACOBSEN
Director, Water Supply & Sewerage
GREATER COPENHAGEN UTILITY

Cities are growing. Today's urban population of 3.2 billion will rise to nearly 5 billion by 2030, when three out of five people will live in cities. Water consumption on a global scale is estimated by the United Nations to increase by up to 30 percent before 2030, leading to an even greater supply gap for countries already facing water stress. At the same time, demand will be concentrated geographically in larger cities. Less than 20 years from now, with a 'business as usual' approach, and average economic growth, demand will be 40 percent greater than known available freshwater resources. Closing this gap requires a new approach to water management.

25 to 50 percent of water frequently lost

A major issue for water utilities to address is the considerable difference between the volume of water they treat and distribute, and that which is invoiced to the customers. This gap is known as Non-Revenue Water (NRW), or urban water loss, and it amounts to between 25 and 50 percent of the total amount of water collected, treated and distributed. Factors causing this gap are inaccurate billing systems, deficient customer registration, leakages caused by deteriorating infrastructure, poor water pressure management, inaccurate metering, reservoir overflow, unnecessary flushing, insufficient management and illegal connections to the water network.

Old pipes not necessarily the problem

In Denmark, water consumption has decreased by 30 percent over a period of 25 years. During the same period GDP increased by 40 percent. In addition, average water losses have been reduced to 7 percent due to political focus on the problem and legal regulation that has motivated the water utilities, consulting companies and technology providers to develop new cost-efficient leakage monitoring technologies and leakage management systems. This proves that high levels of water losses are not correlated with the age of the pipes. If the water distribution system is well maintained and managed even very old pipes may perform well. Eleven percent of water pipes in Copenhagen are over 100 years old and 76 percent are more than 60 years old. Nonetheless, the city has a NRW level below 5 percent.

Reducing NRW by half: a reasonable target

High levels of NRW have a serious impact on the financial viability of water utilities due to revenue losses and unnecessarily high operating costs. NRW directly affects the capacity of utilities to fund necessary expansions of service,

Aarhus, Denmark *The second largest city in Denmark supplies 270,000 customers with 15 million cubic metres (4 billion US gallons) per year of great tasting water that is safe to drink directly from the tap. The water utility, Aarhus Water, has focused on optimising water distribution and today the key performance indicators on efficiency are very impressive. Over the last 10 years Aarhus Water has managed to reduce its NRW to 6 percent and the real pipe loss is only 1.4 cubic metres/km/day. The Infrastructure Leakage Index (ILI) is down to 0.83 – no wonder the city slogan is: 'City of Smiles" (Courtesy: Aarhus Water).*

Odense, Denmark *The home town of Hans Christian Andersen, the world famous writer of fairytales, is located in the heart of Denmark. In Odense 156,000 customers are supplied with 9 million cubic metres (a little more than 2 billion US gallons) water per year. The utility, Odense Water, has for a decade focused on optimising water distribution and the key performance indicators are very impressive. The utility has managed to reduce its NRW level to just 5 percent. Real water loss in Odense stands at only 1.17 cubic metres/km/day, or 19 l/connection/day. At 0.74, the city's Infrastructure Leakage Index (ILI) is one of the best in the world. (Courtesy: VCS Denmark - Water utility of Odense)*

It is essential to reduce excess pressure in the pipes automatically as water loss will be reduced and energy consumption lowered

MORTEN RIIS
Business Development Manager
GRUNDFOS

solve problems, and conduct maintenance. In general, reducing NRW by half is a very achievable target within one to two years. A reduction at that level will generate a lot of extra annual income from increased revenues and reduced costs, while at the same time, providing service to more people without new investment. This should obviously be of interest to politicians and water managers.

A wide range of valuable benefits

A NRW programme will naturally focus on reducing urban water losses and increasing revenue, but in addition it will give other important benefits to the utility and its customers:

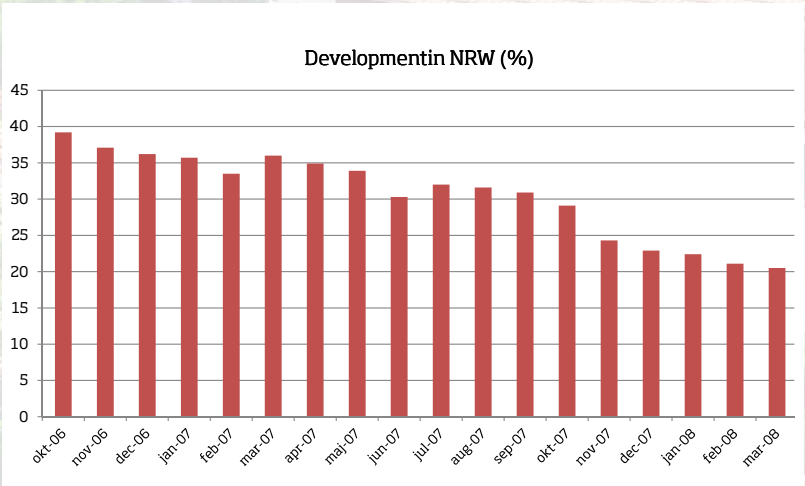
- Optimising water distribution will improve water quality since chlorine content will be better controlled. The first customers will not have too much chlorine and the last customers will not have too little – the water will always be safe. Managing the pressure will also reduce water hammer and the risk of vacuum sucking pollution into the water
- Stress on water resources will be reduced, allowing more people to be served from the same source
- Energy consumption will come down as pressure within the system is adapted to demand. Less water will be treated and distributed while satisfying the same level of demand
- The supply will be more stable. Improved performance will provide full pressure distribution 24 hours a day, 7 days a week
- Management systems will support decision-making and customer service
- Stopping and preventing leaks will reduce damage to street pavements

Re-evaluating priorities is required

NRW is a well-understood challenge by most water utilities, but only few are successful in reducing it. Much of the failure is due to an underestimation of the technical difficulties and the complexity of NRW management, along with a lack of understanding of the potential benefits of taking action. Utilities should be aware that they are sitting on a gold mine. However, NRW reduction is not just a technical issue. It requires a wholesale re-evaluation of the priorities of a utility in carrying out an effective NRW reduction programme, with a trained management and staff keeping it low.

Non-Revenue Water comprises:

1) Apparent losses, also termed 'commercial losses', that are caused by inaccurate customer metering, data-handling errors and illegal tapping into the network.
2) Real losses, also termed 'physical losses', which comprise leakage from all parts of the system and overflows at the utility's storage tanks. Real losses are caused by poor operations and maintenance, the lack of an active leakage control system, and poor quality of underground assets.
3) Unbilled authorized consumption used by the utility for operational purposes, water used for fire fighting, and water provided for free to certain customer groups.



Seremban, Malaysia *With its 500,000 inhabitants, Seremban traditionally experienced water shortfalls and an inefficient water distribution system. With help from Danish experts, the city's water utility was able to reduce its level of NRW from 39 to only 21 percent within 18 months. Besides large energy savings, water savings of 650,000 cubic meters a month were achieved – equivalent to the supply of another 30,000 households. The project included installation of an NRW management system, a leakage monitoring and repair system, targeted meter replacement programme, the detection and repair of more than 3,000 leaks, a geographical information system (GIS), hydraulic modelling of the network, and installation of 55 District Metering Areas and 20 pressure control zones. The return of investment for the total project was 26 months. (Courtesy: EnviDan)*

2. A successful NRW reduction programme

Reducing Non-Revenue Water is a matter of working smart rather than working hard. The key to success is information. The better the information about the distribution system and the better the management systems, the easier it is to prioritise actions in order to manage the NRW reduction programme successfully and achieve fast results

JENS BAADSGAARD PEDERSEN
Chairman Board of Directors
ENVIDAN INTERNATIONAL

Until the early 1990s, there were no reliable and standardized methods to measure water losses in the distribution system. Since then organizations from around the world have developed tools and methodologies to help utilities evaluate and manage water loss. The Water Loss Task Force (WLTF) of the International Water Association (IWA) has also been in action for two decades examining international best practices and developing performance indicators related to water loss.

A series of activities

The more information and data that is available on the drinking water distribution network and the better integrated the management system that is available, the easier it is to get an overview and to prioritise investments and work in order to manage the water loss programme and get results. A strong management system is key to success in prioritising actions to secure fast return on investment.

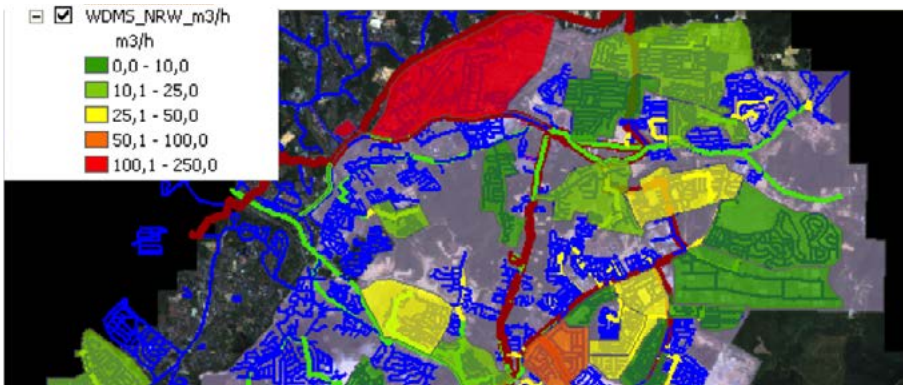
It is very important that an NRW reduction programme be established and understood at the highest level of the utility organisation. NRW reduction must be an agreed strategy for the whole organization, based on a holistic master plan, so that results can be achieved by the implementation of an ambitious programme. To secure the most successful result all levels of staff will need training. Capacity building is a vital part of any NRW programme.

The most expensive element in water loss reduction is the repair or replacement of damaged pipes, which involves street excavations and inevitable disruption to traffic and businesses. In most situations replacing pipes based on pipe age or material will not give an equivalent water loss reduction. To prioritise investment and achieve the fastest possible return, it is necessary to have information about the condition of the water distribution system and a holistic plan for how to best rehabilitate and develop it.

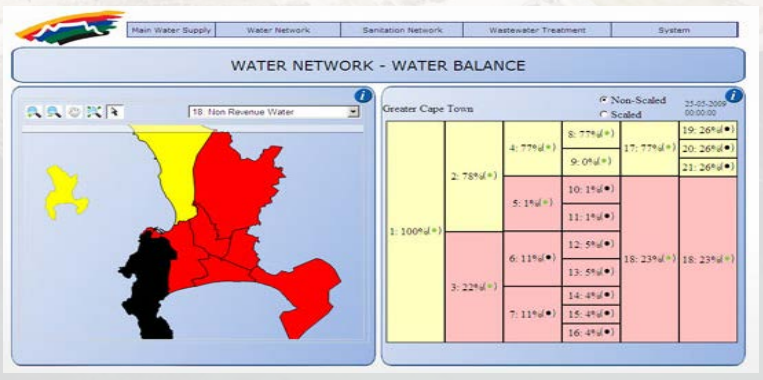
Master plan for NRW reduction

To optimise the work and make the best decisions, a master plan for NRW reduction is needed. This plan will analyse the water distribution network based on available data. Supplementary data collection will be necessary to provide as complete a level of information in the overview as possible. Once completed, the master plan will provide:

- An established baseline for the NRW reduction programme
- A breakdown of the water balance, consisting of relations between the NRW elements (real losses, apparent losses, unbilled authorized consumption, etc.)
- A strategy for establishing management systems, databases, SCADA, GIS and modelling tools



An overview helping to prioritise *A distribution system is very complex. It is necessary to get an overview to find the easiest actions to take. The key to this overview, and to establishing priorities, is data and information. But to manage all the data, other tools are also needed. This is where GIS, SCADA, the NRW management system and databases become important.*



Cape Town, South Africa *The city of Cape Town has more than 130 reservoirs, nearly 700 pumping stations, 17,600 km of pipes and 13 water treatment plants providing 330,000 cubic metres of water a day. A real-time web-based information system provides all the relevant information needed to manage, operate and optimise consumption of the city's water resources. Before being implemented, Cape Town's water system was hard to control. There was plenty of data available but it was inaccessible, tucked away in different databases and differing formats. Up to 25 percent of the city's water supply was lost due to leakage, theft or inaccurate metering. It was a major problem for a city with limited water resources. (Courtesy: DHI).*

Networks are managed more efficiently with a hydraulic model of the water pipe system, which helps managers decide how to respond to pipe breaks and optimise pressure control for leak reduction. It will also help calculate what level of leakage is economically feasible for the water utility

MORTEN RUNGØ
Head of Urban Products
DHI

- Calculation of Economic Level of Leakage (ELL) based on cost-benefit calculations of potential activities
- Activities developed on the basis of cost-benefit calculations (pressure management, district metering, intelligent pumping operation, leak detection, etc.)
- A proposal for District Metering Areas (DMA) and Pressure Management Areas (PMA) based on hydraulic modelling and data analysis
- A prioritised and completed work- and activity plan
- Budgets for the NRW reduction activities and specific ROI

For water utilities aiming to maximise efficiency and minimise operating costs, the reduction of NRW seems attractive. The hard part is working out when it makes good business sense and where the returns on investment will be highest. The Economic Level of Leakage (ELL), which forms part of the master plan, will provide the answers. It takes into account cost benefit analyses relating to each element of NRW, according to the IWA water balance defined for each subarea of the distribution system. It also takes into account the potential influence of the reduction in NRW on future investment in treatment plants, raw water extraction, pumping stations etc., as well as the potential effect on revenue.

Design for future supply

Water distribution systems have often developed step by step over many years with no overall plan. To achieve the best results and the highest return on investment, any physical installation or change of operation must be designed with anticipated future need for water supply in mind, not just be a repeat of the original dimension. A NRW programme is an opportunity to create a Rehabilitation Plan to ensure that the right design is developed for any installation to meet future standards.

This planning is only possible by mapping the existing system and operations, by establishing a well calibrated hydraulic model, using a Geographical Information System (GIS) and utilising a SCADA-connected NRW management system. Together these systems will give the information needed to make sure that whatever installations or changes of operation are implemented result in an optimal and efficient distribution of water with a low NRW.

Smart NRW Management

The 'Smart NRW Management' concept works based on the principle of breaking the distribution system down into smaller more manageable units – District Metering Areas (DMA). A hydraulic model is used to calculate the optimal number and design of these areas. Data produced from the DMAs enables the utility to focus on conducting the most economically advantageous activities. Once fully functional, the system can be further developed by building in a more advanced online system of monitoring and real-time control for the whole distribution system.

Operational phase

The management, reduction and subsequent control of leakage from any system is a long-term and ongoing project. Successful management means continuous monitoring of the Economical Level of Leakage (ELL) - also in the future.

This is possible when the system is well-managed and monitored and when decisions are made based on a holistic management system and reliable data. The focus during the operational phase should be:

- Ongoing smart analyses to optimise the NRW level
- Ongoing pipe replacement, based on the Rehabilitation Plan, targeting prioritised hot spots
- Ongoing active leakage control in hot spot areas based on NRW-smart analyses
- Ongoing emergency leak repair based on an online alarm system (part of the NRW management system) alerting managers when any new leaks arise
- Optimisation of the DMA boundaries and performance based on individual ELL for each DMA
- Long-term upgrading of the distribution system through replacement programmes based on the Rehabilitation Plan

Abu Dhabi, United Arab Emirates *Fresh water is a great challenge in the Middle East and expensive desalinated seawater has become the only solution for most water utility companies. Despite the high costs of desalination, water losses are as high as 45 percent in many areas. To reduce water loss in the distribution network, new technologies have been implemented in Abu Dhabi. A pressure management scheme that controls the supply pressure keeps background leakage to a minimum. An active leakage control system, with noise loggers and online hydraulic models, detects new bursts as they occur. A passive leakage control system, monitoring the level of background leakage, indicates the optimal time for manually sweeping an area for minor leaks. Selected key performance indicators report the overall performance. Efforts in 2011 and 2012 have decreased leakage. The targeted 10 percent maximum leakage has already been achieved in four large DMAs in Al Ain City. The project will be expanded to new DMAs in 2013 (Courtesy: NIRAS).*

3. Good management of water distribution networks

An advanced management system to support the operation is the key to reducing Non-Revenue Water. It provides water utilities with an overview and full control from anywhere. It gives real time access to information and key performance indicators any time of the day or night

JENS BRANDT BERING
Business Unit Director, Water & Utilities
NIRAS

All potable water systems will have a certain quantity of water that doesn't get paid for. A well run utility will keep the level in the low teens. The best utilities will achieve around 3 percent. Utilities with low quality and poorly maintained infrastructure, inadequate procedures, no leakage management systems and no meter testing programmes may lose 40 percent or more of their output. Some utilities may be uncertain about the actual levels of water loss. To achieve a reliable picture, precise metering equipment must be installed both at the pumping inlet and at the customer. This is essential for planning and managing an NRW programme.

Key performance indicators

NRW is one of the most important performance indicators for a water utility. High levels typically indicate the need for large investments in the infrastructure and an upgrade of the utility. Water utilities should focus on their individual Economical Leakage Level (ELL). Investing in reducing the NRW down to the ELL will always be good business and bring other benefits.

However, using NRW as a percentage alone as a key performance indicator (KPI) does not give a true picture of the performance of the utility. Many factors can affect the percentage of water lost as a proportion of water distributed. If a utility maintains a low average pressure in the distribution system, they will have a relatively low NRW percentage. This does not reflect the true condition of the assets or water distribution performance. Another issue that can influence the NRW, calculated as a percentage, is the consumption of water per person. If average individual consumption is high, the losses from the system will show up as a relatively low percentage. If the pipe system is not very extensive, the loss from leakages will likewise show up as relatively low in terms of the NRW percentage.

The right performance indicators

Other KPIs like real losses in litres/connection/day or cubic metres/km/day of pipe are more correct. For most Danish water utilities these KPIs are excellent, with the losses per km typically below 3 cubic metres/day (500 US gallons per mile) and the losses per connection around 60-70 litres/day (13-15 US gallons). During the last 20 years Danish utilities have managed to reduce NRW to an average of 7 percent, with an average service pressure of 30 mWc (3 bar) and consumption per person of 110 litres/day. The Infrastructure Leakage Index (ILI) is typically below 1.5. In Denmark, the most important factor contributing to NRW are real water losses, typically 75 percent of the NRW, with apparent losses amounting to 25 percent of the NRW. Therefore continuous monitoring and fast repair of new leaks by water utilities are vital for a successful reduction of NRW.

Bangkok, Thailand *A comprehensive NRW reduction programme was created for the Bangkok Metropolitan Water Authority to bring the NRW level down by at least 10 percent from the official 36 percent. The key to its success lay in establishing the importance of introducing DMAs and pressure management. A hydraulic model of all the distribution pipes in Bangkok (25,000 km) was set up and calibrated. The GIS system was updated. The hydraulic model was used to separate the city in to 700 DMAs, assist with pressure management and control the inflow to the distribution system depending on demand. (Courtesy: EnviDan)*

Demand driven distribution *Controlling water supply pumps to avoid unnecessarily high water pressure reduces water leakage. This is possible because the demand for water in cities varies widely throughout the day and even over the course of the week. By controlling the pumps based on the pattern of usage, the water pressure can be adjusted according to demand. Optimising water pressure in the distribution network in this way reduces water loss by up to 20 percent. It also addresses energy efficiency and this results in 20 percent in energy savings. In addition, a stable pressure in the distribution network causes less 'wear and tear', helping to reduce burst pipe. A small illustrative film by the pump manufacturer Grundfos explains the concept of demand driven distribution on youtube.com – search for 'Grundfos Demand Driven Distribution' (Courtesy: Grundfos).*

4. Big financial gains from reducing urban water loss

Many water utilities around the world know the value of high quality products and would never gamble with valves installed deep below the surface. They prefer valves they can trust for the next 50 years

MICHAEL RAMLAU HANSEN
Global Brand Manager
AVK VALVES

To secure the water supply for a growing population, fresh water has to be managed more efficiently. There are many benefits to be derived from the adoption and successful implementation of a Non-Revenue Water reduction programme. It will contribute to more efficient management of existing water resources. In this context, it is important to remember that the impact of global climate change is accelerating water scarcity. Projected scenarios relating to water supply show in some cases that a 20 percent decrease in rainfall alone could lead to a 70 percent decrease in the recharging of local aquifers – a potentially devastating blow in semi-arid and arid regions like the Mediterranean Basin, western USA, southern Africa and north-eastern Brazil.

Same amount of water for more people

Reducing water leakages will at least postpone the need for additional water resources in cities with a growing population, as is the case for most cities. Up to 30 percent more people can potentially be served simply by making distribution systems more efficient. In this way, losses are reduced, that otherwise increase the cost of water treatment and pumping, require extra plant capacity and more raw water. It is also true that expanding a water distribution network without any programme for reducing water loss is effectively expanding a cycle of inefficiency. Any investments in the water supply, including new intake and treatment plants, should be considered as opportunities to reduce NRW down to the Economical Leakage Level.

Lower operational costs

If 25-50 percent of the water produced never reaches the end customers, this not only means that significant amounts of precious water are lost, but also that the energy used to treat and distribute the water is lost as well. Further considerable energy savings are obtained since a typical reduction programme ensures more stable water pressure through the system, increasing energy efficiency. In addition, reduced pressure and less fluctuation in pressure will extend the life expectancy of pipes, valves and other equipment.

Higher revenues

High levels of Non-Revenue Water caused by inaccurate metering seriously affects the financial viability of water utilities because of the

High quality equipment is required *It is very important to invest in high quality products in water distribution systems as the equipment is installed underground, beneath the overlying pavement. If the equipment fails or starts leaking it might take long before it is discovered and be costly to repair or exchange. Many water utilities have learned the hard way that substandard equipment might save money when purchased, but is much more expensive in the long term. Products of Danish origin are of very high quality, designed to be used for 50 years or more in operation without any need for service or repair (courtesy: AVK Valves)*

Trenchless pipe replacement, Spain *San Sebastian is a charming historic town located in the Basque region of Spain. With its maze of narrow streets, tight-knit population and half of Spain's Michelin-starred restaurants located in the Old Town, the city is popular with tourists all year round. The city faced one major challenge though. The poorly maintained water pipes beneath the granite paved streets were giving cause for concern about the consequences for its tourism-related business. San Sebastian is one of many examples where Danish technology in 'Trenchless Pipe Replacement' has been used to avoid traditional excavation and social disturbance. (Courtesy: Scandinavian No-Dig Centre)*

Reducing water loss in the water supply is not only important for saving water, but is also essential to improving drinking water safety

SØREN HVILSHØJ
International Water Director
RAMBØLL

lost revenues – typically up to one quarter of the Non-Revenue losses are apparent losses (commercial losses). Lower costs due to efficient management and increased revenues can be transformed into larger working funds for the utility, securing its future efficiency and development.

Safe water quality

The operation of the distribution system tends to have a negative impact on the water quality. In most places it is necessary to add chlorine to disinfect the water before distribution to avoid bacteriological contamination of the water, but if the distribution system doesn't operate properly, it will result in excessively high chlorine content near the pumping station and low or zero chlorine further out in the distribution system. Both are detrimental to the water quality and to the consumer. The flow and age of the distributed water must be as uniform as possible all over the distribution system to make the chlorination efficient.

If the chlorine degrades, a distribution system with a high leakage will be vulnerable to contamination resulting from vacuums developing during low pressure situations. A properly designed, operated and maintained distribution system will minimise the risk of contamination, and it will secure safe drinking water for the consumer.

Other benefits

In addition to the significant financial savings that can be achieved through the implementation of an effective Non-Revenue Water programme, water utilities can benefit in several other ways. For example:

- Stable and secure supply and improved performance are achieved by obtaining 24/7 fully pressurised distribution.
- Customer service relationships can improve as a result of a successful reduction programme. Implementation of certain specific management tools in connection with the programme will increase the overview of customer service and improve advice given to customers.
- The NRW programme is the best foundation for a long term rehabilitation and investment plan, based on the condition of the pipes in each section. Rehabilitation and pipe replacement can be carried out by prioritising those in the poorest condition, not just by replacing the oldest, as is commonplace at present.
- There will be improved understanding and more efficient operation of the distribution system, as well as a greater awareness of unauthorised consumption.
- Training and technology transfer will upgrade the utility at all levels.

Dhaka, Bangladesh *A considerable number of cities around the world face challenges similar to Dhaka, the capital of Bangladesh. Up to 60 percent of distributed water is lost before it reaches consumers, basic sanitation is largely absent and the city has just one wastewater treatment plant for 15 million inhabitants. In addition, the local water and sewage company is limited by inefficient organisation and wages so low that employees are tempted or forced to exploit the system. Today, a team of Danish water engineers and contractors is helping the local utility, Dhaka Water Supply And Sewerage Authority (DWASA), replace virtually all the water supply networks in the city. The replacement of approximately 3,800 kilometres of new water pipes should stop both real water losses and apparent losses. The city is now divided into 84 new District Metering Areas (DMAs) where inflow, consumption and pressure are measured. For the first four that have been finished, the level of Non-Revenue Water has been measured at around 5 percent. The challenge going forward is to keep it at that level. (Courtesy: Grontmij)*

5. Reducing urban water loss: a political priority

Expanding the water distribution network without having a strategy for reducing Non-Revenue Water effectively means you are expanding a cycle of inefficiency

HANS-MARTIN FRIIS MØLLER
Development Director
Water & Energy
GRONTMIJ

Economic incentives are important drivers for changes in behaviour. Politicians in Denmark have for decades understood that taxes are very important tools in this regard. More than twenty years ago regulation requiring certified metering of all water consumption was set up in Denmark, introducing tax on both water consumed and water supplied as well as on NRW.

High price deter unnecessary consumption
This has meant that from 1989 to 2012 the price of water for customers in Denmark has risen from around 2 euros to 7 euros per cubic metre. The price covers the supply of drinking water (22 percent), sewage and wastewater treatment (47 percent) and taxes (31 percent). The dramatic increase in water prices has increased public awareness about saving water.

There has thus been a significant drop in water consumption in Denmark from a per capita average of 170 litres per day in 1989 to 114 litres per day in 2012. In 2000, the European Union approved the Water Framework Directive, which set out requirements for national water pricing policies. It's goal was to provide adequate incentives for efficient water usage as well as to incorporate a user contribution to the cost of providing appropriate water services.

Big incentives to reduce NRW
Danish water utilities have had an incentive to reduce water losses because the amount of water supplied was taxed. Water utilities in Denmark currently pay almost one euro per cubic metre in taxes even on their Non-Revenue Water. To further encourage water suppliers to reduce water losses, Danish authorities impose additional penalties on water utilities that do not reduce NRW to less than 10 percent.

In addition to rising to the challenge of ensuring adequate water resources, and avoiding wasting energy on producing and distributing Non-Revenue Water, the Danish government has created a strong incentive for water utilities to reduce urban water loss and to plan, manage and operate the utilities efficiently to the benefit of both the consumers and the environment.

Representatives of the Danish Parliament meeting their Chinese counterparts to discuss water issues in Shanghai

If your goal is water efficiency, Denmark is ready as a partner

Danish water companies have shown their courage and drive by working with their competitors in order to create the Rethink Water platform. They are showing the world that Denmark is ready to take responsibility and contribute to finding solutions to the major water challenges the world faces

KIRSTEN BROSBØL
Minister for the Environment
DENMARK

Denmark is surrounded by water, yet freshwater is still a scarce resource for us. For 30 years, we have been rethinking water and building expertise within water efficiency. Today, our tap water is as pure as the finest spring water and the water in the harbour of Copenhagen, our capital, is so clean that people swim in it.

Denmark knows water

The knowledge we have about water resources, water security and water efficiency is no coincidence. Successive governments have addressed our country's limited natural resources, concentrating on using them efficiently, and as a nation we strive to provide a safe, pleasant and healthy environment for people to live in.

Knowledge transfer

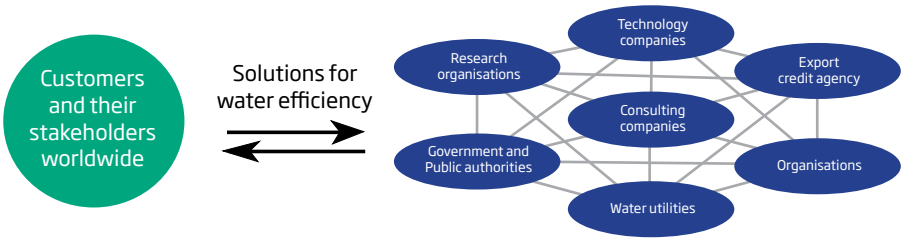
Denmark is not physically powerful, but knowledge is power. Long ago we as Vikings spread fear across the seas. Today, we want to spread something entirely different: knowledge and collaboration on how to globally protect water resources and improve water efficiency. Water is an increasingly scarce resource in most parts of the world. We need to rethink how we use it.

For mutual benefit

As a country, we see great opportunity for mutual benefit in the transfer of knowledge and the growth in both partners' business. Our expertise is in assisting customers and stakeholders reach safe and effective water solutions, while developing their ability to profit from that knowledge. In our work we maintain a healthy respect for different perspectives and agendas, as well as for the environment.

Rethinking water together

Rethink Water is a global network specialising in water efficiency. So far, we are over 60 consulting companies, technology providers, utilities, research institutes and governmental bodies. The network brings together an unusually diverse and valuable mix of clients, consultants, researchers, technology experts and governmental bodies. We have joined forces to share knowledge and create even better water solutions, in Denmark and around the world. We invite you in to collaborate on solving your water challenges and to explore our expertise at www.rethinkwater.dk/whitepapers



Find more white papers, learn more about the Rethink Water network and get in touch with us at:

www.rethinkwater.dk

Consulting companies

Alectia	alectia.com
Bonnerup Consult	bonnerup.net
COWI	cowi.com
EnviDan	envidan.com
Gromtmij	grontmij.dk
Moe & Brødsgaard	moe.dk
Orbicon	orbicon.com
NIRAS	niras.com
Rambøll	ramboll.com
TREDJE NATUR	tredjenatur.dk
Øllgaard	ollgaard.dk

Technology companies

Adept Water Technology	adeptwatertech.com
AKVA group Denmark	akvagroup.com
Aquaporin	aquaporin.dk
AVK	avkvalves.com
Billund Aquaculture	billund-aqua.dk
Biokube	biokube.com
Blue Control	bluecontrol.dk
Danfoss	danfoss.com
Danish Rootzone Technology	rootzone.dk
EcoBeta	ecobeta.com
Envotherm	envotherm.com
Freewater	freewater.dk
Grundfos	grundfos.com
HOH BWT	hoh.com
I-GIS	i-gis.dk
Kamstrup	kamstrup.com
LiqTech International	liqtech.com
MJK Automation	mjk.com
Mycometer	mycometer.com
NOV Flexibles	nov.com/fps
Novozymes	novozymes.com
OxyGuard International	oxyguard.com
PROAGRIA Environment	proagria.dk
RK Plast	rkbioelements.dk
Scandinavian No-Dig Centre	no-dig.dk
Siemens	siemens.com/energy/aeration
Silhorko-Eurowater	eurowater.com
SkyTEM Surveys	skytem.com
Sorbisense	sorbisense.com
Stjernholm	stjernholm.dk
UltraAqua	ultraaqua.com
Wavin	wavin.com
Aarhus Geophysics	aarhusgeo.com
Per Aarsleff	aarsleff.com

Research institutes & demonstration projects

Danish Technological Institute	teknologisk.dk
DHI	dhigroup.com
Geological Surveys of Denmark and Greenland	geus.dk
Kalundborg Industrial Water Demonstration Site	symbiosis.dk

Water utilities

Greater Copenhagen Utility	hofor.dk
VCS Denmark	vcsdenmark.com
North Water	nordvand.dk
Aarhus Water	aarhusvand.dk

Organisations related to water

Association of Waterworks in Denmark	fvd.dk
AquaCircle	aquacircle .org
Copenhagen Cleantech Cluster	cphcleantech.com
Confederation of Danish Industry	di.dk
Danish Water Technology Group	dk-water.com
Danish Water and Wastewater Association	danva.dk
Danish Water Forum	danishwaterforum.dk
Danish Water Services	danishwater.dk
State of Green Consortium	stateofgreen.com
Water In Urban Areas Network	waterinurbanareas.dk

Governmental bodies & other sponsors

City of Copenhagen	kk.dk
Capital Region of Denmark	regionh.dk
Danish Trade Council	um.dk
Danish Ministry of the Environment	mim.dk
Danish Nature Agency	naturstyrelsen.dk
The Branding Denmark Fund	mfonden.dk

State of Green
Join the Future. Think Denmark

DWF
Danish Water Forum