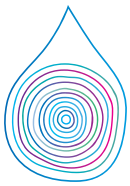
EurEau

Water Matters

An insight into the successes and challenges facing the European water sector

EurEau

The European Federation of National Water Services



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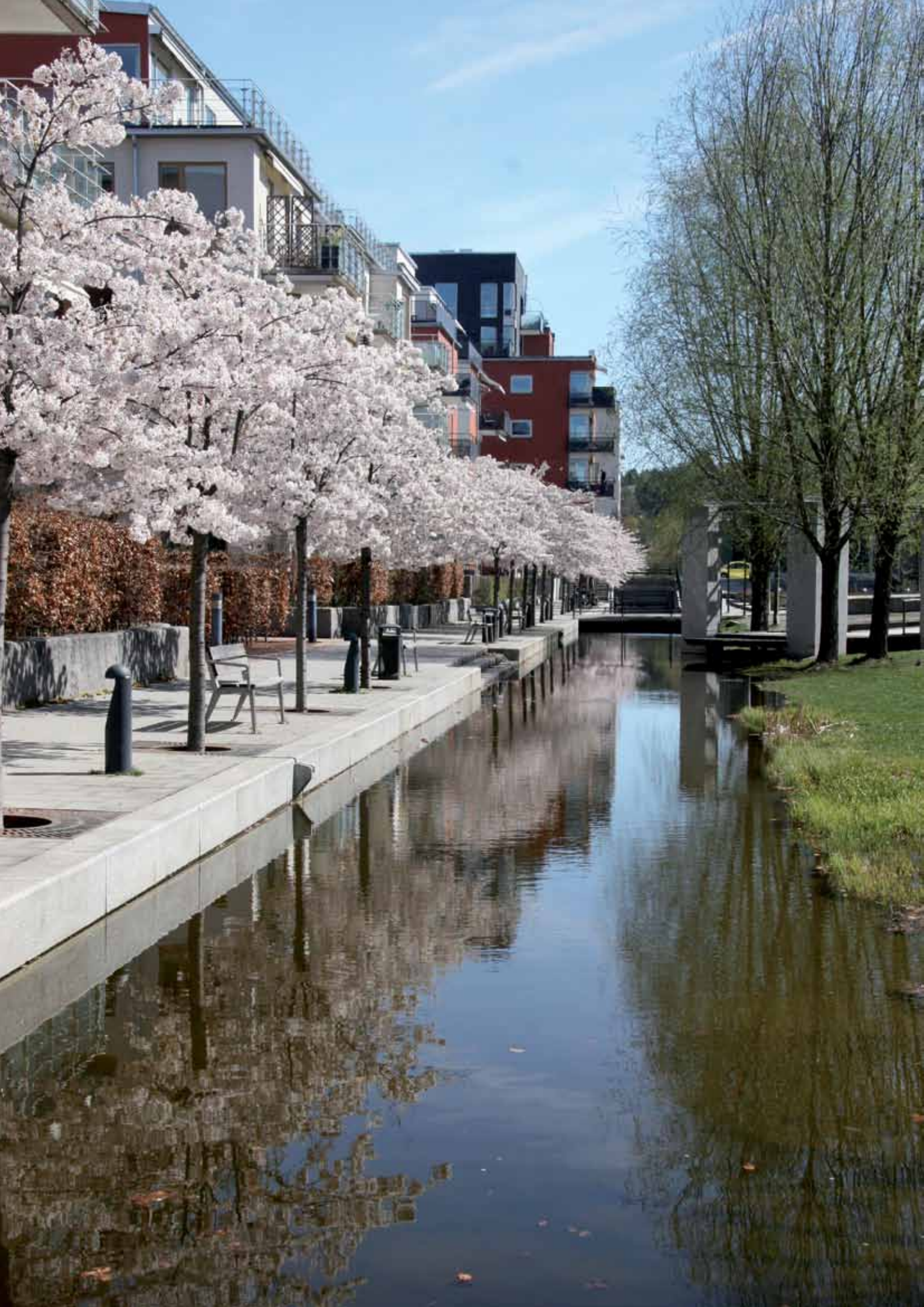


Contents

The Stockholm eco-district Hammarby Sjöstad has water central to its soul, developed around Hammarby Lake and with its own storm water management system. **Credit:** Catherina Eriksen

Water matters

A welcome from EurEau's President

Water matters. It is essential to life, the environment and to the economy. Ensuring water availability is, therefore, essential to generating and sustaining social and economic prosperity. Water is at the heart of all policies because it is the most important shared resource.

Our sector provides clean, safe and reliable drinking water to our customers and ensures the safe return of treated waste water into the cycle.

Employing 542.000 people, we make a significant contribution to the European economy.

One of EurEau's greatest strengths is that we agree common positions and present these to our national and European politicians. Developing a common position challenges us to look at issues from a broader perspective and makes us work together better as a sector.

We are making the human right to water and sanitation, as recognised by the UN, a reality. In addition, we show how the water sector is transparent, engages with consumers and improves services to ensure affordability.

We are entering a crucial period in EU water policy. Several key EU water directives are set to be reviewed before 2020.

The first of these is the Drinking Water Directive. We have worked diligently to find solutions on the transparency proposals and the topic of materials and products in contact with drinking water.

The Urban Waste Water Treatment Directive (UWWTD) is another vital piece of legislation. It is linked to other legislation such as the Bathing Water Directive.

Through these directives, we have cleaner rivers and seas, and citizens are happy to use these as recreational areas. The UWWTD will be evaluated soon and we will participate fully in this process.

▼ Safeguarding the quality of water in our rivers, lakes and groundwater sources has been a key theme of EU legislation, benefitting both the environment and Europe's water customers.

The 2000 Water Framework Directive improved the quality of water in rivers, lakes and groundwater resources, benefitting both the environment and customers. This lynchpin of EU legislation will be reviewed in 2019, giving EU legislators the perfect opportunity to further safeguard water bodies across policy areas; not just for now but also for future generations.

In 2015, the European Commission adopted the ambitious Circular Economy Package to stimulate European businesses and consumers to use and recycle resources in a more sustainable way. We support the recovery of nutrients through the revision of the Fertiliser Regulation and new resource management instruments through water reuse measures. Waste water treatment plants already recover nutrients through sludge production returned to land. New processes that can extract phosphorus and nitrogen from sludge are increasingly applied where it is not possible to use sludge directly as a fertiliser.

We need to be proactive, however. Although the Fertiliser Regulation seeks to significantly facilitate access to organic and waste-based fertilisers, sludge-based products are not yet included in these. Furthermore, bringing them into line with traditional, non-organic fertilisers will be a challenge. Incentives are needed to secure a market for secondary raw materials and to invest in the adaptation of all processes.

There are other challenges. The circular economy has an important role to play regarding water efficiency. This is vital, as water scarcity is something that all of us have to face up to. Scarcity can be addressed through the reuse of treated waste water in safe, cost-effective conditions. Reclaimed water (water destined to be reused) is safe, but the EU must legislate for relevant standards for relevant uses. It is of upmost importance that the standards are adapted to the projected use and defined in a regulatory framework.

We want to protect human health. We address issues concerning the management of water services or water governance as a whole, as the central focus must remain on human health. We are happy to deliver support and expertise at technical and governance level throughout the world.

Our members are often directly involved in decentralised cooperation initiatives which contribute to the UN's Sustainable Development Goals, specifically No.6 for clean water and sanitation for all.

All this means that our customers have access to safe and clean water whenever they need it. Waste water is collected and treated before being returned to the environment. We have cleaner rivers and lakes. But we need to do more to protect our vulnerable water resources.

The Water Framework Directive set objectives for the future of Europe's water. EU citizens and citizen groups will be crucial in helping to keep our water clean.

We work with EU policymakers and with our stakeholders to ensure that our water resources are effectively managed and protected. We do this by working with others to guarantee that EU legislation is the most robust it can be.

This helps guarantee that we, and our children, and our children's children will have access to this vital resource. This is our legacy.

We are very proud of the work we do. In this publication we present EurEau, our work and the issues we focus on, as well as some of the challenges we face. Our members highlight topics that are high on their agenda from their national perspective. Through this, we shine a light on the triumphs and concerns of the water sector, the problems and how we address them.

Bruno Tisserand
President, EurEau

EurEau: the voice of Europe's water sector

It is not a secret: most of the rules regarding drinking water and waste water applicable in EU and EEA Member States are decided at European level. The EU also adopts legislation which affects the water sector indirectly. This includes the chemicals regulation REACH, the Circular Economy Package and the Mercury Regulation, just to name a few.

The water sector needs a strong voice to ensure that the complexity of water services issues are duly taken into account. How can we ensure affordability while responding to new health challenges and climate change adaptation? How can we become a major player in the circular economy while maintaining a high level of environmental and health protection?

These are just two of the questions our sector needs to find answers to. Even more importantly, we must ensure that European legislation addresses these questions holistically while offering flexibility to Member States, stimulating innovation and encouraging new financing models.

▼ The future for European water will include finding solutions to health challenges and adapting to climate change. With EurEau members spanning the continent, a great deal of expertise exists.

In this context, we support all initiatives to develop an open and output-oriented dialogue between us and other sectors such as agriculture and pharmaceuticals. Sustainable solutions can only be found together.

With 32 member associations from 29 EU and EFTA countries, EurEau is the recognised voice of the European water sector. We are unique in that we represent water service operators from a range of ownership and management models, covering both drinking water supply and waste water treatment. This gives us a great strength. We can offer the European institutions a position that is supported by the entire water sector. It is based on a unique network of more than 200 experts from across Europe providing both scientific data from the national level and real life experience of proposed solutions.

We are a reliable partner to the European institutions. We are also a valuable platform to our members for learning. New ideas and successful solutions in one country or region may be of interest to others, be it in the field of water management, recovering resources from waste water, adaptation to climate change or any other area of interest. Given our wide geographical coverage, our federation combines know-how and expertise from very different backgrounds in terms of geographical conditions or political and regulatory frameworks.

Together we will make the upcoming revision of European water policy a legacy that will protect our water now and for future generations.

Oliver Loebel
Secretary General, EurEau

32 Members

29 Countries

Austria
ÖWAV – Austrian Water and Waste Management Association
ÖVGW – Austrian Association for Gas and Water

Belgium
Belgaqua - Belgian Federation for the Water Sector

Bulgaria
BWA - Bulgarian Water Association

Croatia
GVIK – Croatian Water and Waste Water Association

Cyprus
Cypriot Association of Water and Sewerage Boards

Czech Republic
SOVAK – Water Supply and Sewerage Association of the Czech Republic

Denmark
DANVA – Danish Water and Waste Water Association

Estonia
EVEL – Estonian Water Works Association

Finland
FIWA – Finnish Water Utilities Association

France
FP2E – Professional Federation of Water Companies

Germany
BDEW – German Association of Energy and Water Industries
DVGW – German Technical and Scientific Association for Gas and Water

Greece
EDEYA – Hellenic Association of Municipal Water Supply and Sewerage Companies

Hungary
MaViz – Hungarian Water Utility Association

Ireland
CCMA – The County and City Managers' Association

Italy
Utilitalia – Federation of Energy, Water and Environmental Services

Luxembourg
ALUSEAU – Luxembourg Association of Water Services

Malta
WSC – Water Services Corporation

Norway
Norsk Vann – Norwegian Water

Poland
IGWP – Polish Waterworks Chamber of Commerce

Portugal
APDA – Portuguese Association of Water and Waste Water Services

Romania
ARA – Romanian Water Association

Serbia (Associate Member)
CCIS – Chamber of Commerce and Industry of Serbia

Slovakia
AVS – Association of Water Companies

Slovenia
Chamber of Commerce and Industry of Slovenia – Chamber of Public Utilities

Spain
AEAS – Spanish Water and Waste Water Association

Sweden
Svenskt Vatten – The Swedish Water and Waste Water Association

Switzerland
SVGW – Swiss Gas and Water Industry Association

The Netherlands
UvW – Dutch Water Authorities
Vewin – Association of Dutch Water Companies

UK
Water UK

The future of European water and water services

There are nine major challenges ahead for Europe's drinking water and waste water operators. Long term thinking should mix with technological innovation

By Dr Claudia Castell-Exner and Carl-Emil Larsen, EurEau Vice Presidents

Water is the most important shared resource. EurEau is fully committed to the continuous supply of clean water and the safe return of treated waste water into the water cycle.

Our members actively protect water resources by providing and implementing solutions to water pollution and scarcity, delivering public health and economic growth, and ensuring the continuous supply of high quality water now and for future generations of Europeans.

Water service coverage differs across Europe. Overall, more than 95% of the population among our members are connected to drinking water services, while 86% of people are connected to waste water collection services. Of this latter figure, more than 96% are connected to a waste water treatment plant.

We see nine challenges at the core of our work in protecting this precious natural resource while performing sustainable, innovative and reliable water services.

1. Protecting a vulnerable resource with funding and good governance

Safe drinking water at the tap and waste water treatment are essential for human health. Surface and groundwater quality is vital for all water operators, regardless of where they are so that they can deliver high quality water services to customers.

Almost everything we do affects either the quantity or the quality of water resources. Water resources protection and management need to be considered in other policy areas.

In particular, water protection measures should be integrated and implemented in relevant European policies such as the Common Agricultural Policy, energy policy and European chemical legislation (REACH, rules governing the authorisation of pesticides, biocides and pharmaceutical products) as well as tourism and recreational policies. EU water legislation features many success stories but a lot remains to be done in order to ensure that our water resources are effectively protected. Appropriate funding and good governance are key factors in meeting this objective.

2. Fostering sustainable economic growth and creating jobs

Water services directly employ around 542.000 people in Europe. Across the sector, we invest €36bn annually to maintaining and renewing the water infrastructure and we have an annual turnover of €82bn.

Our sector is stable and employment in it has been constant despite the economic and financial crisis because jobs cannot be delocalised.

We will continue to need people with appropriate skills in maintenance, engineering, research and development and a host of other areas. We also give people the opportunity to work with us through apprenticeships, traineeships and numerous training programmes.

3. The value of water in the circular economy

Waste water contains valuable resources such as energy, phosphorus, nitrogen and other nutrients that can be recovered and reused in a circular economy, fostering economic growth and job creation. European legislation should be a driver for innovation and allow for the development of good practices to recover these resources. Incentives to

Water companies have traditionally planned long term but in an industry that is increasingly driven by innovation, flexibility should be included in future plans.

channel recovered resources into the market for secondary materials, in a sustainable manner, should be put in place.

4. Source control approach for micropollutants

Micropollutants originating from the use of substances such as pharmaceuticals, veterinary drugs, personal hygiene products or household chemicals, microplastics (from textiles, car tyres, etc), nanoparticles and pesticides may represent a risk for water resources. As their use increases, micropollutants represent a challenge for water resources and for water operators once they enter the water cycle. In line with the Precautionary Principle and the EU treaties, pollution should be prevented and controlled as much as possible at the source rather than applying unsustainable end-of-pipe solutions.

5. Setting the right price for water services to maintain the infrastructure

The price that consumers pay for water services must strike the right balance between the affordability of the services and the need to recover the cost for water services while ensuring the necessary investments to build, maintain and renew the infrastructure. We support greater transparency of water bills so that customers can understand the real costs of supplying drinking water and collecting and treating waste water.

In fact, while the affordability of water services is crucial to realising the human right to water and sanitation, if the price for water services is artificially low, the costs of maintaining the infrastructure will have to be covered through taxes or subsidies, or the investments be postponed to future generations. A sustainable water sector is essential for the steady development of our societies as indicated by the UN's Sustainable Development Goals.

6. Growing impact of climate change on water

Extreme weather events are becoming more frequent. Floods and droughts are regular occurrences in Europe.

Water managers should develop adaptation measures to improve the resilience of water supply and waste water systems. The water sector is ready to be more ambitious, set targets and apply innovative solutions for climate change adaptation. We need to work together, developing a holistic, cross-societal approach to deal with it.

7. Resource efficiency in the water sector

Responsible use, appropriate allocation and efficient delivery are fundamental to ensuring the best use of a scarce resource. Water operators endeavour to be more energy efficient, use chemical substances wisely in water treatment processes and recover nutrients and energy in waste water treatment processes in order to be as sustainable as possible.

8. Managing long term assets in a fast-changing environment with innovative ideas

Traditionally, water services look at the long term when planning and constructing their waterworks, distribution networks, collection systems and treatment plants. Some parts of the water infrastructure last for 50 years or more. The water sector has to balance its long term thinking with an appropriate level of flexibility, allowing infrastructure to be responsive and adapt to a fast-changing environment and innovative solutions.

9. Increasing the public understanding of the water sector

The water sector must continue to engage effectively with its customers and other stakeholders to ensure there is a greater understanding of the many ways that water matters. Customer and stakeholder engagement are fundamental in order to achieve an understanding of mutual priorities and needs.

Mutual benefits

Water is a limited resource but the EU's Water Framework Directive is making Member States work together for a more sustainable future

By Karmenu Vella, EU Commissioner for the Environment, Maritime Affairs and Fisheries

Europe's water policies are modern, progressive and ambitious. With sustainability at their heart, they are designed to ensure sufficient quantities of clean water for Europe's citizens. Citizens want their rivers to be clean, and households, enterprises and farmers need sufficient supplies of healthy water. Nature needs rivers that flow in a natural pattern so that fish and biodiversity can thrive.

Protecting our waters takes a concerted effort. The centrepiece of water policy is the Water Framework Directive, which obliges the European Union and its Member States to work together at a local level to manage European water bodies. The directive is built around cooperation, as more than 60% of our rivers, lakes, aquifers and coastal areas are shared by two or more countries.

The legislation is paying dividends. Member States have analysed pressures, improved monitoring systems and reformed their water management institutions as a result of obligations in the directive. They have developed measures and plans, and invested in implementation. Pollution is going down as cities and industry improve treatment, and water is allocated and used more efficiently. Less is lost from pipes, our rivers and wetlands are being restored, and life is getting easier for migratory fish.

Despite that progress, many EU waters remain under pressure. Last year, only half of our surface waters met the standards we use for 'good status'. Redressing the balance won't be easy. Many of these pressures are systemic in nature and result either from the way we live or from infrastructure that has been in place for many years. The impacts of climate change complicate the picture, exacerbating the effects of floods, drought and water scarcity. These problems are often compounded further by risky land use decisions.

Although there are challenges ahead, Europe has many innovative solutions to offer. Good practices across the EU show how an acceptable status of water can be achieved, with modern measures tailored to specific needs and conditions.

Local water managers will solve some of these problems but others need to be tackled on a much wider scale. Overall, Europe still needs to take a more coordinated approach, both domestically and with non-EU countries. But more than anything, we need to improve the way water is treated in related policies. Policies like agriculture, energy and spatial planning need to be designed to pay more attention to these issues, and EU financial mechanisms also need to be adapted. More investment is needed on many fronts, not just to combat pollution and losses but also to maintain and renew water infrastructure.

Agriculture is a good illustration of where things need to change. Farms are significant users of water as they need good quality water in sufficient quantity but they constitute a significant pressure on the resource as a whole. In Europe, 90% of river basins are affected by agriculture and the pressures that it can bring, such as nutrient overload, pollution from pesticides and over-abstraction. These can stand in the way of achieving good status. So we need policies that make agricultural production sustainable and don't cause water status to deteriorate.

A process of reflection is ongoing in this area, and this is the approach I have agreed to with my colleagues at the Commission, most notably with Commissioner Phil Hogan who is responsible for agriculture, as we work towards a common agenda. The process also needs to be followed through in the Member States so I'm inviting ministers for environment to approach their agricultural

counterparts with a view to engaging them in similar discussions. Better coordinated policies will safeguard supplies, ensuring that farmers have sufficient quantities of good quality water for the longer term.

The urban dimension, too, is a major concern. Cities need to strengthen their approach to water management, with policies that are in line with the needs of today and prepared for the challenges of the future. Discussions along these lines with city authorities are already bearing fruit. The Leeuwarden Declaration and the Pact of Amsterdam are examples of how cities are increasingly committed to improving water quality and ensuring water efficiency.

Europe's water legislation brings advantages for the whole of society and for our health. When we prevent pollution, we save money by having nothing to fix. Pricing policies based on cost recovery and making polluters pay both improve sustainability. When we use water more efficiently, it means more water for all economic sectors. When we restore rivers to their natural shape, there are benefits not just for fish and local ecosystems but also for tourism and recreation. Well-designed flood protection can help renew urban spaces.

One of the central concerns of this Commission has been getting Europe onto a more sustainable track, where we use our limited resources more carefully. This applies to metals and plastics but it also applies to water, which is a more limited resource than we sometimes imagine. Wherever water is used, it can always be either recycled or released by one user and used by another. Next year, the Commission will be proposing a new initiative on reusing water, making it easier for Member States to draw on new and existing technologies – technologies that we are already exporting around the world.

Water organisations across Europe are proving increasingly innovative, bringing extra employment, economic improvements and a better environment for all.

The potential for water reuse in Europe is gigantic. Agriculture, for example, could vastly increase its use of treated waste water. At the moment, 1 billion cubic metres is being reused. That could become 6 billion cubic metres. And waste water often contains valuable substances that can be extracted so that what was once a pollutant can become a useful material to be returned to the market.

Water is a tremendous driver of innovation. By encouraging the industry to innovate and find solutions here in Europe, we make it more competitive at the global level. So these challenges can create economic benefits, bringing jobs, growth and satisfaction.

The principle elements of European water policy are sound but that doesn't mean that there isn't room for improvement. In cooperation with Member States, the Commission will soon launch a review of the legislative framework for water with a view to consolidating, modernising and simplifying it wherever necessary.

The process should allow us to identify robust options that will deliver the sort of water policy that citizens demand. The review will be wide-ranging, safeguarding the current level of ambition but looking for ways to speed up the full implementation Europe needs. In addition, the Drinking Water Directive is undergoing an evaluation.

The Commission will continue to support the efforts of Member States and we are counting on their support for the work ahead. We will try to improve access to finance water-related projects so as to attract more private investment going to this sector. We will talk more extensively about water governance and break down barriers between sectors.

We all want a Europe that is safe, prosperous and resilient to climate change. That is the best way of offering a high quality of life to our citizens. To do that, we need to keep water high on the political agenda.

The Slovak Presidency of the Council of the EU has been instrumental in this endeavour. And, as water is much more than an environmental issue, we need to work closely with colleagues on many different fronts to address all the pressures on our water.

We all want good status for our waters and we are heading in the right direction. But achieving our goals will require a greater degree of cooperation.

Integrating water into the circular economy

Europe shouldn't take the availability and access to water for granted. Citizens, industries and authorities are all responsible for its preservation

By Michel Dantin, Member of the European Parliament and President of the Rhône-Mediterranean Water Basin

In the European Parliament, Michael Dantin is responsible for the working group Water and Agriculture, which brings together politicians and stakeholders to debate key themes. Dantin considers water a significant horizontal political and multisectoral topic. He advocates the application of the principles of a circular economy to water.

In the history of the greatest civilisations, people are born and build empires around water, often on the banks of rivers. Egyptians, Romans and Greeks are some examples. Water irrigates our fields, feeds our economy, is a vehicle for industry and gives health. It is not insignificant that one of the United Nations' Sustainable Development Goals covers clean water and sanitation.

Access to drinking water and sanitation is one of the priority objectives to trigger the development of poor and emerging countries. In Europe, we take water availability and access to water for granted. This is a mistake. Climate change, intensification of human activities and population growth are causing water stress that will reactivate the threat of water shortages in the coming decades. Already, farmers are suffering from exceptional floods and repeated periods of drought in Europe, the cost of which has amounted to €100bn in 30 years.

Therefore we – particularly in Europe – have to re-learn how to save water.

We have to remember that water is a shared good that we use daily. Naturally, there is a right to access quality water, and also a duty. We citizens, local and regional authorities, companies, water services and elected representatives are responsible for the preservation of this resource.

Yet what did the 22nd UN Climate Change Conference (COP 22) in Marrakech have to say about water? Few things, judging by the conclusions. And certainly not any more than at COP 21, which saw the emergence of a historic agreement confirming the commitment of the international community to limit global warming to 2°C by 2100. It is a disappointing assessment on the international climate change scene that water is not seen as a priority on the political agenda.

In civil society we see the inverse; a hyperactivity of the water actors who contribute to the transition to a circular economy. Everywhere in Europe, the water services, responsible for providing water and sanitation, have developed service models that are adapted to the territory and the needs of citizens. In the last few years, we have seen an intensification of the rhythm of maintenance and an extension of infrastructural investments, with the goal of guaranteeing access to this resource in a sustainable way.

Water operators invest heavily in new technologies, notably to treat water. Today, technology allows us to filter out more micropollutants and better respond to consumer demands for more effective treatments at an affordable price.

The potential of water is evident also in energy. First of all, we can produce water thanks to hydrotechnology. Then we have energy saving: improving procedures allow us to use less water, which results in a saving of energy and a reduction in greenhouse gas emissions. Technological advancements, particularly in digital technology, using intelligent water meters (smart grids) and the introduction of innovative services, also help us guarantee optimal water management.

Another key point of the circular economy is the use of new treatment technologies to provide solutions for the reuse of waste water. The challenge is large; it is a matter of reducing net withdrawals while ensuring a return of water to the environment in a better state. These recycled waters are used, for example, in agricultural and public space

irrigation. In the last link in the circular chain, the resulting sludge from these waste waters is treated and some of it used as natural fertilisers for agricultural production.

These private initiatives prove that solutions exist to reduce the pressures of human activities on water resources. Water operators made a strong appeal at COP 22 during a day dedicated to water: political decision-makers must take note and define a medium and long term vision and to set a framework to reduce pressure on the water system and promote water reuse.

Implementing standards will require more dialogue between the water reliant sectors of agriculture, industry, health, energy and tourism. Only a multisectoral approach can lead to a fully functioning circular economy.

In my role of President of the working group Water and Agriculture in the European Parliament, I take it upon myself to inform politicians and EU institutions in this domain. I, together with EurEau, organise conferences on the key themes such as micropollutants, water reuse and financial instruments, with the aim of advancing the legislative work on these topics.

For me, there are two priority objectives in setting a political framework for civil society action. On the one hand, it is essential to integrate the circular economy with water. On the other, there is an urgent need for an integrated and multisectoral approach to water policy.

The principles of the circular economy are clear: the goal is to preserve, reuse and recycle the resources we use in a closed circle. Waste is thus reintegrated into the chain as a product. In the language of water, sanitation is key for the model of the circular economy. At the level of the European Union, work is progressing; it is an intensive time for legislation in the European Parliament. We will have to work on setting a common framework for the reuse of waste water and on the revision of the Drinking Water Directive, the pillar of European action for the benefit of citizens.

We must mainstream water policy. Agriculture, industry, health, energy and tourism, all these policies impact the quality of water in Europe. Today, agricultural activities account for a significant proportion of water pollution in the EU. I believe that enhanced dialogue between actors in different sectors is needed at all levels of governance in the development and implementation of standards.

In this regard, I welcome the creation of the European Commission's Water and Agriculture Task Force, which aims to introduce adaptation policies into the European Commission through a closer relationship between the Directorates of Agriculture and the Environment. This will achieve the objectives of good water status in Europe. This example of intersectoral dialogue must be replicated in all areas, beginning with health. Building a circular water economy is a real challenge, a legacy that we must pass on to future generations.

These actions must follow the path of the Water Framework Directive (WFD) which manages the resource at the level of the major water cycle, without limiting itself to the problems of distribution and sanitation. This governance framework should guide the transition to a circular water economy. However, the WFD today suffers from significant implementation shortcomings and interpretative discrepancies between Member States.

I am not the defender of deep reform of the WFD because, from a regulatory point of view, it is an effective framework. On the contrary, I consider that adjustments should be made to the text in order to clarify concepts, improve the sharing of responsibilities between stakeholders and create synergies with other sectoral policies. These adjustments will achieve the ultimate objective of the WFD of the 'good status' of water in Europe.

Building a circular water economy is a real challenge; it is a legacy that we must pass on to future generations.

Innovating a new future

Developing fresh approaches to managing future water challenges is critical to a cleaner, greener, better-value tomorrow

By Kari Elisabeth Fagernæsm, Chair of the EurEau Joint Working Group on Innovation

Often people think of new products when the word 'innovation' is mentioned, thus giving into the myth that innovation is only about 'new goods'. But this is not necessarily so.

New products are a small part of the picture. Innovation is also about finding different ways of making, thinking and seeing. Examples of such game-changers are many. To name a few: the Xerox 914 copying machine (1959), Tesla Roadster electric car (2008) and Airbnb (2008).

Innovation is defined by Anurag Satpathy, Arjun Agrawal and Sanjay Mohapatra in *Innovation Strategy For Enterprises In Emerging Economies* (Emerald Group Publishing Limited, 2015) as "exploiting new ideas leading to the creation of a new product, process or service". Innovation is not just the invention of something new that is important, but actually 'bringing it to market', or putting it into practise and using it in a manner that leads to new products, services or systems that add value or improve quality.

Innovation has become a critical survival skill when looking at predictions for how we will live, work and communicate.

Successful innovation requires a certain level of prediction. In order to be successful, we not only have to respond to our current customer or organisational needs but also anticipate future trends and develop an idea, product, service, process or tools that allows us to meet future demand rapidly and effectively.

Innovation is therefore of the utmost importance for Europe's future competitiveness in the water sector and has a spinoff function in regard to societal challenges.

It can't just be seen as an appendix to research. There is a risk that many of the ideas and technologies developed will remain outside the market and will never be used for our welfare and growth. There are a lot of public and European projects at the early stage of the innovation cycle, i.e. research. The European water sector needs to benefit from these.

▼ Nutrients and biomass can be extracted from waste water and used in agriculture.

What role does EurEau play?

EurEau is engaged in different entities related to research and innovation. It is represented in the European Innovation Partnerships (EIPs) on water, implemented by the European Commission to remove barriers and bottlenecks to innovation in the water sector, as a member of the High Level Steering Group.

We are a member of the advisory Board of the Water Joint Programming Initiative (Water JPI). We are also part of the Water Supply and Sanitation

Technology Platform's (WssTP) General Assembly, which is focused on the technological aspects of innovation in water.

The EurEau Joint Working Group on Innovation

Innovation in water is essential and encompasses many areas. Water operators are constantly on the lookout for new ways to make the water they provide to consumers safe. We also look for new ways to treat the waste water we return to the environment. With water shortages becoming increasingly common in warmer areas, we have to find methods to provide water security. We also need new means of extracting nutrients and biomass from waste water and to use these products in our agriculture when possible.

Innovation in water is essential and wide-ranging. Water operators are constantly on the lookout for ways to improve. We are a member of the WssTP, we participate in certain research projects and platforms as a member of advisory groups and we relay information on research and innovation through our communications. However, we see that water utilities in nearly all Member States have difficulties in accessing innovation. Sometimes even the research provides technical solutions that do not respond to the water services needs.

This is usually as a result of policy rather than technology, as operators are regulated on their capacity to invest – in time and money – in innovation. Therefore, we need to focus our efforts on public policy (regulation and economics), management and partnerships.

The Joint Working Group is a platform for discussions on these issues and the organisation of the research and innovation work in EurEau. The fruits of these discussions will be fed into our stakeholders such as the WssTP, the EIPs on water and the Water JPI.

Innovation is of the utmost importance to face the water sector's challenges. But good innovation has an added societal bonus; it also means a better environment for everyone and potentially better value as reflected in water bills.

The Hamburg Water Cycle project in Germany treats separate streams of waste water: blackwater (from toilets), greywater (kitchen use, showers, etc) and rainwater.

Contribute to the clean-up

Europe needs a strategic approach to combating micropollutants, tackling the problem at source. Further EU legislation is required

By Michael Bentveltsen, Chair of the EurEau Joint Working Group on Micropollutants

Pharmaceuticals, pesticides, cosmetics and many other daily products contain chemical substances produced by man. When we use them, they end up in the environment and particularly in our surface waters as micropollutants.

These micropollutants are a challenge for waste water operators, whose mission is to treat waste water to ensure the protection of the environment and ecosystems, and for drinking water operators, who have to rely on clean sources to provide us all with drinking water.

Advanced treatment processes to remove micropollutants from water exist but they are energy intensive and often substance specific. In addition, they are costly and perform poorly in environmental analysis. Innovative technologies and solutions addressing these drawbacks are being developed.

We want to see micropollutants prevented from entering the water cycle in the first place, and legislation enacted at EU level to do this. Establishing the conditions that support such a source control approach is an EU-wide challenge but this needs to be faced.

▼ Ecolabelling would make Europe's consumers more aware of the products they use, ultimately leading to fewer micropollutants in our water.

Three governing principles

EU legislation is based on three principles: the Precautionary Principle, the Control-at-Source Principle and the Polluter-Pays Principle.

We have consistently advocated for a control-at-source approach to micropollutants as well as for the implementation of the Precautionary Principle in environmental policy. These are laid down in EU treaties to protect the environment.

These principles constitute the underlying philosophy behind the Water Framework Directive (WFD) and far reaching European chemical legislation such as the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation, the Plant Protection Products Regulation, the Biocides Regulation and cosmetics legislation.

A Europe-wide strategic approach to micropollutants

These principles are haphazardly applied in EU law. The EU urgently needs to adopt a strategic approach to micropollutants based on the Control-at-Source Principle while considering the entire life cycle of substances when legislating.

We would also like to see the ecolabel used more extensively on products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw materials through to production, use and disposal. This would contribute to raising awareness among citizens and help them make smarter decisions about the products they use. Specifically, we would like to see action on the following:

1. Pharmaceuticals in the environment

We support the European Commission's adoption of a strategic approach to pharmaceuticals in the environment.

2. Microplastics

Marine litter, including microplastics, is a global challenge that needs holistic solutions involving many stakeholders, also taking into account the Polluter-Pays Principle.

We are encouraged by the steps currently being taken across the EU to ban the use of plastic microbeads in certain cosmetic products. We want to see source control actions to reduce marine litter.

3. Pesticides

Pesticides are having a negative impact on the quality of water resources, and drinking water operators have to increasingly resort to extra and expensive treatment while consumers bear the cost.

The introduction of stringent cutoff criteria within the authorisation process of active substances reflects the legislator's intention to tackle the impacts of pesticides on the environment. However, these new requirements are only effective on the authorisation of new active substances, not on the ones currently in use.

Adequate drinking water-related criteria should be taken into account in the chemicals' authorisation phase.

4. Need for specific regulation on chemicals in textiles

More than 10% of the substances used in the textile industry are identified to be of potential concern for human health and 5% are expected to have a very harmful impact on the environment. We therefore want to see an enhanced regulation of chemicals in textiles.

5. Phasing out dental amalgam in the EU

Mercury is one of the most hazardous environmental toxins on the planet and is a threat to human health and the environment as elementary mercury accumulates in water, sediments and living organisms. Phasing out mercury's use should be of primary importance. Dental amalgam is one of the major sources of mercury in the aquatic environment. Its ban can also be regarded as best practice or best-available technology to reduce the flow of mercury in urban areas.

6. Better use of REACH

The 2006 REACH regulation is a key instrument to control hazardous substances entering the urban water cycle and to fulfil the requirements for good chemical status in the WFD. It is essential that its authorisation process is used much more frequently, identifying more substances of high concern and using the authorisation process in a strict way.

Samples of water can contain 15 types of antibiotics. On their own, each would be harmless but a mix of products could have an environmental impact.

The control-at-source approach is key to delivering the circular economy

Fewer harmful substances in the environment will result in cleaner groundwater, rivers, lakes, coasts and seas, and a better quality of the residual products obtained from the treatment of waste water. Water suppliers will have access to adequate and reliable drinking water resources that are protected from contamination.

An effective source-control approach makes the reuse of water and nutrients, like nitrogen and phosphorus from waste water and sludge, possible.

In fact, sewage sludge and waste water are valuable sources that can be reused and recycled if they fulfil appropriate quality criteria. In that sense, source control can contribute to the circular economy, creating jobs and a sustainable society.

Fewer harmful substances in our water cycle and the environment benefits everyone. We can make this happen by contributing to the legislative process of EU institutions.

Water quality is improving

The all-encompassing Water Framework Directive might be failing to meet its demanding objectives but the quality of our water environment is on the rise

By Anders Finnson, Chair of the EurEau Joint Working Group on the Water Framework Directive

The Water Framework Directive (WFD; 2000/60/EC) is the European Union's overarching framework for water policy. It obliges Member States to achieve water quality goals by 2015.

The directive aimed to improve the ecological and chemical quality (or 'good status') of ground and surface water (rivers, lakes, transitional waters and coastal waters) in the EU.

Despite the efforts made, the objectives will not be met, with 47% of EU water bodies covered by the directive failing to achieve the aim of good status. The reasons go well beyond the control of the water sector. Issues such as the impacts of climate change, population growth, changing customer needs and various economic factors are already having a major impact on water resources.

The directive will be reviewed by the European Commission in 2019. EurEau is preparing for this review of a key piece of legislation through a joint working group made up of technical – and other – experts on drinking water, waste water and legal and economic issues.

Through EU legislation, better treatment of waste water and industrial waste have improved the state of surface water, which is good news for wildlife.

The directive brought many benefits despite the failure to fully meet the objectives. As a result of the measures already in place, the quality of our water environment has greatly improved. We also know much more about the status of European water bodies compared to 15 years ago.

Our knowledge of the human impact on water bodies has improved and we now have a better understanding of the different sectors' (household, industry and agriculture) impact on water body quality status, allowing measures to be more effective and targeted. The WFD also has increased our awareness on micropollutants and, being based on the Precautionary Principle and the Polluter-Pays Principle, it reinforces the need for the source control approach.

As well as bringing environmental and ecological benefits, the WFD has been a driver for innovation and has brought direct and indirect economic growth and jobs to Europe. Besides having an impact on water resources, agriculture, industry, manufacturing and tourism rely on, and benefit from, the protection of water resources and effective water services.

The WFD has also started to be an important driver in increasing the public understanding of the value of water.

A revision must ensure a more effective and efficient protection of the aquatic environment and water resources. This should be achieved primarily through more source-control measures and through the necessary links to other policies like the Common Agricultural Policy (CAP) or the EU chemicals legislation.

This will interlink the objectives of the WFD with these corresponding and relevant policies for the sake of the water environment and water cycle.

The EU Water Framework Directive of 2000 had primary aims of cleaning up Europe's surface water and groundwater while making citizens more aware of issues.

The principle of cost recovery must also be upheld and we need to ensure customers understand the true costs and value of water.

The WFD has started the process of improving the aquatic environment. We need to use the revision process to improve the WFD's effectiveness in the light of what has already been done. Given the complexity and huge costs of delivering the directive's vision, which we all share, EurEau members believe more time should be given to reach the goals of the WFD, which are not met in all countries, by extending the WFD to additional cycles.

Any revision of the WFD must align its objectives with other sectors' legislation, such as CAP and the chemicals legislation (e.g. REACH Regulation, and regulations regarding pesticides, biocides, pharmaceuticals and cosmetics).

For EurEau members, the WFD is more than the most important EU legislative instrument for the protection of water bodies and the aquatic environment in European countries: it is the main thrust to delivering sustainable water services effectively.

As the WFD is key to all the work that EurEau members do, it is vital that we are part of the discussions. We want a robust and comprehensive system of water governance that actively protects our environment and water sources so that we will have safe, clean water to use in our homes and businesses and for our leisure.

The EurEau Joint Working Group on the Water Framework Directive: what role does EurEau play today?

The European institutions and Member States have already started an informal process of evaluating the WFD, where Member States can bring case studies, good practices and outline solutions to challenges faced in the implementation of the directive. The Water Directors have also started a discussion that will serve as a Member State's input to the review.

EurEau members have critically assessed the WFD and proposed solutions to challenging aspects of the legislation. The three EurEau committees were heavily involved in the debate, expressing similar views.

The Joint Working Group is responsible for establishing EurEau positions on the WFD, taking into account, but not limited to, the aspects highlighted in the internal workshop held in 2015 in Milan.

Our first tasks going forward are to publish EurEau positions on 'customers and cost recovery' and on 'greater EU policy coordination'.

Taking the waste out of waste water

Reusing water for agriculture and in horticulture frees up fresh, unused water for drinking – a bonus for regions that will be hardest hit by climate change

By Roberto Mazzini, Chair of the EurEau Joint Working Group on Water Reuse

Water is a precious resource. Where the pressure on the resource is too strong, it is necessary to reuse what we have. We treat the water that comes from our drains, sinks and toilets to remove pollutants and protect the environment. With additional appropriate treatment, we can reach a quality allowing us to reuse this treated waste water. It is one way to increase the available water resources, mitigating water scarcity.

Addressing water scarcity through the reuse of treated waste water in safe and cost-effective conditions is also a major step to maintaining water resources for all. The EU can support water reuse projects and raise the image of reclaimed water towards the end users by ensuring its quality and safety. Our treatment methods ensure that water that goes back into the water cycle is safe and healthy.

In certain regions, water reuse is vital. By reusing water in industry, horticulture, agriculture, sport and leisure, we are freeing up fresh drinking water stocks.

Reuse of treated waste water can have significant environmental, social and economic benefits. Reusing waste water can be beneficial in farming, to give one example, as by reusing water, farmers can be assured of a continuous supply, reducing the risk of crop failure and catastrophic income losses.

Other sectors, such as the food industry, tourism and recreational industries would also benefit. Increasing water reuse would increase the number of jobs in these and the water sectors.

▼ Waste water can be cleaned and reused.

What is the role of the EurEau Joint Working Group on Water Reuse?

The European Commission is committed to developing a number of actions to promote water reuse at EU level in the Circular Economy Package (CEP). These actions aim at overcoming the main barriers to water reuse in a cost-effective and safe way for both human health and the environment.

The appropriate use of treated waste water depends upon its quality and, therefore, the treatment it undergoes. To ensure safe water reuse, it is important to develop the regulatory framework that applies the appropriate minimum water quality requirements according to the specific use.

It is also of utmost importance to ensure the adequate and reliable operation of treatment and distribution systems. To do this, we need robust and comprehensive EU legislation to create the

Recreational industries such as golf courses and municipal parks would benefit from the reuse of treated water, which, in turn, would guarantee more drinking water.

environment in which water operators can develop and implement solutions to produce water for reuse.

We engage through the Joint Working Group (JWG) with European institutions to help them develop the appropriate legislative proposals to satisfy the needs of the water service and to ensure the appropriate quality requirements to make reuse safe for health and the environment. We also raise awareness among policymakers as to why it is important to reuse water and assure customers that water reuse is perfectly safe.

In 2016, with the input of the JWG, the Commission published a guidance document on how to better integrate reuse, water planning and management into the existing regulatory framework.

We expect legislation on minimum requirements for water reuse in irrigation and aquifer recharge, and a review of the best available techniques reference documents for relevant industrial sectors. The Commission will support research and innovation in the water reuse sector and invest more money in this.

EurEau's members are fully committed to the continuous supply of clean water and the safe return of treated waste water into the water cycle. We are already developing actions to make drinking water and waste water services more resource efficient. Other sectors, such as the food industry, tourism and sport and leisure, also benefit.

We need robust and comprehensive legislation from the EU to enable the CEP to be realised by establishing EU-wide, common, minimum quality standards for reuse. We – the water operators – work with the European Commission to bring legislation that is cost-efficient and safe for people's health and the environment.

Protecting our most precious resource

Precaution, sustainability and effective legislation are needed to better support Europe's drinking water supply

By Arjen Frentz, Chair of the EurEau Committee on Drinking Water and Jos van den Akker, Committee Coordinator

EurEau's three committees meet three times a year. Our members bring expertise to the federation and national perspectives to our work. This guarantees that the outcome of our work is always high quality and reliable.

EurEau's Committee on Drinking Water covers water supply, drinking water quality and water resources protection. Arjen Frentz (Vewin, The Netherlands) has chaired the committee since 2015. He works closely with three working group chairs: Claudia Castell-Exner (DVGW, Germany) and Jan Peter van der Hoek (Waternet, The Netherlands) on Water Quality; and Jim Marshall (Water UK, UK) on Water Resources. Frentz chairs the working group on Water Supply.

EurEau's goal is to protect surface water and groundwater resources. We focus on key challenges, such as promoting a source control approach for pollutants, highlighting water and energy efficiency in the sector and mitigating the impact of climate change on water resources.

The main concern for the drinking water committee is the evaluation of the Drinking Water Directive (98/83/EC). Work has been ongoing by the European Commission with a study carried out on the relevance, effectiveness, efficiency, coherence and the EU-added value of the directive.

We are all looking at the review options, which include an update of water quality parameters, the inclusion of the WHO risk-based approach, information to consumers and an EU-wide approach for materials and products which are fit for purpose with drinking water.

The European Commission will start the review of the directive in 2017. We are contributing to the process and supporting the Commission with their studies. We participate in stakeholder meetings and group meetings organised by the European Commission. Besides this, we organise meetings with experts and stakeholders to support discussions on policy options. This way, EurEau ensures that policy considerations will also be based on the most up-to-date information.

We are also working on issues such as agriculture and water, pesticides, micropollutants and water reuse. On water reuse, the European Commission may propose minimum quality standards for irrigation and aquifer recharge in 2017.

We want to ensure that the Commission enforces standards to protect the environment and human health, while allowing for cost-effective water reuse in countries that need solutions to tackle water scarcity.

Surface and groundwater

European drinking water is produced from surface water (50%) and groundwater (50%). Protecting these resources from contamination is vital for ensuring clean and safe drinking water. Operators strive to provide this but need robust legislation to preserve resources.

It also requires that EU water legislation, such as the Water Framework Directive (WFD), are properly implemented.

We advocate preventative protection of drinking water resources over water treatment. Water operators treat raw water to comply with the regulatory framework.

The required treatment may involve high costs and environmental impact (for example: energy use). Thus, the end-of-pipe treatment should remain the last option. We need comprehensive

A source-control approach will help reduce emissions at the source and prevent harmful material coming into contact with drinking water.

Overexploitation of groundwater can lead to difficulties with quantity and quality; 50% of Europe's water is taken from the ground.

legislation that is effectively implemented in Member States to better protect the quality of water resources used for drinking water abstraction.

Preventative protection rather than treatment

Our central principle is that preventative protection of drinking water resources should take precedence over water treatment and that a source-control approach should prevent contamination at the origin. The aim is to keep harmful substances away from the water cycle. Measures are:

- Keeping anthropogenic (harmful and persistent) substances away from drinking water resources.
- Preventing contamination at the source.
- Classifying emissions according to possible dangerous effects in line with the state of knowledge and technology.
- No contamination of water resources (both diffuse pollution and industrial discharges) should be tolerated that could endanger the use or suitable use for drinking water abstraction.
- Managing spatial developments.

Water resource protection and planning

Keeping pollutants out of the water cycle is a challenging task. Further EU action has to be taken in the approval, use and disposal of substances and replacing hazardous substances with non-hazardous alternatives, e.g. substances that can be degraded more easily and completely.

The case of groundwater is even more critical as it can be used only to the degree to which it can be renewed since overexploitation represents a threat to quantity and quality. In the interests of sustainability, strategies for the protection of water bodies should include:

- Improving the EU approval, authorisation and registration of chemical substances by adding adequate drinking water quality related criteria.
- Monitoring for pollution and identifying the pathways by which pollutants enter the water bodies.
- Measures to prevent the use of particular substances.
- Measures to reduce pollution at the source.

The European Commission should take our concerns into account in their revision of the Priority Substances list. This also means we need to urgently address pollution from substances of emerging concern, such as pharmaceuticals and micropollutants.

Furthermore, the goals of article 7.3 of the WFD – which obliges Member States to protect their drinking water resources – should be better incorporated. This will reduce the level of purification treatment required in the production of drinking water.

By advocating our positions to European decision-makers and to Member States, who ultimately are responsible for protecting water resources, we protect consumers' health and the environment.

We urge the European Commission and Member States to better protect water resources. Efficient and effective legislation and environmental awareness are needed to prevent deterioration and improve the quality of water bodies.

Prevention is better than cure

Much progress has been made in educating the public about what can be thrown into sewers. Now legislation is required for a control-at-source approach

By Greet De Gueldre and Jean-Pierre Silan, co-Chairs of the EurEau Committee on Waste Water

The safe collection, treatment and return of waste water is vital for our economy and society. Add to this the fact that waste water is a rich source of energy, vital nutrients and fertilisers, and that treated waste water can be reused, and we have a resource that can make significant contributions to maintaining water for future generations and to meeting key environmental and economic goals.

EurEau's Committee on Waste Water examines how we treat and can use waste water in Europe. The committee is supported by three working groups and their chairs: Waste Water Resources (Arne Haarr, Norsk Vann, Norway), Trade Effluents (Michael Bentvelsen, Unie van Waterschappen, The Netherlands); and Compliance (Sarah Gillman, Scottish Water, UK).

In all, the committee has over 50 members with an interest in protecting public health and the aquatic environment in a sustainable way, for example, by promoting energy savings, nutrients recycling and the reuse of treated water.

The committee's main topics for this term are: addressing the issues of micropollutants by promoting source control as often as possible; enhancing resource efficiency and nutrient recycling in the waste water sector as part of the circular economy; building resilience to climate change; protecting the environment through better management of urban waters; and proactively addressing the revision of the Water Framework Directive (WFD) (foreseen for 2019).

The principle piece of EU legislation governing our work is the Urban Waste Water Treatment Directive (UWWTD), adopted in 1991. Its main objective was to legislate for the collection and treatment of urban waste water leading to sustainable environmental protection from urban domestic and industrial pollution. It achieved this in part by combating the accumulation of nutrients in sensitive water systems, as these support the growth of algae, depleting the shallow waters of oxygen and therefore aquatic life. The WFD implementation largely benefits from this work.

Brown gold and the circular economy

The European Commission's Circular Economy Package (CEP) will help all of us use and recycle resources in a more sustainable way. This will be achieved by extracting the maximum value and use from raw materials, products and waste, while promoting energy savings.

Waste water is a source of secondary raw materials. We support the revision of the Fertilisers Regulation that opens the door to an EU-wide market for recovered nutrients and hopefully for high-controlled bioproducts from sewage sludge like composts and ashes.

Our members already recover nutrients from waste water that can be used directly in agriculture in certain Member States or through extraction processes if the direct use of biosolids in agriculture is not authorised. We advocate that all solutions should be available to increase the recovery of the good materials from sewage sludge.

Water, water everywhere…

Water is too precious to be used once. It is crucial that water is managed so that everyone can benefit from it. Water reuse is the use of treated waste water. It is one way to increase the available water resources, mitigating water scarcity. Water reuse has environmental, social and economic gains.

The CEP proposed addressing water scarcity through the reuse of treated waste water in safe and cost-effective conditions. It is a major step to maintaining water resources for all. It is a tool to

Wet wipes that end up in waste water treatment infrastructure can cause significant operational problems by clogging pumps and screens or blocking sewers

support water reuse projects and raise the image of reclaimed water towards the end users by ensuring its quality and safety. Reused water is safe.

Europe needs to establish common, minimum-quality standards according to the foreseen use of treated waste water that protects health and the environment. We, the water operators, are working with European institutions and Member States to bring in water reuse legislation. Our members have the experience and technology to achieve ambitious EU-wide quality standards set for the safe reuse of treated waste water.

Waste water collecting systems and the effects of heavy rain

System performance should no longer be measured only in terms of compliance with discharge standards for waste water treatment plants but should also consider the performance of the collecting system, now often the weak link in the system.

Ageing sewers require extensive renovation investment, rehabilitation, replacement and upgrades to reduce waste water loss or infiltration of groundwater. The impact of these projects on urban mobility has seen the emergence of 'trenchless' techniques, thus opening economic opportunities.

The consequences of climate change vary across regions and require adapting infrastructure, especially where the storm water drainage systems face intense rainfall events.

The waste water collecting systems are often combined (i.e. sewage and rainwater are mixed in the same pipe) and are then designed with 'safety valves' to avoid overloading and urban flooding. On some occasions, these combined sewer overflows can result in waste water being released into the natural environment during heavy rain. The waste water is certainly diluted by large amounts of rainwater but the actual contents of polluted waste water remains relatively unknown. These overflows are regularly held responsible for the failure to achieve environmental quality objectives.

The solution – an overall but site specific integrated management of storm water and waste water in the urban cycle – involves many stakeholders other than water operators, for example, spatial planners and local decision-makers who need to integrate the management of runoff from the initial designs of their urban development projects.

More than pee and poo: our waste

There is no life possible without the production of waste. The residue of our lives, themselves reflections of our consumption, end up in our treatment plants.

Many products such as organic waste, paper, wet wipes, detergents, cosmetics and personal hygiene products, scouring agents, descaling agents, disinfectants, microfibres and pharmaceutical residues, to mention a few, are found in waste water. The compliance to the UWWTD that drove the design of our waste water treatment plants (WWTPs) did not include all these pollutants.

Treating contaminants is costly and upgrading our WWTPs will impact bills. The source-control approach which avoids contaminants ending up in sewers would be the most efficient. With European institutions, we need to educate the public on what can or can't be thrown into sewers. We also need to develop legislative instruments to make the control-at-source approach for pollutants a reality, to integrate biodegradation tests when making and marketing products and to inform the consumer on the proper disposal route.

In 25 years, the UWWTD has changed the way we look at the impact of our individual and collective behaviour. Many challenges lie ahead. We strive to anticipate and meet these challenges each day. Safeguarding our water is everybody's business, from political leaders to water consumers, through academia, research centres, engineering firms, network operators and many others.

It will be for the EU to channel and encourage these developments in a rigorous but flexible legal framework, respectful of the different actors and their investment capacity, to continue to improve these aquatic environments.

Economic aspects of water services

There is a human right to water and sanitation, so the balance between availability and affordability is fundamental to the water service process

By Carl-Emil Larsen, Chair of the EurEau Committee for Economic and Legal Affairs, and Susanne Vangsgaard, Committee Coordinator

The organisation and economic framework of the water sector in Europe is very diverse and reflects the subsidiarity principle which EurEau supports. In all European countries, the economic aspects of the supply of both drinking and waste water services have always been interlinked, but since 2000 the Cost Recovery Principle and its implementation have been at the very top of the agenda.

EurEau's Committee on Economic and Legal Affairs focuses on the costs and governance of drinking and waste water. It is chaired by Carl-Emil Larsen, with Susanne Vansgaard as Committee Coordinator. The committee is supported by two working groups and their chairs: Regulation and Governance (Per Seeliger, ErftVerband, Germany); and Economics (David Berman, FP2E, France). The 60 members in the committee encompass professionals such as lawyers, directors of utilities/ operators and advisers.

The Committee's main working topics are water pricing, managing long term assets, increasing the public understanding of the water sector and the realisation of the right to water and sanitation.

We work hard to create awareness and visibility of our views in regard to both cost recovery and affordability. This contributes to the work that needs to be done in cooperation with the service operators, members of EurEau and the authorities. In EurEau, we are conscious that there is still much to be done in creating awareness and visibility.

In EU countries, decreasing water consumption means lower bills for the customer but falling revenue for operators.

Economic aspects in the water sector

Economic aspects of the drinking water and waste water services have always been interlinked. Article 9 of the EU Water Framework Directive (WFD) demands that EU Member States shall take account of the principle of cost recovery in regard to drinking and waste water services. Implementing this directive resulted in comprehensive discussions, which are still ongoing. The European Commission is to review this ambitious directive.

The human right to water and sanitation as formulated by the UN means that the service must be available, accessible, affordable, acceptable and safe. This message is also important for the Right2Water campaign from 2014, which was signed by almost 1.9 million EU citizens.

In general, national authorities and economic regulators have increased pressure on water operators to be more efficient. This means that service providers' performance and water tariffs are on the national and local agendas. At the same time, there is a trend towards decreasing water consumption per capita over time – an important fact, particularly when we take into account that most of a water operator's cost component is represented by fixed costs (assets), ranging from 60-80% of total financial outlay.

In many Members States, there is a risk of reduced revenue from decreasing consumption, as reflected in water bills. This means that operators

Costs to the customer should include the financing of long term investments, which shares the benefits between current and future generations.

have less money to reinvest in their infrastructure. Furthermore, organisations such as the European Investment Bank and the European Commission, which have contributed to investment financing through loans and grants, are evaluating their programmes in relation to the water sector. This is an issue of special interest for Members States where the recovery of costs are not financed by consumers and national taxes.

Tariffs and affordability

One of the main areas we work on is the human right to water and sanitation. In order to strike a balance between availability and affordability, pricing policies and affordability mechanisms play a fundamental role. In countries where these mechanisms are needed, EurEau recommends using social policy measures targeting persons facing affordability problems.

Pricing is an important issue. An artificially low level of water prices would lead to the depletion of water resources and fail to secure investments in infrastructure maintenance, leaving a heavy burden of investment for future generations.

Keeping tariffs artificially low would generate a vicious cycle of underfunded services, inadequate investment and ageing infrastructure. The quality of water services would decrease and future users will not be able to enjoy the same level of quality at a similar degree of affordability.

This should be considered in the context of decreasing water consumption that entails a risk of reduced income for water service providers. It may constitute an identifiable risk to the sustainability of the European water services. So, in the view of EurEau, the focus of the political debate should be broad and refer to the sustainability of water services as required by EU directives and national legislation, leaving affordability considerations to be addressed by social policy instruments at national level.

Water tariffs and the Cost-Recovery Principle

Setting water tariffs is the responsibility of national and local authorities. However, the European Court of Justice indicated that Member States may, subject to certain conditions, opt not to proceed with the recovery of costs for a given water use activity, where this does not compromise the purposes and the achievement of the objectives of that directive.

This could lead to a scenario where Member States decide to levy either low or no domestic water charges or fund service providers solely or largely through central government subvention. Under such a scenario, the need of the water services for a long term, stable and reliable income in order to allow them to raise funds for investment would be undermined.

The users of water services must be charged the full cost of the service thus allowing the costs to be recovered and let water bills finance investment in water infrastructure, ensuring adequate funding for the water service provider.

Costs to be recovered from consumers should include depreciation, renewal and maintenance costs, as well as the cost of financing long term investments so that benefits are shared between current and future generations in a sustainable manner. The revenue which service providers receive needs to cover the totality of these costs, be it received from customers, various water users or governmental organisations.

The charges should be set on the basis of the investment needs of the water infrastructure. Further, water and waste water service providers are subject to strict regulation, since they render their services in a monopoly regime.

There may be a need for the Cost-Recovery Principle, which is currently stated in the WFD, to be further strengthened in the upcoming revision of the legislation. Any review should take into account the '3Ts' methodology, bringing together tariffs, taxes and transfers. The 3Ts represent a powerful tool in unlocking our understanding of fund sources.

Focus in the near future

EurEau endeavours to make policymakers aware of the need for investment. We will also increase transparency to the benefit of consumers, owners of utilities/providers, authorities and politicians on local, national and European levels.

National perspectives

The Gavleån River runs through the Swedish city Gävle; in the lower part of the river, you will find salmon and sea trout, making it a popular spot for fishing. **Credit:** Catherina Eriksen

Liquid assets

Education and training are a vital element of the Austrian water sector, improving the quality of the service

By Anna Pomassl, Drinking Water Expert, ÖVGW and Clemens Steidl, Head of Waste Water Management, ÖWAV

Austria has two associations in the water service sector: the Austrian Association for Gas and Water (ÖVGW) and the Austrian Water and Waste Management Association (ÖWAV).

ÖVGW has a long history. Founded in 1881, this non-profit organisation represents Austrian water supply industries and their associated sectors. Its core concern is ensuring that research and development in gas and water supply remain at the cutting edge of science and technology. Currently, 250 drinking water utility operators are members of ÖVGW.

ÖVGW is the sole association for the Austrian drinking water sector, representing the interests of the water supply sector.

Among its many tasks, ÖVGW compiles rules and guidelines for the gas and water sectors. As a platform for information sharing, ÖVGW communicates the work of water utility operators and raises awareness for drinking water related issues among the public.

Furthermore, ÖVGW supports research and development projects in collaboration with research departments and universities and offers certification of persons and products as well as further education and training.

With more than 2.000 member organisations, ÖWAV represents the entire Austrian water and waste management sector.

ÖWAV is a non-profit organisation and is, therefore, considered as an 'independent counsellor' with the goal of achieving sustainable water, waste water and waste management objectives in Austria.

The main objectives of ÖWAV are qualification and quality management in water and waste management and the balance of information and interests, both internally and externally.

A glimpse of drinking water supply in Austria

Austria is rich in high quality drinking water resources, with 50% coming from groundwater and 50% from springwater resources. Surface water is not used as a drinking water resource.

Austria's drinking water sector is heterogeneous, with more than 5.000 small-scale water utilities providing essentially untreated drinking water to 7 million centrally supplied inhabitants (90% of the population). The remaining 10% are off the main grid (self-supplied).

The majority of drinking water suppliers are local municipalities (69%). Ten per cent of drinking water utilities are run by water cooperations and another 11% are managed by water unions.

Austrian drinking water suppliers regularly monitor drinking water quality and operations.

Administration

National and federal state levels are responsible for drinking water and waste water-related issues. At the national level, the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management is responsible for environmental regulations, while the Ministry of Health monitors drinking water quality.

The nine federal state governments grant water permits and are responsible for the technical inspection of water utilities. There is no water regulator in Austria.

Legal situation

Austria joined the European Union in 1995, therefore adopting EU legislation. Austria transposed the EU Drinking Water Directive in 1998, which regulates drinking water quality, amending the Austrian Drinking Water Act.

Unlike many European nations, Austria doesn't use surface water for its drinking water; half of its supply is from groundwater and the rest is from natural springs.

In 2000, the EU Water Framework Directive was also transposed into the Austrian Water Act, regulating technical requirements, water permits and the protection of the country's water resources.

The EU Drinking Water Directive defines standards for water for human consumption (drinking water), which must not be undermined by national legislation. However, Member States may define national standards, which supplement EU standards.

Austrian authorities took advantage of the opportunity to include a passage requiring that personnel operating drinking water utilities were to be specially educated and trained in water supplying technical matters and hygiene in order to safeguard proper management and safe drinking water quality.

Education and training programmes for personnel in the drinking water sector

Until 1970, when ÖVGW launched its first seminars for drinking water utility operators, there was no dedicated education and training programme. Thus, ÖVGW seminars for 'water masters' was the first programme of its kind to educate and train drinking water utility personnel.

From 1971-73, 140 people passed the water master exam, a prerequisite to call themselves 'water master'. Back then, the course book had 24 chapters with 300 pages.

Anticipating the need from its members, mostly very small-scale water suppliers, ÖVGW introduced another education programme for small water utilities – the 'water guard' – in 1973. At that time, the course book contained 110 pages. In 1979, the education programme for water masters was

Hauptkläranlage is Vienna's major waste water treatment plant in the low-lying district of Simmering. Much of Vienna's sewage system uses gentle gradients, so little pumping is required to get the waste to its destination.

developed further, introducing training courses with lecturers who had practical experience: microbiologists, chemists and other water utility operators.

With more than 20 years' experience in training water masters, ÖVGW decided to apply for accreditation at the Austrian accreditation authority, the Ministry of Economics, to certify personnel according to EN ISO 17024 in 1999. External auditors regularly confirm that ÖVGW fulfils the requirements.

In total, ÖVGW offers three types of education and training programmes. These are:

1. Basic training courses that take one day, providing general knowledge about the technical background and documentation duties of water quality and addressing operators of suppliers of less than 10m3 per day.
2. Water guard courses, customised for utility operators providing more than 10m3, lasting for three days.
3. Five-day water master courses, with lectures on water quality, water treatment, construction, engineering and management, and tailored for water operators that provide over 100m3 per day. ÖVGW is accredited to offer water master courses and to grant certificates.

Every education programme is customised to the needs of its target group, reflecting different organisational structures and levels of complexity of water distribution systems.

Education and training of water masters at ÖVGW

ÖVGW guideline W10 describes the conditions for the examination of water masters for obtaining a water master certificate, according to EN ISO 17024. It comprises requirements for candidates, auditors, exams, training and continuous training.

ÖVGW's education and training committee is responsible for the coursebook and its contents. The coursebook summarises all relevant up-to-date information, relevant legal requirements, rules, guidelines and standards. The coursebook is under permanent review and regularly updated in accordance with the relevant authorities. The trainers must have many years of professional experience in the drinking water sector.

In order to receive the water master certificate, applicants have to pass a written exam at the end of the five-day course. The exam is valid for five years. Water masters can prolong the certificate for five more years if they have continuous training within the period of validity and pass an exam for prolongation.

ÖVGW's event department organises water master courses. Its varied tasks range from registration and training schedules to billing.

ÖVGW's certification department keeps a record of water masters, information on continuous training, results of exams and the expiration dates of certificates. The number of educated personnel in the drinking water sector has been rising ever since. In November 2016, there were 1.985 certified water masters.

In 2002, the Austrian Ministry of Health acknowledged that ÖVGW education and training programmes are in accordance with the requirements of the Austrian Drinking Water Act. However, water masters are not an individual professional category according to commercial law.

ÖVGW has all the relevant up-to-date information on standards, legal requirements, state-of-the-art technologies

and direct feedback on professional experiences. This enables ÖVGW to offer high quality education and training programmes for water utility operators and professionals in the drinking water sector.

Therefore, well-trained and highly educated personnel in water utility companies help to improve the quality of service, hence contributing to the high standards and excellent drinking water quality.

Training in waste water system management at ÖWAV

The apprenticeship as a skilled worker in sewage management is divided into two main working areas:

- A technician working at waste water treatment plants.
- A sewer system operator.

The training for both of these takes place over a period of three years.

Waste water treatment technicians attend two weeks of practical training, three weeks in a basic course, one week in a laboratory course, one week in mechanical engineering, one week in electrical engineering, three days on a measurement technology course and one week in an advanced course in current issues before they sit an exam.

Sewer system operators attend one week of practical training, a one week basic course, three days in a sewer cleaning course, one week on a survey and restoration course, one week on an operational management and maintenance course, a one week electrical engineering course and an advanced course in current issues before they sit an exam.

The waste water treatment technicians and the sewer operator are able to manage waste water treatment plants and sewer systems by the end of their training. They are also able to maintain and service machinery, evaluate and report breakdowns, perform minor repairs, evaluate safety, health and hygiene issues on the factory premises, handle treatment, reutilisation or removal of accumulating waste materials, and document and monitor performed measurements and operations.

Above all, the technician learns all aspects on the proper and efficient operational management of a waste water treatment plant or sewer system. In order to provide a comprehensive and practice-oriented advanced training apart from the basic training, a Neighbourhood of Waste Water Treatment Plant and Sewer System Operators Network was established. Here, participants receive substantial information, technical literature and necessary working aids.

Conclusion

ÖVGW and ÖWAV are long-established associations in the water service sector. When it comes to professional training for personnel in drinking and waste water services, fostering knowledge and expertise is the main aim, not commercial motives. Both associations are non-profit organisations working mostly in an honorary capacity.

Education and training are an essential element of the Austrian water setup. Know-how and experience are seen as a prerequisite for high-quality services in the water service sector. In general, the water supply and sanitation staff in Austria are highly qualified and staff turnover is generally low.

Knowledge and expertise are the primary aims of the Austrian water sector. Supply and sanitation staff are rigorously trained, leading to a superior product.

Revenue drains

Falling water consumption in many parts of Western Europe is impacting the business model of water suppliers. How do we deal with this drop in revenue?

By Cédric Prevedello, Scientific Advisor, Aquawal on behalf of Belgaqua

Why is the demand for drinking water decreasing? Evidence shows that in Europe, but more acutely in Western Europe, drinking water consumption per capita is falling.

This is also the case in Belgium, where consumption per capita is reducing each year at an annual average rate of 1–1.5% (*Figure 1*).

Even if demographic growth means that overall demand should be increasing, it is not enough to maintain the sales from year to year.

There are two main reasons behind this decline in water consumption in Belgium.

1. *More efficient devices*

   The fall in demand is linked with more water-efficient domestic appliances such as washing machines, dishwashers and toilets.

2. *Changes in economic activity*

   The shift in the economy from secondary to tertiary activities, reinforced by the recent global economic crises, means that industries in Western Europe, especially, are using less and less water.

The evolution of the price of water is often mentioned as having a high potential impact on water consumption. While it is true that the overall price of drinking water is increasing in most countries, there is no evidence that the overall price increase per cubic metre explains the fall in demand, as price elasticity for water is usually very low.

Water stress across Europe

Generally, Europe has adequate water resources, although significant differences exist between regions. Indeed, if we look at the state of water resources in Western Europe, only 7.1% of groundwater bodies are of poor quantitative status.

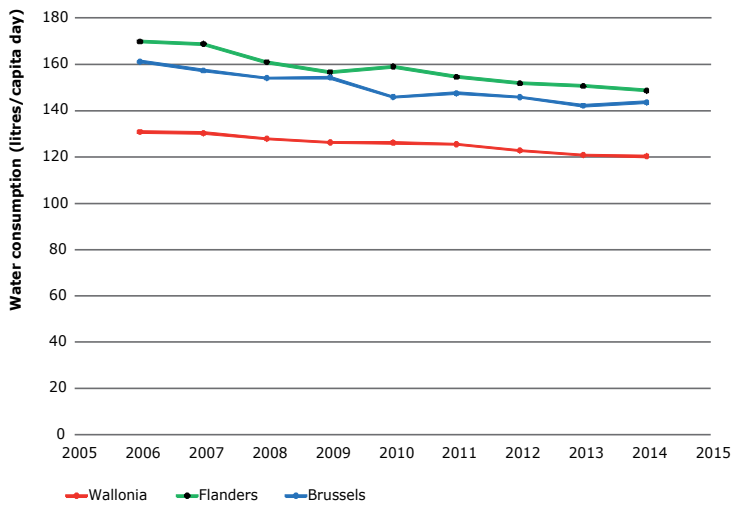
Nonetheless, water scarcity and drought are an increasingly frequent and widespread phenomena, with demand for water sometimes exceeding resources. Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of freshwater resources in terms of quantity (aquifer over-exploitation, dry rivers, etc).

The recent update of the indicator for water stress (Water Exploitation Index Plus, or WEI+), published by the European Environment Agency, shows that, at river basin level, the highest stress levels are found in the Mediterranean region during spring and summer.

For the rest of the year this region, and the rest of the EU generally, uses less than 10% of the annual renewable amount of water in the catchment areas of its river basins. If we take a deeper look at these figures, we can see that agriculture is by far

▼ Figure 1.

Evolution of water consumption in Belgium for all uses (household, industrial, agriculture), 2006-14



Sources: Aquawal, Belgaqua, Hydrobru, VMM, Statbel

the greatest user of water and, therefore, largely responsible for high water stress in the Mediterranean region. Abstraction by agriculture also explains the inter-seasonal variability of this index. As shown by these figures, public water supply does not impact heavily on the quantitative status of water bodies.

Impacts of lower water consumption

In many countries that apply the full Cost-Recovery Principle – among them Belgium – water sales are the only way to recover costs and to gather funds in order to invest in infrastructure. Water pricing schemes usually tend to incorporate a high variable part. This is to incentivise water savings as stipulated by European directives. These pricing schemes are contrary to the cost structure of water services. Indeed, about 80% of the cost of service provision is related to infrastructure and services and, therefore, only about 20% of the total cost is related to the quantity of water delivered.

As water consumption declines, so does the income of water suppliers, while costs do not reduce accordingly.

To compensate for this, operators have three solutions:

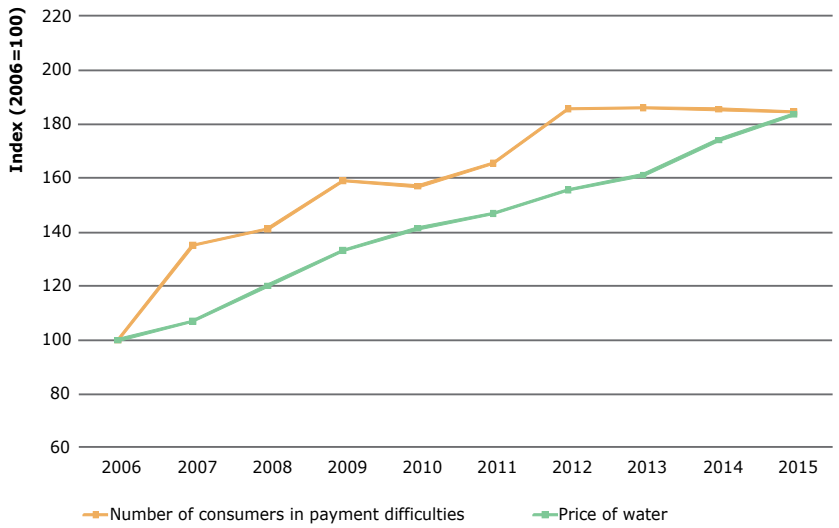
- Increase the price of water.
- Reduce the amount invested in infrastructure.
- Or a combination of both.

The first solution is not popular among users and often operators are not free to set water prices as a lot of countries have economic regulations regarding the price of water. Added to this, consumers are very critical about price increases. Water operators must explain clearly why these increases happen, especially when the product and the service remain unchanged.

The second solution is not sustainable as it creates a hidden debt for future generations. The lack of investment in the public network has a negative impact on the economy due to

With less revenue from bills, many providers limit price increases while reducing investment in the network. This could lead to increased investment costs down the line.

Comparative evolution of the price of water and payment difficulties in Wallonia (2006-15)



Source: Aquawal

Figure 2.

As the price increases, affordability is lowered, giving birth to a vicious circle, reducing the efficiency of water services and again affordability, especially for households.

Mitigating the negative consequences of reducing water consumption

Operators, aware of these problems and of the fact that this decline will probably go on for many years, try to mitigate the consequences of the drop in consumption.

One of the solutions is to make all policymakers aware of these consequences, which are not usually well-known by them, though it is a major preoccupation of water utilities.

jobs not being created and missed economic growth. It can also be counterproductive to water saving efforts because this underinvestment can result in more leakages and/or a deteriorated service.

Water service providers need a long term vision on their investment needs. Water pipes or sewers usually last for several decades and utilities tend to strive for a 1% annual renewal rate.

When faced with reduced revenues and increasing costs, water operators tend to opt for the third solution, i.e. combining both approaches by limiting price increases and reducing investment. This has two consequences: a higher price for today and higher investment costs in the future.

But the main problem of increasing water bills is that more consumers have difficulty in paying them. This is particularly the case in southern Belgium where the difficulty in paying for water is, in the long term, directly proportional to the mean price of water (*Figure 2*). The latter, as previously demonstrated, being negatively correlated with the consumption level.

Affordability can then be hampered by this consumption decrease, leading to less efficient water services. Indeed, more payment difficulties means more costs for operators, and more costs also put a stress on the price of water that must then be increased in turn in order to balance the budget.

There is an urgent need for water service companies to revisit their business and pricing models. Consumers should be made aware of the reasons for price rises.

Another measure that can be taken is to adopt a pricing scheme which has a larger fixed component, as is the case, for instance, in Switzerland, making it more in line with the cost structure of water and waste water services. The counterpart of this is that the volumetric price of water will be less dependent on the level of consumption, therefore reducing the negative impact of the drop of demand on water prices.

Regarding affordability issues, water operators have implemented various systems in order to address the problems that can be encountered for a small part of the population, such as solidarity funds, discounts for some categories of the population or reduced prices for a quantity of cubic metres.

Consumers may be more open to price changes if they are included in the decision, through, for example, having consumers on water management boards. Consumers are also included in economic regulatory bodies or advisory councils.

Conclusions

Generally, water consumption reduction is a good thing when it comes to saving energy and making the best use of our scarce water resources. However, we, like other EurEau members, would like to draw attention to the imperative need for a careful analysis of economic and social impacts and its potential effect on the sustainability of the level of services.

It is clear that water service providers have to adjust their business and pricing models. Consumers must be included in the decision-making process. Belgian, as well as other European, operators are in favour of a pricing scheme that has a higher fixed price component. This can ensure the long term planning of investments while reducing the risk of lacking the necessary funds to reach this goal.

Finally, water saving measures should be applied according to the local conditions and take into account the availability of water as well as considering a holistic approach, including all water users.

With climate change comes water scarcity, although for much of Europe, less than 10% of the yearly renewable amount of water in catchment areas is used.

Road to reform

Improvements in the Bulgarian water supply and sanitation sector are under way. However, more investment and further EU assistance is still required

By Ivan Ivanov, President, Bulgarian Water Association

The reform of the Bulgarian water supply and sanitation (WSS) sector has been an issue since the mid 1990s. The reform itself was partially prepared by different governments over the years but for one reason or another, aside from separate timid steps, it did not start properly.

One of these steps included establishing a water regulator as part of the energy regulatory body, which failed to bring results. The real changes were set in motion by the World Bank when they proposed a strategy for the development and management of water supply and sanitation in Bulgaria, approved in 2014. We expect this will lead to a financially, technically and environmentally sustainable WSS sector that provides high quality WSS services at tariffs affordable to customers.

Current condition of the WSS sector

There are 51 WSS operators in Bulgaria. These hold, maintain and operate the WSS systems and facilities and provide WSS services to customers against payment. Fourteen operators are 100% state owned, 15 have mixed municipal and state ownership, 21 are 100% municipally owned and one operator, Sofiyska Voda JSC, is a public-private partnership with predominantly private ownership.

A more precise report shows that a total of 64 companies are registered as WSS operators, including some small private companies that provide services to a limited number of customers and/or hold WSS facilities.

According to a report by the Energy and Water Regulatory Commission (the Bulgarian regulator), WSS operators belong to four groups: big ones (eight), which service populations exceeding 220.000 people and whose annual revenues exceed €10m; average-sized ones (20), with 75.000 people serviced and annual revenues of between €2.5m-€10m; small ones (14), which service a population between 18.000-75.000 people and have annual revenues between €200.000-€2.5m; and micro ones (9), which service fewer than 18.000 residents.

As a whole, Bulgaria's WSS sector is inefficient when compared to its European peers: water losses are higher than in other EU countries, staff productivity is lower and the frequency of failure is among the highest. According to data from the National Statistical Institute, water losses, both technical and commercial, exceed 60% and for some WSS operators they are even up to 80%.

Capital investments in the sector are below the level needed to maintain the existing infrastructure. EU grants are the main source of funding and they are predominantly focused on constructing sewage and waste water treatment plants and not so much on WSS network maintenance. The length of the supply network is over 70.000km, which supplies water to 99% of the population.

In the meantime, the average age of water supply networks exceeds 35 years. Calculations show that in order to maintain them in their current condition, €332m will be needed per year. In other words, over €1.5bn is needed just for the maintenance of water supply networks over a five-year period. It can be concluded that the investment in network maintenance over the last few years was grossly insufficient.

Apart from maintenance, investment is needed to modernise water supply systems and improve their efficiency, as well as to construct drainage and waste water treatment systems in order to comply with the Urban Waste Water Treatment Directive. Bulgaria has unfulfilled commitments as per the Treaty for Accession to the European Union, namely regarding the provision of waste water drainage

and treatment for agglomerations of over 10.000 equivalent residents by the end of 2010 and for agglomerations of between 2.000 and 10.000 equivalent residents by the end of 2014. The financial resources needed to align sewage and waste water treatment facilities to the EU requirements are estimated at €3.6bn.

In Bulgaria, the average age of the supply network is 35 years old; it is thought that over €1.5bn is needed for supply maintenance over the next five years. Recent investment has been too low.

Reforms, objectives and principles

The sector's situation clearly justifies the need for a reliable financial plan for the short, mid and long term. The implementation of such a plan could only be ensured by carrying out deep reforms – a combination of measures and practices – which would result in specific amendments to the legislative and institutional framework and would enable the WWS operators to be direct beneficiaries of EU grants.

These would also improve the WSS operator's possibilities for co-funding capital investment, including investment in WSS infrastructure, which is a public state and public municipal property. Review of the current dividend policy is needed in order to allow profit to remain in the companies and be used for re-investing, increased tariff revenues and developing the regulator's capacity.

The reform's leading principles are:

- *Financial sustainability*: providing sufficient and timely resources for the funding of the sector's investment plan.
- *Efficiency*: optimising policies and practices to achieve compliance and the cost-effective meeting of objectives.
- *Affordability*: resolving the issues related to tariff affordability through suitable social policies.
- *Predictability*: WSS operators and the water regulator working together to achieve the sector's main objectives.
- *Transparency*: publishing data about the condition of the WSS sector and a comparative analysis of the WSS operators' activity in order to encourage sustainable WSS practices.
- *Competitiveness and economies of scale*: consolidation of, and introducing benchmarking of, WSS operators to enhance efficiency and service quality.

Main themes of the reform

Lists of assets

The information about existing assets was incomplete when the reform commenced and remains so today. Most of the assets were constructed by the WSS operators and are included in their accounting balance sheets, but there are also assets constructed by the municipalities, the state or third parties, some of which have never been registered. Operators do not keep complete records on the changes made on assets as a result of emergency or scheduled capital investment activities.

The reform envisages preparing complete lists of all known assets and transforming them into public property – municipal or state, depending on each asset's scope of application. Thus, assets, for instance water mains, which service more than one municipality, become state assets and all others are public municipal assets. It is supposed that the process of asset inventory in order to transfer them to their new owners will, in itself, improve the WSS operators' assets databases.

New sector contractual framework: Municipal WSS Association (MWSSA) – WSS operators

Once they own all WSS assets, the municipalities should determine who will manage their day-to-day operation and

Inefficiency is a problem for the Bulgarian water supply and sanitation sector. Compared to other European nations, staff productivity is low and water losses in the system high. Reform will bring competitiveness.

maintenance. To avoid system disruptions, the reform envisages that the municipalities within a territory on which currently existing operators perform their activities (so-called designated territory) should be united in a MWSSA. The state is also involved, holding 33% of the MWSSA.

The associations are to take decisions on working with the currently existing operators, by means of direct negotiation, 15-year contracts for the maintenance and operation of WSS systems and facilities. These contracts set the rights and obligations of the WSS operators. Their obligations include the implementation of an investment programme of a given amount and meeting specific key performance indicator levels.

Attracting investment

It is believed that operators which service bigger populations are more viable, more effective and more capable of attracting loan capital for investments.

Therefore, the reform plans for the MWSSA to comprise all municipalities within an administrative region in Bulgaria (a total of 28), and thus each region should have one MWSSA and one WSS operator.

Failure of the business plan

State water regulations were introduced in 2007. The business plans approved by the Energy and Water Regulatory Commission were impossible to carry out due to the absolute discrepancy between the WSS tariffs and the objectives set.

The business planning process envisaged the preparation and approval of a five year business plan with a specific investment programme and indicative objectives, followed by an independent process of tariff approval based on models that failed to take into consideration the funds needed to fulfil investment intentions.

The reform envisages a change to the legislation so as to ensure a direct link between investments and the WSS operators' revenues, by guaranteeing a social affordability threshold for prices. An important new element of the tariff is the recognised admissible depreciation of public assets used by the operator. These measures should be combined with enhancing the regulator's capacity and resource security.

Prioritising needs

Individual investments without clearly defined priorities and a systematic approach do not result in the improvements expected. In view of the scarce resources and big needs of the sector, it is essential to determine the most critical needs and focus investments on them.

Therefore, the reform envisages starting with the preparation of regional master plans and their subsequent development into regional feasibility studies.

Implementation and difficulties encountered

The reform, including the thematic areas listed previously and their accompanying measures, was set as a preceding condition for the provision of funds under the Operational Programme Environment 2014–2020. This poses a risk for our country of failing to receive the funds approved under this programme, but on the other hand, it is a strong driver for the new government to bring the reforms to an end.

Many of the measures planned should have been completed by the end of 2016, so at the time of writing, it is not possible to make a confident summary of the actual implementation and the difficulties encountered.

Ownership of WSS assets

With the joint efforts of the state, the municipalities and the WSS operators, the lists of known WSS assets were prepared and submitted to the Ministry of Regional Development and Public Works, to be registered as public ones.

Once again it was confirmed that there are many operational assets for which no documentation has been provided, which makes them assets of an unclear status, and even illegal ones.

The lack of a solution to the specific method of taking assets off the WSS operators' balance sheets even now makes them face the risk of an accounting loss or excess profit. Some WSS operators have taken public assets off their balance sheets and others have not, waiting for more specific instructions.

Making all WSS assets public is regarded by many stakeholders as the first step towards sector concessions, which is not perceived well by all, and it may lead to issues preventing EU funding.

New sector contractual framework

Contracts between the MWSSA and the WSS operators were signed everywhere. However, they pose two main questions for WSS operators: how realistic and feasible are they?, and how will the relations between the MWSSA and the regulator be governed in case of discrepancies between the contract and the five year business plans?

The contracts signed were prepared and proposed by the main owner of WSS assets, the MRDPW, without engaging in detailed discussions with the operators and the regulator. They follow a universal logic and are based on the expert assessment of the respective WSS operator's investment capabilities. As a whole, they should be the basis for the five year business plans but in some cases the priorities set by the regulator do not correspond to the contractual ones.

This double regulation – contractual and centralised – may prove to be an impediment for the companies' efficient operational and investment activity.

Consolidation of WSS operators

The WSS sector consolidation proved to be the biggest challenge for the reform. Most municipalities which own WSS operators refused to transfer their WSS activity to the big WSS operators despite the direct threat that in this case the entire administrative region to which they belong will not be funded under the Operational Programme Environment 2014-2020. In some cases, where companies performed well, this was expected, but in the case of others it was surprising. Reasons may include an incorrect communication strategy, a lack of clarity about the future of the companies affected and their staff, or political and other motivations.

Reform at the regulators

The legislation was amended with operational price models and procedures for preparing and approving the five year business plans. This, of course, needs to be proven by their practical application. There are fears that because of the short deadlines for preparation and review of business plans, these documents will not be the best possible. During preparation, substantial changes occur in the operator's expenses and the procedure provides no possibilities for accommodating them. The measures and investment envisaged lead to an increase of WSS service tariffs (30% on average) as early as the first year, which will be hard for customers to accept. For some WSS operators, the tariffs exceed the social affordability threshold.

The regulator's expert capacity is improving, but the available financial resources are insufficient for a detailed review of all WSS operators' five year business plans.

A regional approach to investment planning

Regional master plans were prepared but based on incomplete and not fully verified information. They demonstrated the need for investment whose amount exceeded expectations.

Preparation of feasibility studies for 16 administrative regions with single WSS operators is under way. This will delay the implementation of investments until after 2018.

Conclusion

The Bulgarian WSS sector made a decisive move to implement a reform that will ensure greater investment, its efficient implementation and a higher quality of the services provided. The reform is being applied based on a precisely prepared, widely debated and officially approved strategic framework.

The difficulties encountered in the reform's implementation are mainly related to the lack of preliminary analysis of the measures accompanying the reaching of strategic objectives, which is used as grounds among critical circles to raise issues regarding review of some of the reform's major principles.

Urgent financial needs and the reform's link to EU funding are key engines for its successful completion.

Water tariffs and affordability

The Danish water sector is determined to meet global climate goals while effectively adapting to inevitable changes in weather conditions

By Carl-Emil Larsen, CEO, Helle Katrine Andersen, Vice President and Miriam Feilberg, Senior Consultant, DANVA

An agenda for change driven by the water sector

Water utilities today face a double and mutually dependent challenge of adapting to inevitable climate change and at the same time acting responsibly to demands from society by reducing greenhouse gas emissions wherever possible.

To fulfil this double agenda, the Danes are among the global frontrunners in the water sector when it comes to strengthening resilience towards urban climate change and at the same time contributing to overall carbon neutrality within the sector.

The water sector's climate vision: reduce emissions and improve resilience

DANVA, the Danish Water and Waste Water Association, has, for some time, favoured an active engagement in combating climate change problems from Danish utilities and the water sector.

As early as 2009, DANVA adopted a vision for proactive climate change adaptation that deals with both elements of climate change:

- Solutions for reducing greenhouse gas emissions in the water sector.
- Adaptive measures minimising the consequences of climate change in the sector.

Our vision foresees provisions for the sustainable funding of interventions and the need for a clear distribution of roles and responsibilities.

Both elements were later included in the general Danish Water Vision 2025, covering the entire Danish water sector. It was adopted in 2015 by key water stakeholders in Denmark as a joint vision for the sector towards 2025.

Denmark's largest waste water treatment site is BIOFOS at Lynetten, Copenhagen. It is one of the world's most energy-efficient plants of its kind.

A national Water Vision

The Water Vision paper has a strong focus on innovation and the promotion of growth within the water sector combined with environmental responsibility such as: "Danish water solutions deliver liveability for the people and the planet. We aim at turning global challenges into possibilities for sustainable growth." The focus on reducing greenhouse gas emissions was a key element in DANVA's climate vision and became an objective for the water sector in general with the aim of ensuring that Danish water utilities in the future will be net energy producers and carbon neutral in a way that will contribute to reducing both greenhouse gas emissions and prices for water distribution and sewage treatment.

Reducing energy consumption in the water sector as an element in the strategy for carbon neutrality in Copenhagen

The water companies' active engagement in the climate change agenda is best demonstrated with a case from the Greater Copenhagen Utility, the largest water utility in Denmark. It supplies water to one in five Danes, more than a million customers in Greater Copenhagen. Greater Copenhagen Utility also manages storm water, sewage water discharge and installs wind turbines to produce climate friendly energy to the city. Furthermore, it supplies district heating and cooling to consumers in the Greater Copenhagen area.

The Greater Copenhagen Utility is owned by eight municipalities in and around Copenhagen. One of them, the Municipality of Copenhagen, has developed a Climate Plan to provide the framework for the city's climate change activities.

The Climate Plan was prepared prior to COP 15, the climate change conference in Copenhagen in 2009, and sets out ambitious targets for the mitigation of climate change.

The target is: in 2025, Copenhagen will be the first capital city in the world to be CO2 neutral. The main focus is to make energy production carbon neutral, to reduce energy consumption and promote bicycling and public transportation overall as a way to reduce emissions.

If Copenhagen is to become carbon neutral in 2025, the water sector needs to contribute and the Greater Copenhagen Utility is an engaged stakeholder in this field.

As a multipurpose utility, Greater Copenhagen Utility covers 98% of heating requirements in Copenhagen and out of this, 46% is carbon neutral district heating. The energy comes from various sources including solar panels built on the utility's premises and newly constructed wind turbines. These are now able to deliver the equivalent of the entire municipal government's electricity needs and will, in the future, contribute even more to fulfilling the vision of carbon neutrality by 2025.

Within water supply, there is a solid focus on energy saving throughout the organisation and beyond as the utility provides information to guide consumers in saving water. Greater Copenhagen Utility invests significantly in new pipelines, plants and equipment to this aim.

Denmark has set a target of no more than 10% losses in the water distribution networks and there is a fine for leakage rates above this. In Copenhagen, the leakage rate in the water distribution networks is around 7%. This is one of the elements in reducing energy consumption, as a loss of water in the distribution networks is also a waste of energy used in the production and pumping of water.

Energy production at waste water treatment plants

Another key stakeholder in the Copenhagen area is BIOFOS, the waste water treatment company of Copenhagen. BIOFOS operates the largest waste water treatment plant in Denmark and treats the waste water of 1.2 million people living in the Greater Copenhagen area at three treatment plants.

Being keen to contribute to Copenhagen's climate targets and the circular economy, BIOFOS has invested significantly in the development of new technologies. The purpose is to reuse and recover resources from waste water and use these to produce electricity, biogas and district heating.

BIOFOS has set ambitious targets:

- All residual products from core treatment processes will be recycled or made use of from 2025.
- BIOFOS as a whole to be carbon neutral by 2025.
- BIOFOS as a whole to be net energy producing by 2025.
- All planning, coordination, management and operation of rain and waste water management is considered as one cohesive system throughout the entire BIOFOS catchment area by 2025.

In Copenhagen, we are already seeing results as we work to achieve carbon neutrality:

- Greater Copenhagen Utility has reduced its energy consumption by 25%.

~ The energy balance of BIOFOS in 2015 was plus 27,369 MWh or 150% net energy surplus in all BIOFOS's field of operations. This was based on energy produced from waste water. The initial target has thus been achieved and BIOFOS will now set a new target for energy production.

Similar results in the reduction of greenhouse gas emissions and an increase in energy production can be seen in other cities in Denmark such as Aarhus, Odense and Billund.

The Ministry of Environment and Food of Denmark reports that energy consumption in the water sector has declined by more than 20% over the last five years. The sector as a whole has gone from producing 12% of the energy it consumes to 27% today. The Ministry estimates that a net energy producing water sector in Denmark is possible without compromising environmental standards.

Water sector impacts on climate change

Around 8% of the greenhouse gas emissions from the total industry sector are related to waste water treatment. This has been recognised by the EU as significant and relevant for the EU's reduction targets alongside solid waste management and the open burning of waste.

Raising new forests contributes positively to climate change mitigation by carbon storage and is listed among EU reduction targets under land use. When groundwater protection is carried out through afforestation, as we see in cities like Odense and Skanderborg, where utilities help raise new forest areas, it contributes to climate change mitigation while providing recreational areas for citizens.

Greenhouse gases include conventional greenhouse gases such as carbon dioxide and methane. Nitrous oxide is emitted from waste water treatment plants and is a powerful greenhouse gas, which at the same time contributes to the depletion of the ozone layer. It is estimated that about 14% of global greenhouse gas emissions are caused by nitrous oxide from various sources including waste water treatment plants. This is also an important area for Danish utilities to pay attention to.

Resilience and climate change adaptation

Denmark has, like many other European countries, experienced the impact of climate change in the form of frequent heavy rain and cloudbursts. It is not enough to reduce greenhouse gas emissions. We need to improve resilience and the ability to cope with the changing climate. With this aim, the Danish government in 2012 took the first steps towards improved planning and management of climate change adaptation in Danish cities.

Key elements in this process include improved legislation, new rules on funding, improved planning framework and better cooperation among stakeholders. Securing a clearer distribution of roles and responsibilities within the Danish water sector has been an important starting point for the development of climate change adaptation plans.

Danish water utilities are responsible for storm water management, flood prevention and the implementation of climate change adaptation measures in urban areas related to water management. The utility is responsible for water management on public land and runoff from private property that is connected to the sewer system.

Municipalities are responsible for improving urban areas and improving liveability, whereas private landowners have to protect their own buildings, including the financing of these measures.

Climate change adaptation plans are the responsibility of the municipality but in practice they are developed in close cooperation with utilities. The climate change adaptation plans are based on the mapping of property values and risks. This risk mapping is the basis for a prioritisation of adaptation measures within the municipalities.

Costs and benefits of improved resilience

Funding for climate change adaptation is costly and has to be implemented over a long period. Copenhagen experienced a severe cloudburst in July 2011 with 150mm of rain in two hours, causing close to €1bn in damage to property.

As a response to this destructive cloudburst, Copenhagen prepared a Cloudburst Management Plan in close collaboration with HOFOR, the utility of Greater Copenhagen. Based on a cost benefit analysis, this plan describes 300 projects in public areas with an estimated construction period of 20 years.

The Cloudburst Management Plan is expected to cost around €500m, which makes improving resilience cost-effective, but new ways to secure funding are still necessary.

Sewers and storm water management have traditionally been financed through water tariffs. Surface solutions can also

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The Sønæs park at Viborg is an example of how storm water management and urban development can work together. The site can absorb huge amounts of rainwater.

be funded through water tariffs as long as they can be distinguished clearly as having a drainage function (canals, open basins, etc).

A new element in Danish storm water management is mixed solutions that are owned, constructed and maintained by the municipality but funded through water tariffs. This funding scheme has contributed to a number of new adaptation projects all over the country but there is still a need for new and innovative ways to secure funding for new projects that are necessary and cost-efficient in a longer perspective. Many of these can contribute not only to more climate resilient cities but also to more liveable cities.

The role of the water sector in meeting global climate goals

We have come a long way in delivering results like climate change adaptation plans for municipalities, funding for adaptation measures and net energy producing waste water treatment plants. The Danish government ratified the COP 21 agreement in 2016. In the water sector we have seen, however, that action on the ground to meet climate objectives is driven by the sector itself. It has taken proactive action recently to meet the climate targets, starting from the DANVA formulated vision for a carbon neutral water sector in 2025.

Since 2009, several Danish cities and utilities have announced similar climate targets and visions and we have experienced a truly bottom-up process, where utility staff and managers are now focusing on energy and water savings in all daily activities.

The key lesson learned in Denmark is that action is a matter of leadership and a change of mindset. Utilities that aim for change and set ambitious targets generate remarkable results.

Activities by utilities and other local stakeholders need to be accompanied by the right legislative framework and a clear link between sector legislation in energy, waste and water sectors. We also see a need to pay attention to regulatory barriers to ensure that economic regulation does not slow down or stop relevant initiatives.

Finding the best fit

With a goal of sustainability by 2021, Estonia is studying its public water supply and waste water services to find its most effective operations

By Indrek Tamberg, Member of the Management Board, Keskkonnaahendused OÜ on behalf of the Estonian Waterworks Association

Since Estonia's re-independence in 1991, development and investment in the water sector has been mainly subsidy driven. In the 1990s, subsidies for water infrastructure were still small. In addition, the level of infrastructure depreciation and national legislation did not encourage any large-scale investment in the sector. However, the need for investment increased significantly over the following decade due to tightening legislation (transposition of directives following accession to the EU) and ageing infrastructure. These growing investment needs meant that the government and the EU were involved in financing the projects.

The Estonian water sector received its largest investments during the last EU funding programming period and before the EU accession (2004-13), when over €700m in subsidies was allocated from the EU Cohesion Fund and €190m in subsidies from the national Environmental Programme managing nationally collected environmental charges.

For the current EU funding programming period (2014-20), the Cohesion Fund is allocating significantly smaller funds, less than €150m, to support the water sector. The subsidies from the environmental programme also keep decreasing substantially. We must consider the fact that such amounts of subsidies from the EU and the government will end, starting from 2021.

▼ The Estonian water sector is aiming to be sustainable by 2021 without EU subsidies. A study will identify the ideal company sizes to achieve this.

Estonia's population is 1.3 million; of this, 1.1 million inhabitants are connected to the public water supply and sewage system. Approximately 200 companies provide water and sewage services. The two largest of these companies, Tallinna Vesi and Tartu Veevärk, provide services to 540.000 inhabitants, around 42% of people connected to the public water and sewage system.

The majority of the 200 water companies provide their services within very small service areas. Companies are generally owned by the local municipality and until 2005, it was typical to have one water company operating in each municipality. After 2005, the Ministry of the Environment initiated the setting up of regional water companies. This resulted in five regional companies – each administrating between three and 20 municipality areas – being established.

The aim of setting up regional companies was to make the water sector more efficient and to better coordinate the EU subsidies-based investments. These regional companies were a prerequisite for receiving EU financing. The expansion of the existing, and set up of new, regional water companies continued after the government's one-time initiative, but the number of small water companies still remains too high.

The main problem with small water companies is their lack of economic sustainability. The revenue they receive from tariffs is not enough to cover infrastructure investments. The required increase in tariffs would be so high that the customers could not afford it. Today, the water bill is 1.5% of household

income on average. However, to pay for the necessary infrastructural investments, this would have to be closer to nearly 4% in smaller service areas.

Over the last decade, large investments were made into smaller areas so that the service quality and compliance with environmental requirements would not drop immediately. However, the risk of not meeting the service quality as well as the environmental requirements will significantly increase over the long term (10+ years). At the same time, there is already a certain number of small water companies (e.g. water cooperatives) who, in fact, do not meet the environmental requirements, nor ensure sufficient service quality.

A determining factor in the Estonian water sector is the administrative reform which merges municipalities. The merging municipalities are expected to consolidate the water companies they own. In some areas, water companies are implementing administrative reform. Large companies have taken over water services in rural municipalities. When this happens, there is no significant impact on water price. Though the water price in smaller service areas is usually higher than in larger service areas, the overall price increase is compensated by optimised labour costs and equipment. At the same time, some mergers have indicated that the larger water companies take little interest in smaller ones whose service quality is below par because operating in those areas is economically unreasonable and a price increase would be inevitable. This price increase would have to be passed on to consumers.

Considering the fact that starting from 2021, the Estonian water sector should be sustainable without subsidies from the EU, the Estonian Waterworks Association is carrying out a study that will identify the water sector models and company sizes that would best suit the country. The models being considered must ensure affordable prices for providing sustainable services in the long term and provide waste water collections in areas with a low population equivalent.

The study compares various existing types of water operators. This kind of comparison gives us a good idea of what could be the most efficient model. It is obvious that companies operating only in the waste water collecting areas with over 10.000 people equivalent (pe) are more sustainable than companies operating in the waste water collecting areas with under 2.000 pe. Most probably, the optimal size for a regional water company would be one that, in the event of merging smaller waste water collecting areas with larger service areas, would not increase the price level in larger service areas by more than 10-15%.

In Estonia at present, the average water bill is 1.5% of household income. It would need to rise to 4% in some areas for infrastructural improvement.

The study also analyses various forms of water operators. To measure the alternatives, three or four of the most common types of water operators in Europe are assessed from the perspective of the national legislation and economic situation.

Today, the most common type of water operator in Estonia is a unit owned by the local municipality, which also owns the infrastructure and provides both drinking and waste water services. So the study, for example, considers alternatives where the owner of the infrastructure is an exclusive legal entity, owned by the local municipality. The municipality organises calls to find an operator to provide services for an agreed period of time. This kind of approach creates competition between water companies and abolishes their monopoly position.

The study also considers the alternative common in Nordic countries where water services are provided by the local municipality without creating a business unit for this purpose.

Once the water operator model and water company size that would best suit Estonia have been identified, respective motions to amendment will be submitted to the writer of a legislative drafting, in order to ensure incentives and legal bases for implementing the model.

Even though the study under preparation does not impose an obligation on water companies to reorganise their operations or merge, it will provide analysed results for setting up the most optimal water company and will serve as a strategy paper for developing sustainable water plants.

Holistic risk management

Approaches to safeguarding drinking water and waste water utilities, and how a web-based risk management tool has been successfully trialled

By Riina Liikanen, Osmo Seppälä and Saijariina Toivikko, Finnish Water Utilities Association; Heidi Ekholm and Mari Heinonen, Helsinki Region Environmental Services Authority; Heli Härkki, Pöyry Finland Oy; Jarkko Rapala and Raili Venäläinen, Ministry of Social Affairs and Health; and Kaisa Valkonen, The Water Protection Association of the River Kokemäenjoki

Water supply and sanitation are critical services and contribute to a safe, healthy environment and society. Many different kinds of hazards and hazardous events may adversely affect water supply and sewage operations and ultimately have an impact on our customers.

Thus, water utilities are aware of the possibility of those hazards and hazardous events occurring and they are prepared to manage the related risks accordingly.

Risks may be caused by events which the water utility cannot control, things like extreme weather conditions and vandalism, or by the utility's own operations, e.g. lack of maintenance or human error. These threats should be systematically identified and the risks related to them assessed and treated accordingly. Depending on the cause, probability and severity, the risk can be mitigated by removing or reducing it, or accepted if the required risk management actions are unrealistic.

Nonetheless, it is vital that water utilities are prepared for what to do in the case of an emergency situation, taking contingencies and alternatives into account so as to assure continued water services for their consumers.

Legal framework in Finland

In accordance with the Finnish Drinking Water Decree, the operational monitoring of drinking water supply should be based on risk assessment. The Drinking Water Decree also obliges health protection authorities to prepare plans to safeguard drinking water quality in Finland.

These plans must be made in cooperation with water suppliers and they must be based on risk assessment. The amended annex II of the European

Storm water runoff and melting snow seeping into broken structures of the sewage network have been identified as the most common problems during risk assessment.

Drinking Water Directive allows for risk assessment-based monitoring of drinking water quality on specified terms.

In the implementation of annex II of the EU legislation, the Finnish national Health Protection Act was amended to allow for obligatory risk assessment-based drinking water quality monitoring beginning from November 2017.

The Finnish national Water Services Act, in turn, compels water utilities to be aware of the risks related to the quantity and quality of their raw water and the risks related to their plant facilities. Water suppliers and health protection authorities are mandated to fulfil all these risk-assessment requirements through one, collaborative drinking water quality related risk assessment for each water supplier.

The Environmental Protection Act stipulates that all waste water treatment plants exceeding a population equivalent of 100 must have an environmental permit.

As permit holders, waste water treatment plants must have a plan of what to do in the case of an emergency, which is based on a risk assessment. This plan must cover actions to prevent accidents and to limit the negative consequences of these to health and the environment.

The creation of a national Water Cycle Safety Plan (WCSP) was included in the 2011 government programme of Finland to assure safe drinking water in all eventualities.

A Water Safety Plan (WSP), a Building Water Safety Plan and a Sanitation Safety Plan (SSP) were developed in Finland under the leadership of the Ministry of Social Affairs and Health to achieve the goals of the WCSP.

Figure 1 illustrates the framework of these plans and their connections to land use planning, the protection of water sources and water supply in communities and buildings, as well as the cycle of waste water treatment and natural resources.

National web-based tools for the Water Safety Plan and Sanitation Safety Plan

The national web-based tools for water and sanitation safety planning were developed in cooperation with water utilities, health and environmental protection authorities and other stakeholders between 2012-14. The tools were launched for public use by the Ministry of Social Affairs and Health in 2015. The tools can be used free of charge by water utilities and authorities.

The WSP and SSP applications follow the general principles of risk management. WSP principles introduced by the World Health Organization are implemented in the WSP tool and it covers the management of drinking water quality related risks in the drinking water supply chain from catchment to point of delivery.

The SSP tool manages the health and environmental risks of the sewage system and waste water treatment. The SSP also covers the entire sewage system from the user's connection point to the effluent discharge and all the process points in between.

Side processes and support functions such as automation, working methods, communications, professional skills and data security are included in the scheme. The overall approach of the SSPs is holistic, which differs from the methods used in SSPs in some other countries.

The WSP and SSP tools provide:

- Guidelines for needed source data and building the risk management team.

Interconnections between Water Safety Plan, Building Water Safety Plan and Sanitation Safety Plan

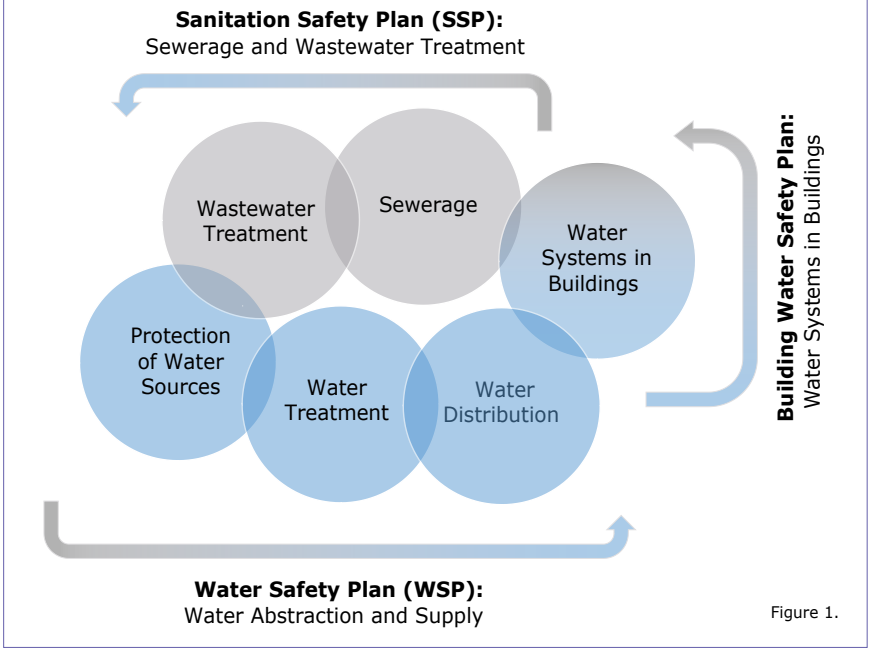


Figure 1.

The risk assessment matrix of the WSP tool

Risk categories and respective actions L = Low, no immediate action M = Moderate, complementary actions to reduce the risk level, scheduled improvement plan required H = High, complementary actions to reduce the risk level, scheduled improvement plan for immediate actions		Consequences			
		No adverse health impacts	Exceeds the national recommended limits for chemical or aesthetical quality	Exceeds the national recommended limits for microbiological quality and radioactivity	Exceeds the national limits for safe drinking water and/or using the water cause epidemic or severe health impacts
		Insignificant (1)	Moderate (2)	Major (3)	Severe (4)
Likelihood	Rare (1)	L	L	M	H
	Once in 5 to 10 years Unlikely (2)	L	L	M	H
	Once in 1 to 5 years Possible (3)	L	M	H	H
	Once in a year or more often Almost certain (4)	L	M	H	H

Figure 2.

- A graphical tool for constructing the flow diagrams of the system.
- Checklists for identifying hazards and hazardous events for the different phases of the process. Predefined questions help to identify the presence of hazards and hazardous events.
- National 4x4 risk assessment matrices with guidance. The matrices are based on the legislation in order to support the uniformity of risk assessment as well as surveillance of the authorities (*Figure 2*). In the WSP, the risk assessment is in two phases, without and with present risk management measures. In the SSP, the present risk management measures are taken into consideration in the first phase of the risk assessment.
- Examples of possible control measures to manage any risks.
- Templates for scheduling the improvement plans to implement the missing risk management measures.
- Sorted lists of risks. The risks can be sorted either on the basis of their severity or by process points.
- Guidance and templates for internal or external auditing of the risk management.

The easy to use, secure, online application offers a uniform toolbox for water utilities for hazard identification, risk assessment and risk management in the context of WSPs and SSPs.

By combining WSPs and SSPs in the same framework, the application improves the awareness of risks the sewage system poses to drinking water and supports the protection of drinking water from waste water related contamination.

The tools also provide background information for planning and assist water utilities in incorporating risk management to their overall decision-making and management processes. The application also serves health and environmental protection authorities in directing risk-based monitoring. The application has an option to allow authorities to follow the risk management process through the tool.

WSPs and SSPs in practice

The risk assessments are conducted in workshops, mainly in brainstorming sessions. One advantage of the tools is that they require cooperation between different organisational levels as well as with authorities, which facilitates the exchange of information.

In this way, the tools promote community learning, allowing common experience-based learning both within the organisation and between the different stakeholders.

Experiences from the first WSPs using the web-based tool indicate that the key for a successful WSP is a committed, multidisciplinary team comprised of water utility plant workers. Additional team members such as external experts are also needed, especially when dealing with risks associated with raw water abstraction and water distribution.

Based on the checklist data in the web-based tool, 70% of the risk management actions related to raw water quality require cooperation between the water utility and other operators in the area. On the other hand, this also means that water utilities cannot manage all the risks themselves but their stakeholders must be made aware of them and commit to the necessary measures.

In most cases, the WSP has shown that the most critical high level risks are already well managed and most improvements are needed to manage other high level risks. The methodological tool with the extensive list of identified hazards also assists in identifying new hazards in most water utilities.

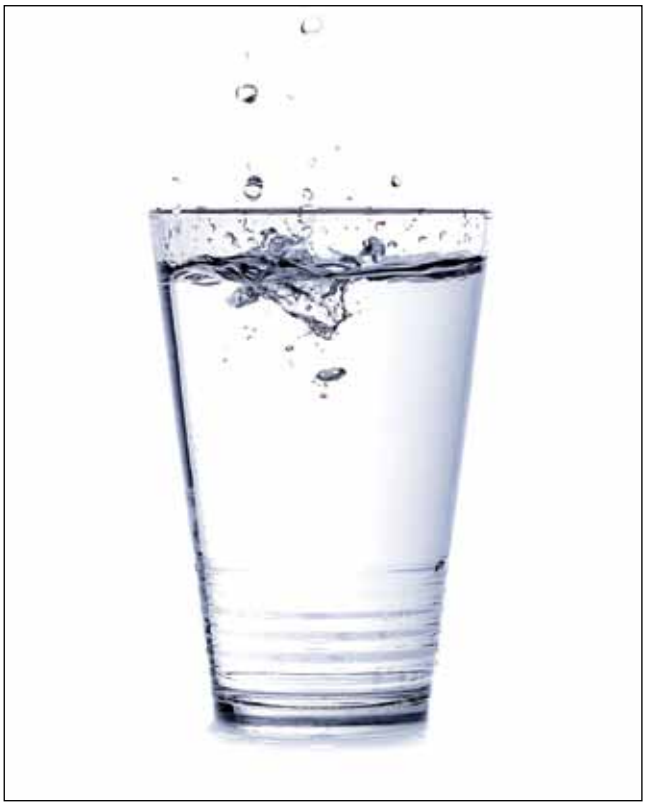
Experience from the SSP indicates that critical risks are commonly identified in the sewage network rather than in the waste water treatment process itself. Typically, the condition of the sewer network and increased flow caused by storm water runoff and melting snow infiltrating through broken structures or illegal connections are the most commonly identified issues in the risk assessment.

In some small- and medium-sized waste water treatment plants, the risk assessment has revealed a vulnerability related to the human resources in cases where the person in charge of the treatment process usually works alone and the know-how is not shared with others. This increases the risk for disturbances during holiday periods and off-duty hours.

Both WSPs and SSPs are resource-consuming exercises and require commitment from the utility's management; first to do the exercise and then to implement the necessary improvements indicated by the risk assessment.

In addition to the risk management improvement measures, the preparation plans and crisis action plans often need updating in accordance with the results of risk assessment in order to ensure the continuity of operations in all situations.

The undeniable benefits of the web-based WSP and SSP tools are improved operational reliability and quality of operations through improved risk management and surveillance of the processes. Conducting the WSPs or SSPs increases the expertise of a water utility's personnel and authorities as well as other stakeholders throughout the entire operational chain in question.



The 2011, the Water Cycle Safety Plan assured drinking water in Finland. A Water Safety Plan, Building Water Safety Plan and Sanitation Safety Plan followed.

The tools also help in prioritising the investments to increase the security of water supply and sanitation services. The provided uniform risk assessment procedure improves the security of the services of the water utility using the tool, but also at a national level.

WSPs and SSPs in the future: soon to launch in Asia

The web-based WSP and SSP tools have been successfully used in Finland. The positive experiences encourage even wider application in the future, and not just in Scandinavia; the tool will soon be launched in Vietnam.

The use of the tools has already led to new ideas and suggestions to further improve them. Regular updates are planned and needed. These improvements will be made in close cooperation with water utilities.

Freedom to meet targets

The transparency of the French governance model works for the public management of its water and waste water services

By Dominique Gatel, Director of Public Affairs/ Water, Veolia and Chloé Simeha, Head of EU Public Affairs, Suez

Water services should be subject to solutions adopted locally. In France, this principle is applied to its extreme, leaving municipalities free to determine how to meet water policy targets that are defined at European or national level. This common sense approach shapes the way economic actors bring their know-how and innovation capacity in technical, social, contractual and environmental matters to municipalities and their citizens.

This freedom needs to be balanced by a strong public governance to frame and make the most of this local democracy. One example is the possibility to disclose data about the quality of service and its price in a harmonised manner so that citizens may understand the issues. Elected officials benchmark the solutions and results for more informed choices.

Municipalities' organisation for water services delivery

Water and waste water services, legally, are 'public services of a commercial nature', placed under the responsibility of municipalities or their groupings. There are more than 30.000 municipalities but 70% of people have their drinking water and waste water services organised jointly with other municipalities in inter-municipal services.

Municipalities and inter-municipal bodies have a duty to determine water tariffs, the service level requirements and investments. Furthermore, they consult with the Municipal Commission for local services and establish local rules for services.

The choice of the service delivery mode is enshrined in the principle of free administration of municipalities. This remains the ultimate decision-making body in any political, financial and technical matter and remains accountable to citizens and control bodies. For example, the law on municipal administration of 1837 stated: "The municipal councils shall deliberate on and settle the following matters: water...". In concrete terms, a municipality may either manage the services itself or vote to tender out this task to private operators. There are 7.000 ongoing contracts and with close to 700 tenders per year in water/waste water services, with an average contract duration of 12 years.

Transparency in public water supply and waste water services

Naturally, citizens demand information about the performance of water and waste water services, in particular to make sure they are getting value for money. Since 1995, French mayors have had to publish an annual report on the price and quality of water and waste water services. These reports contain information about how services are organised, as well as costs, prices and investment.

The question of shared indicators, which could describe the quality of the service, was raised in the early 2000s and the federations representing cities, operators and AFNOR (the French standardisation body) started building a set of performance indicators that would detail the service's performance, using the publications of Alegre et al, 2000 and Matos et al, 2003. The performance indicators take into account the contracted service performances and any room for improvement in areas such as the quality of drinking water, service continuity/quality provided to consumers and the implementation of knowledge tools by the local authorities for their underground assets.

One of the actors' objectives was to reflect on the main technical performance items such as compliance and leakage but also on social aspects such as the price and the recourse to the solidarity fund, and also to give a view on the financial sustainability of the service.

As early as 2004, private operators started gathering data and in 2006, the Law on Water and the Aquatic Environments (implementing the EU's Water Framework Directive) recognised the list of indicators and created a new agency, the National Office for Water and Aquatic Environments, which took charge of organising data collection, storage and interpretation of collected data. In practice, the database is fed by local authorities and allows each city and citizen to benchmark the performances of its own city with those of similar characteristics. The updating of this database became mandatory in 2015.

Organisation of water/waste water service provision in France

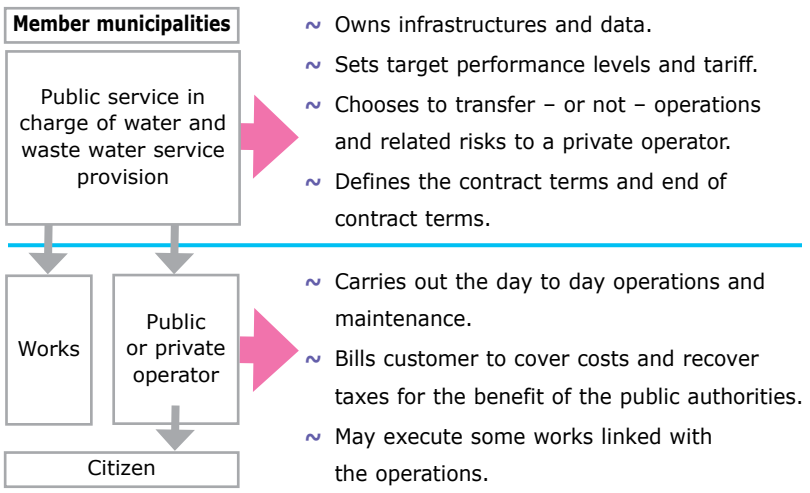


Figure 1.

Records show that performance improves gradually for most services. For example, in the case of Paris, the drinking water networks operations were delegated to two private operators from 1985 to 2009. The results show leakage rates declining from 22% in 1985 to 4% in 2009.

These improvements were obtained through district metering, the installation of GSM sensors to locate leaks and active leakage control measures. In other cities, 100% of meters are equipped with automatic meter reading, increasing the frequency of metering and enabling daily consumption control on the internet.

The benefits of this setting are numerous, starting with the increasing awareness of citizens about water matters and also the settling of a number of earlier debates which lacked evidence, and are now substantiated, regardless of the public or private nature of the local operator.

Another obvious benefit is that academics have an extensive database enabling the identification of possible improvement factors or the impact of the service structure on the performance or price, with a view to sharing such knowledge through peer-reviewed scientific literature.

For example, research has shown that the apparent 10% price difference between in-house and delegated management is fully cancelled when taking into account the characteristics of the service (network, quality of raw water, etc) (Chong et al, 2015), illustrating that competition is a common sense solution to ensure organisations strive for performance.

Tighter regulatory context

This increased transparency should be seen as part of a wider modernisation of the legal environment of the sector, which makes the most of the technology commonly available, the progresses in legal terms, especially during the 1990s with the Barnier and Sapin laws on transparency and public tendering, or with the legislation requesting municipalities to separate the accounting for water and waste water services from the other municipal services. These changes were called for to ensure traceability of budget decisions and avoid cross-subsidisation. At the same time, the various regulatory authorities were given more powers of verification.

Conclusion

The French governance model for water services is decentralised and presents an important level of private participation through delegated public management, in which competition is fierce. Over the past 20 years, the involvement of users in the organisation of water services has greatly improved, including improved public reporting on performance indicators.

The benefits are many: improved benchmarking of services' performance for decision-makers and citizens; efficiency gains through more informed choices; reducing asymmetry of information; detecting aggressive bidding more efficiently and increasing stakeholder participation. The Federation of French Water Companies (FP2E) supports the transparency of water services performance at EU level, as good governance solutions to enhance the public management of services.

Integrated thinking

Water and agriculture are inextricably linked but in Germany, there are water pollution problems caused by farming that must be urgently addressed

by Dr Claudia Castell-Exner, Deputy Head of Water Department, DVGW and Professor Dr-Ing Frieder Haakh, Technical Director, Zweckverband Landeswasser-versorgung

The upsurge in land cultivation that has taken place over the past 60 years, coupled with the high use of fertilisers and pesticides and intensive mass animal farming, has led to significant increases in yield and productivity but also to massive environmental pollution. These factors increasingly threaten our drinking water resources.

One of the core problems is nitrates, commonly found in fertiliser, which ends up in groundwater resources. Due to this, farming is one of the main drivers of water pollution by nitrates. This is not a new problem. Cooperation agreements between water resources managers and farmers, and to some extent central water protection programmes at a regional level over the last 30 years, go some way to preventing nitrates from entering drinking water resources.

So far, billions of euros have been spent on compensatory payments to farmers in return for using less nitrates and pesticides in their work and therefore reducing the risk of these ending up in drinking water resources.

Nitrates

Let us first consider the nitrates problem in Germany. In the European Commission's report on the implementation of the Nitrates Directive (91/676/EEC), Germany is ranked in the penultimate place before Malta for nitrates pollution. One reason for this is the unacceptably poor nitrogen efficiency of only 50%, caused by inadequate specifications in the implementation of the directive in Germany as well as a lack of controls and checks. The EU launched proceedings against Germany on the grounds of a non-satisfactory implementation of the EU Nitrates Directive.

And here's why: agriculture makes up 0.8% of the German gross domestic product, which is an extremely low share; it employs 2.5% of all employees and it receives half of its income from subsidies. However, the legacy that is left for our children can increasingly be measured as environmental pollution of vast proportions.

In agricultural areas, half of the groundwater is already contaminated to such a degree that it may

▼ In agricultural Germany, as much as 50% of groundwater is unusable for drinking water; in the entirety of the country, 10-15% of drinking water has nitrate contamination.

During the 4th Forum of the Future of Agriculture in 2011, Environment Minister Janez Potočnik stated that the European Agricultural Policy needed a 'green' future.

no longer be used as a drinking water resource. Looking at Germany as a whole, we can assume that 10-15% of drinking water resources are severely contaminated with nitrates. A conservative agricultural policy led by the German farmers' association has systematically dismissed, suppressed and denied the associated environmental impact, and proposed solutions from the agricultural lobby are still lacking. Any German car manufacturer is more transparent than a farm as far as environmental pollution is concerned! This is no longer socially acceptable. Industrial agriculture is increasingly perceived as a burden for the environment by citizens.

But let us return to the drinking water resources. Due to the long response time of the 'agricultural system' and the nitrates-contaminated groundwater bodies, action must be taken immediately – now!

The most important objective is to cut the nitrates excesses to under 50kg N/ha per annum, measured according to the farm gate balance (PARCOM method). This requires, in particular, the long overdue improvement of nitrogen efficiency. The regulatory implementation of this is to be achieved by a bundle of clearly defined, binding and controllable measures, infringements of which are punishable by law. We also need to link all relevant environmental data and make it publicly available. It is high time to introduce a modern, environmentally compatible agricultural system, the associated normative framework and the latter's enforcement as well as the transparency of agricultural data for the ordinary citizen.

The last revision of the European Common Agricultural Policy (CAP) got off to a good start. The then Environment Commissioner, Janez Potočnik, announced a fundamental realignment of priorities: 'greening' was to become the hallmark of agricultural policy between 2014 and 2020.

The future CAP must be green

"It is essential that the future CAP contributes the public goods we need to meet the environmental and climate challenges we are facing today. I do not see how the amount of public funds spent on agriculture can be legitimised unless the future CAP makes a significant contribution to reaching the EU's environmental and climate targets. We must tackle these challenges today to avoid much bigger problems in the future. I strongly believe that prevention is better than cure. If there is a CAP in the future, it must be green. And we must not only sanction farmers who do not respect environmental rules, we must also reward those who do provide environmental public goods, because the market does not reward them for that."

Janez Potočnik, 'The future CAP must be green', The 4th Forum of the Future of Agriculture, 2011

EurEau supported the greening measures of agricultural practices as incentives for farmers and emphasised that water resource protection is one of the most important components in attaining sustainable agricultural practices. As such, EurEau stressed in 2013 that more specific 'blueing measures' should be included in the new legislation to pave the way for a water resource protecting farming, covering specific water related requirements in:

- Plant nutrition and fertilisation.
- Land utilisation and cultivation.
- Plant protection (pest management).
- Water management.
- Organisation and management.

Apart from the initial euphoria, not much is left of this commitment to a more environmentally sound agriculture. On top of that, many Member States – among them Germany – are not dedicated to implementing the Nitrates Directive, even within the scope of periodic revisions. Thus, the requirements for the sustainable protection of drinking water resources are still not taken seriously, as if everyone still failed to see the importance of the elementary objective of the Nitrates Directive, i.e. the reduction of nitrates contamination from agricultural sources. Even in the face of all the appeals on the

part of the water utilities and environmental associations, basic aspects are still lacking.

There is common agreement among experts that it is necessary to:

- Determine the fertiliser requirement specifically for the respective site.
- Introduce broader peripheral strips of land along bodies of water and controllable distance regulations.
- Establish reduced upper limits for organic nitrogen fertilisation without exceptions and without derogation rules for fermentation residues.
- Adapt the blocking periods to plant requirements and vegetation periods.
- Introduce the gross farm gate balance for nutrient comparisons and their assessment, without deduction of any environmentally relevant nitrates and phosphorus losses and to subsequently disclose this as environmental data.
- That storage capacities for nine months in the case of liquid and six months in the case of solid farm fertilisers are sufficient to meet the requirements of demand-based fertilisation.
- That exceeding the upper limits for organic nitrogen fertilisation and the permissible nitrogen excess will be punished as a regulatory offence.
- That regulatory offences will entail a monetary fine.
- That if quality objective limits for groundwater and surface water are exceeded, further requirements on fertilisation will be imposed.

Pesticides

Raw water for the public drinking water supply should largely be free of pesticide residues. The intensive agriculture practised today makes use of chemical pest management to protect crops. However, depending on local conditions, protecting drinking water resources can require measures that have to go beyond the requirements of a comprehensive water pollution control.

Contrary to the specifications of plant health legislation for integrated plant protection, in practical application, the use of chemicals is given precedence over other measures for the protection of crops. For economic reasons, pesticides are the standard procedure instead of the last resort. This is only possible because the consequential costs of the use of pesticides in agriculture can be passed on to the consumer.

The further increase of the annual tonnage of pesticide sales in Germany proves that the restriction of chemical plant protection according to the German Plant Protection Act (PflSchG) and the operational implementation of EU law through the National Action Plan are failing. With the exception of 1998, the annual tonnage between 1995 and 2005 amounted to approximately 35.000 tonnes of active substances.

Since 2006, sales have increased and now amount to more than 46.000 tonnes of active substances (for 2014). This inevitably leads to water pollution; 50% of the groundwater resources are already contaminated by pesticide residues, and this is rising. As soon as the use of pesticides in water protection areas causes thresholds to be exceeded, water operators need to use more costly treatment techniques and national economic efficiency is negatively impacted.

Conspicuous findings concentrate on 'hot-spots'. The protection of these sometimes sensitive catchment areas (e.g. karst) with a pesticide usage beyond the pollution load capacity of the location is not currently possible. PflSchG, with its approach of undivided comprehensive water protection with the 'same protection level for all' fails at this point; there is no interlinking of plant protection, water, agricultural and drinking water laws. In the absence of clear specifications, the implementation of European law by means of a National Action Plan leads to a dilution instead of an effective operationalisation of EU law with measurable results in the form of declining application rates and decreasing concentrations in ground and surface waters.

Pesticides' active substances are designed to be highly effective in selective instances, while being rapidly degradable and evolving metabolites. It is not feasible to do without metabolites but these metabolites should be as harmless as possible. These requirements can be met by different thresholds or health-related indication values. EU law must be developed further in this regard by anchoring the health-related indication values in EU law. Pesticides with concentrations of nonrelevant metabolites greater than health-related indication values may no longer be licensed.

Apart from the quantities applied, the efficiency of pesticides is also of importance for an evaluation of the use of pesticides from an environmental protection point of view. Thus, modern, highly effective pesticides can – despite a lower dosage – exhibit the same hazard potential as older pesticides requiring a higher dosage. Too little is known about the synergies of

pesticide residue cocktails. The previous cumulative value has not displayed any effect and must be replaced by new evaluation approaches, taken, for instance, from effect-related analytics.

As far as the nonrelevant metabolites are concerned, PflSchG comes to nothing. In addition, there is no consistency either in national or EU law. Furthermore, EU water policy is not consistently implemented in Member States and remains ineffective on account of vague objectives, inconsistent enforcement and strong lobbying from the agricultural sector. We need the consistent implementation of drastic measures based on clearly measurable target figures (tonnages and concentrations).

Pesticide use is standard practice rather than the last resort in German agriculture. For those receiving EU subsidies, emissions figures should be disclosed. If figures are not reached, payment should be stopped.

The interlinking of water, agricultural and plant protection policies with the following mechanisms is mandatory:

- The interlinking of emissions and (permissible) emissions (in concrete terms: a ban on using an active substance in the catchment area if 75% of the limit is exceeded).
- Prioritisation of ecologically compatible methods by taxing the polluting substances (pesticide levy or withdrawal of EU funding when these substances are applied).
- Promotion of environmentally compatible methods or compensation for damages (for instance for the required treatment technology) with the funds that are thereby released.

Conclusions

The EU urgently needs to align chemical law, agricultural policy, water and environmental law. Integrated thinking and acting must be implemented at EU level. The coexistence of conflicting legislation weakens its influence and efficiency.

Both for pesticides in general and for nitrates in particular, binding rehabilitation targets for water resources, combined with strict measures for agricultural and other emission sources are urgently required. This means: if emission targets (75% of target value) are exceeded in drinking water resources, this must lead to the sanction-reinforced reduction of emissions (nitrates) or an application ban (pesticides), in particular on agriculturally used areas. According to the drinking water quality parameters set in the Drinking Water Directive, emission thresholds have to be set/determined in agricultural, water or environmental law.

This binding element between chemical, environmental, agricultural and drinking water policies is missing. For an effect to be achieved, payments within the scope of the CAP must be based on consistent and measurable parameters (integrated plant protection, nitrates balances, specific pesticide expenditure). Payments alone for (ineffective) measures must be stopped, i.e. every measure must be allocated to a measurable target figure. This in turn requires the consistent, binding recording of emission data for pesticides and nutrients in agriculture at the level of the individual agricultural holding. For transparency, the emission data of all agricultural holdings receiving EU subsidies must be disclosed within the scope of providing environmental information to EU citizens.

Consistent action must be taken against implementation deficits at the level of the Member States. There are implementation deficits, no awareness deficits!

The CAP, the Nitrates Directive 91/676/EEC, the Pesticide Approval Regulation (EC/1107/2009), as well as the Water Framework Directive (2000/60/EC) need to be evaluated and realigned with regard to the 'water and agriculture' nexus, followed by a subsequent adjustment of the legal act.

EU chemicals, agricultural, environmental and drinking water policies must be interlinked and payments for environmental performances in agriculture linked with target figures. Integrated thinking and acting is what is needed.

Cities of the future

Zero sludge production may seem the impossible dream of municipalities, yet considerable sludge reduction can be achieved with bio-augmentation

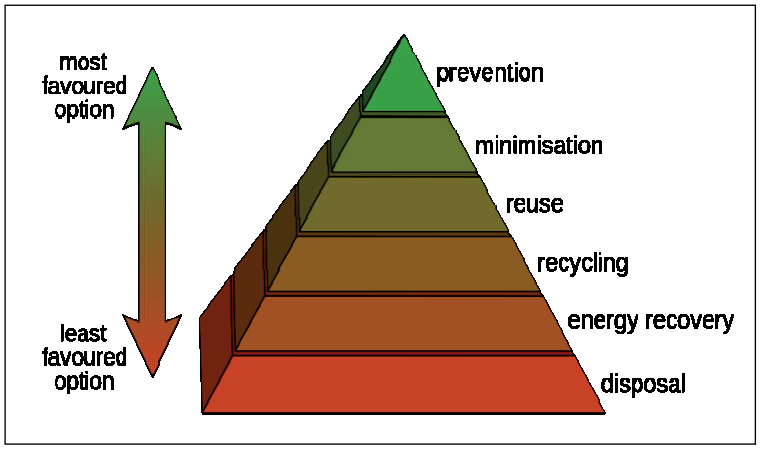
By Mark Sklivaniotis and Andreas Angelakis, Honorary Consultants at the Hellenic Association of Drinking Water and Waste Water Municipal Companies

The management of bio-solids (sludge) derived from the treatment of domestic waste water has been a difficult issue for years. A great deal of research and technological innovation have evolved around this problem. This material is a solid waste which, if not managed properly, generates difficulties in two critical infrastructure sectors: waste water treatment and solid waste management. The general approach of solid waste management is usually portrayed by a pyramid (*Figure 1*):

In a report prepared by Milieu, WRc and Risk & Policy Analysts for the European Commission, the estimated sludge production for 2010 was 11.6 million total dry solids tonnes per annum (TDS) with the following disposal distribution: recycled to land 42%; incinerated 27%; landfill 14%; other 16%. For Greece, it was 260.000 TDS: recycled to land 5%; incinerated 0%; landfill 95%; other 0%.

In Europe, the main management options are in the three lower parts of the pyramid, whereas in Greece, the lowest level of the pyramid is the predominant choice. This has shortcomings. First, the addition of sludge to municipal solid waste creates a lot of handling problems and has forced many municipal landfill operators to request significant sludge input minimisation or to sharply increase the gate fee. Secondly, there is the EU policy to minimise the organic part of the waste deposited to landfills to less than 5%. In the long run, this practically bans sludge from landfill sites.

Figure 1.



In Patras, with a population of 220.000, the sludge management problem from waste water treatment plants endangered the smooth operation of the plant. After outsourcing sludge transport and disposal services to far away composting sites, various options were examined for a viable, environmentally friendly and cost-effective solution. Besides the practical and financial aspects of the alternatives, social mistrust and opposition for any activity involving sludge management was strong. So 'climbing to the top of the pyramid', and, therefore, a zero-sludge process, became necessary.

A number of private companies' case studies claimed considerable sludge reduction using specific and dedicated micro-organisms and micro-nutrients contained in their product. In some cases, this was claimed to be as high as 50%. This method is called bio-augmentation. Veria, with 70.000 inhabitants, applied bio-augmentation for some time and, most importantly, used Greek technology. They claimed to be able to get to the top of the pyramid, avoiding the production of sludge by more than 85%. A pilot application began in Patras in 2014, which extended to a permanent operation.

What is bio-augmentation?

Bio-augmentation enhances the process of the biological decomposition of pollutants in waste water by naturally occurring micro-organisms. This is done through adding selected micro-organisms that are far more efficient in converting the carbon and nitrogen compound to carbon dioxide and nitrogen without producing a lot of extra biomass population. These micro-organisms

are facultative, capable of functioning in aerobic, anoxic and anaerobic environments. The bacteria are not genetically engineered; they are naturally occurring but specially selected.

The added bacteria become dominant and the existing ones are adapted and assimilated to coexist and collaborate. In suitable conditions, the added micro-organisms produce enzymes that enhance the biological process. The degradation of complex molecules, oils and greases into simple ones leads to the production of volatile fatty acids (VFAs), i.e. acetic, butyric, propionic acid, etc. The VFAs are then easily converted to carbon dioxide and water in aerobic conditions, methane and hydrogen in anaerobic conditions and free available energy. The breakdown and molecular destruction occurs in up to 80% of the total biomass through catabolism. Only 20% of the total biomass is utilised for the synthesis of new bacteria. The process requires less oxygen supply as the ammonia is converted to nitrites and then nitrogen without first being converted to nitrates where the largest consumption of oxygen occurs, depending on operational conditions.

Adding sludge to municipal solid waste has led to problems with landfill operators, who have asked for sludge input minimisation. Furthermore, the EU has stipulated that sludge should be, at most, 5% of the landfill total.

Application cases in Greece

A number of successful cases are running in Patras, Veria, Heraklion and a few other cities, not to forget a few cases in the islands, like Corfu and Lesbos, where sludge management is a more difficult issue.

In every case, the benefit is not limited to sludge reduction. Some of the other benefits are: great odour reduction; robustness to load variations; resistance to toxic 'attacks' (NH4 180mg/l); small but measurable energy reduction; and the reduction of maintenance (limited dewatering). There are also financial gains. The cost of the technology application is a third of the cost for sludge management without counting the saving from lower electricity and chemical consumption as well as the man hours engaged in dewatering activities.

One extra note of environmental significance: the University of Patras measured the inlet and outlet concentrations for a number of pharmaceutical substances detected in sewage. Its data confirms that the removal efficiency was 85-100%, which is much higher when compared to a typical biological waste water treatment process. This is very encouraging but has to be confirmed with more case studies.

Is this the end of sludge?

This technology can only be seen as one more tool in the battle to manage the biological treatment process and could be of great help when sludge management problems are difficult to solve. Despite the fact that this particular Greek technology achieves near-zero sludge production, other bio-augmentation technologies report sludge reduction of almost 50%. So sludge will never go away. In cases where the general circumstances are right, sludge can be an energy source and an asset. Having said that, we must not exclude larger energy gains from the application of bio-augmentation. Since facultative bacteria that act most effectively in an anoxic environment are the main 'instrument' of the process, further study and optimisation of the process application can bring considerable reduction in aeration cost, which will probably outperform the energy gains from the potential biogas production if sludge was produced.

Some cities of the future may indeed work with near-zero sludge production in terms of waste water management. Bio-augmentation can be one tool in achieving this and certainly there are others. What is most important to remember is that innovation is the most powerful lever to development and success. Sometimes innovative ideas look crazy but they must be given a chance. And sometimes they come from a spot of the globe that is not a typical 'technology power'.

Real-time remote monitoring

Malta's reliance on desalination means that water bills are high so stopping leaks had to be achieved. An Automated Meter Management was the answer

By Charles Brincat, CEO, Stephen Zerafa, Head of Public Relations and Stefan Riolo, Director, Distribution Network, Water Services Corporation International Limited

Since water is a precious resource, its production and distribution must be carried out in an environmentally responsible and cost-effective manner. This is even more so in the case of Malta where 60% of the nation's potable water is produced by burning fossil fuels that generate electricity to run our three reverse osmosis plants. The remaining 40% comes from an underground aquifer that is already suffering from over-abstraction.

So it is understandable that potable water in Malta, a country situated in an arid region, is far more costly to produce than in countries with wetter climates. This stark reality is reflected in consumers' bills. Water is therefore a social issue which can create political repercussions at times.

Due to this 'water-stressed' situation, every water connection in Malta has been individually metered for billing purposes since the 1950s, thereby embracing very early on the principles of 'pay per use' and 'full cost recovery' that were more recently implemented elsewhere in Europe. It is thus no surprise that the Water Services Corporation (WSC) in Malta is also the first water company in the world to implement a nationwide Automated Meter Management (AMM) system. This system carries high capital and recurrent costs, which are included within water tariffs, in line with the aforementioned full cost recovery principles.

The subsequent increase in the cost of water raises interesting questions because the initial capital outlay of the project is never justified simply because it substitutes manual meter reading by automated reading for billing purposes. On the contrary, manual meter reading is by far cheaper than installing such a complex system. This is why AMM should not be looked upon as merely a way to obtain consumers' readings remotely, thereby avoiding the need for human meter readers. The rich information made available through smart water metering can be used for much more.

A typical water meter and radio data transmitter. It's what you do with the information and how you interpret it that matters.

Malta's AMM system began in 2013 with a nationwide smart meter installation campaign in all premises. Overall coverage stands at around 86%, while the island of Gozo is close to 100%. Around 256.000 water meters wirelessly transmit millions of bytes of data every hour, which is sorted in a way that helps to improve operational efficiency both qualitatively and quantitatively.

WSC's Strategic Information section spearheaded a number of initiatives intended to use this real-time information and analysis to create operational tools for its technical sections. Most important is the use of remote reading of customer water meters and the monitoring of consumption figures to detect household leakages. This has proved to be a powerful tool that provides engineers with enough information to solve otherwise complex problems.

Studies show that consumers use water in a number of variations of a standard distribution curve. But whatever the lifestyle, number of

inhabitants or consumption profile, water use in the majority of cases goes down to zero at some point in the space of 24 hours, most likely during the more silent hours of the day. Intelligent algorithms detect individual accounts that deviate from this norm to highlight potential losses.

When water from a public utility leaks into a private residence (usually a basement) from the public infrastructure, it causes severe damage to third-party property. It also exposes the corporation to compensation claims, wastes a precious resource and obviously contributes to inflate 'non-revenue water'. Such leakage is prioritised and technicians address these cases with urgency, but the often complex nature of these cases calls for the sequential shutting off of areas in order to trace the origins of such leaks. But closing consumers' water in the middle of summer is frustrating and leads to vociferous yet justified complaints in both conventional and social media.

A close study of the topography of an area surrounding a leakage complaint is correlated with the smart meter readings of surrounding dwellings. If a particular neighbour's consumption is pinpointed as deviating from the norm, there is a high probability that the residence in question has an internal leak that may be contributing to the water seepage into the complainant's property. Analysis of the data provided by remote reading allows our technicians to address such complex leaks in a shorter time.

This tool also works for what is termed as 'internal leakage', that is leakage inside private property after the meter, which can carry severe financial burdens. Early in 2016, WSC launched a system whereby its customer care department informs customers of any suspicious unaccounted-for or abnormal consumption.

Unaccounted-for consumption often arises from buried water pipes or defective flushing cisterns which, because they are situated after the meter, are the tenant's responsibility. This type of consumption can go unnoticed for long periods of time. The information acquired from regular remote reading allows WSC to create various typical tenant water consumption profiles. These vary from a typical family of four in a terraced house to a single person in a studio flat. When engineers notice that particular consumption does not follow the norm or does not go down to zero without a valid reason, tenants are notified of possible internal leakages.

Apart from this, a newly launched web-based application lets householders monitor their own water consumption in real time, allowing them to identify and eliminate suspicious consumption when away from home. In these cases, so-called 'suspicious' consumption could be some sort of unauthorised water use or it could simply be an extravagant lifestyle, wasting hundreds of litres per day in extreme cases.

Because such consumption can be monitored by registered users, corrective action can be taken to curtail wastage. Feedback received from satisfied persons, unaware that they were hitherto paying for 'avoidable' consumption, confirm that this is also having a positive effect on WSC's public image.

To conclude, AMM entails substantial investment in terms of capital, technical and human resources. It is therefore imperative that any water company investing in such a system is innovative, creating the best possible applications and solutions that make good use of the wealth of information available. However, when it comes to calculate AMM's effects on the bottom line, this is not so easy, as many of the benefits accrued are qualitative rather than quantitative. Although the technology allows more efficient operations and greater interaction with consumers, in themselves never-ending processes, it is virtually impossible to put definite figures on increased profits or reduced costs.

A semi-arid country must always do its utmost to reduce infrastructural and private leakages. A dripping tap may only leak droplets but undetected leaks can become a substantial financial burden if left unaddressed.

Curing our medicinal ailment

The Dutch water sector believes that pharmaceutical residues should not be found in drinking water sources. Responsibility should be taken along the chain

By Michael Bentvelsen, International Business Development, Unie van Waterschappen and Lieke Coonen, Adviser Public Affairs, Vewin

Around 10-15 years ago, the first research reports were published stating that surface water in The Netherlands contained pharmaceutical residues. The concentrations of these residues were extremely low. The residues, however, included a wide range of substances. Not all these substances were medicines in the strictest sense.

The female hormone oestrogen, the active substance in the contraceptive pill, and radiographic contrast agents were, for instance, also detected in the water.

In The Netherlands, surface water (including major rivers) is used for the production of drinking water. There were indications that endocrine disrupters in particular might affect the aquatic ecosystem. These research results therefore prompted more detailed research into the problem.

The Dutch Ministry of Infrastructure and the Environment explored the issue of pharmaceutical residues in the water supply together with the pharmaceutical industry, the healthcare sector, drinking water companies and the water authorities in order to formulate measures to improve water quality. This process was difficult.

Although we created a better picture of the concentrations of detected substances from various international research projects, we learned very little about the ecological impact. No water quality standards have been set for this category of substances and, unlike pesticides, an obvious impact on the health of the ecosystem can't be proven.

The European Commission failed to add diclofenac and estradiol to the list of priority substances, partly because there were questions about the consequences: at what level should measures be taken when standards are exceeded? The European Parliament, therefore, asked for a strategy paper on measurements to reduce pharmaceuticals in the environment.

Oestrogen, diclofenac and estradiol can be found in sources of drinking water. The Dutch National Institute for Public Health and the Environment published a report stating that medicine finding its way into drinking water is a cause for concern.

Residues do not belong in water sources

Unie van Waterschappen (water authorities; responsible for water quality and waste water treatment) and Vewin (the association of water companies) take the view that any further purification of effluent from the waste water treatment plants can only be supported if there is a problem and if it appears that a control-at-source approach is insufficient. The drinking water companies are of the opinion that pharmaceutical residues do not belong in drinking water sources and want measures to be taken to ensure that these do not get into the ground and surface waters.

Unie van Waterschappen and Vewin have been working to improve waste water treatment. Adding activated carbon to the process removes up to 90% of medical residue.

Unie van Waterschappen and Vewin sent a letter to the Dutch Secretary of State for the Environment in 2014 in which they advocated a three-track approach. This proposed the following actions:

- Definition of the problem: is there a problem and if so, how big is it?
- Can it be addressed at source?
- Examine possible measures to remove residues of pharmaceuticals in the water chain, including additional stages in the treatment process at the waste water treatment plants or measures during the production of drinking water.

Based on the above three points, an integrated policy consideration was made that needed political support for the measures to be taken and the cost.

Chain approach to residues of pharmaceuticals in water

The Dutch Ministry of Infrastructure and the Environment has accepted the proposal of Unie van Waterschappen and Vewin and is currently working on the Chain Approach to Residues of Pharmaceuticals in Water. In the Chain Approach, all parties in the pharmaceutical and water chain will map out the challenges and possible measures.

This is done at each part of the chain: Development & Authorisation; Prescription & Use; and Waste & Treatment. Wherever possible, a control-at-source approach is important. It is, however, clear that all the links in the chain should accept their responsibility to resolve the pharmaceutical problem. We should have an implementation programme in 2017, to begin in 2018.

In addition to identifying measures in all the three stages of the supply chain, it is important to interpret the problem. To do this, the Ministry of Infrastructure and the Environment has commissioned the National Institute for Public Health and the Environment (RIVM) to draw up an interpretation report. The report, *Pharmaceuticals and Water Quality*, was published in 2016. It shows that there is cause for concern about the effects of medicines on water quality.

As people live longer, we are seeing greater use of medicines for the old. Urine collection bags and their separate disposal could limit the pharmaceutical problem.

The Netherlands is participating in the Transnational Action Programme on Emerging Substances, where knowledge on combating water concerns are shared.

In The Netherlands, the safe concentration in surface water is exceeded for some pharmaceuticals. Laboratory studies have shown that medicines affect aquatic organisms. The quality of drinking water is in order, but the sources of drinking water may come under pressure due to increasing residues of pharmaceuticals in water caused by an ageing population and climate change. Residuals of medicines for humans and for animals have also been measured in groundwater in lower concentrations. Veterinary medicines can leach into surface and groundwater, both sources for the production of drinking water. Once residues of medicines get into the groundwater, they continue to be present for a long period of time.

Development & Authorisation

The following arrangements have been made with specific parties. Regarding the Development & Authorisation stage, the openness and accessibility of environmental data pertaining to medicines is critical, preferably regulated at European level. However, we are also developing a Dutch system in anticipation of a European system. The pharmaceutical industry is committed wherever possible to develop more 'green' medicines that reduce the environmental impact through, for example, better degradability in the environment and/or different forms of administration. Water and healthcare providers will better quantify the concentrations of residues of veterinary medicines in surface and groundwater and are committed to better understanding the effects of this.

Prescription & Use

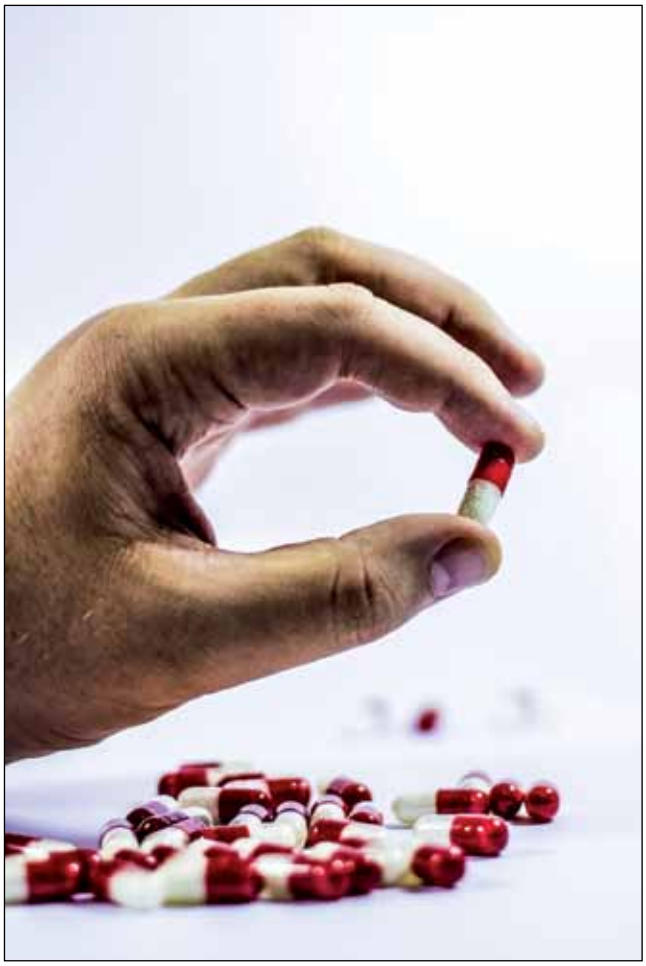
In the Prescription & Use stage, raising awareness in the healthcare sector and among consumers about the effects of medicines on water quality is key. First and foremost, the commitment to disease prevention and encouraging proper use of medicines is important.

For medicines that are a problem for ecology and the production of drinking water, the healthcare sector, in cooperation with the water sector, is being proactive using urine collection bags, local collection and separate disposal of highly harmful agents or prescribing a less-polluting agent having equivalent effect. The Ministry of Infrastructure and the Environment is having research done into whether pairs of medicines can be produced having the same effect but whereby one has less environmental impact than the other.

Unie van Waterschappen and Vewin are encouraging measures to control at source. For example, research into the treatment of waste water from hospitals, but also discussing with doctors about the introduction of urine collection bags after the use of radiological contrast agents or about the choice of which medicine to prescribe. In the Dutch city of Meppel, doctors have decided to no longer prescribe diclofenac as there are alternative drugs available.

Waste & Treatment

In the last step of the chain, Waste & Treatment, municipalities and pharmacists are seeking the best way of collecting unused medicines locally. Unie van Waterschappen and drinking water companies monitor pharmaceuticals in the water, and some drinking water companies have intensified their water purification process or are conducting research into this. The Dutch research institutes STOWA and KWR Watercycle Research Institute have conducted investigations in recent



More environmentally friendly medicines, for example, those that better degrade or have less-polluting agents, are increasingly prescribed by doctors in the EU.

years regarding the occurrence and effects of medicines in water. The water authorities have started a hot spot analysis, which, among other things, examines where the impact of pharmaceutical residues and endocrine disrupters is the greatest, based on the size of the waste water treatment plant in relation to the receiving surface water.

Water authorities, the drinking water sector and other relevant parties are exploring cost-effective ways to largely remove medicine residues at waste water treatment plants, for example in pilot projects.

A good example is the Schone Maas Waterketen project (Clean Meuse Water Chain). The water quality of the Meuse is seriously impacted by effluent discharge. Particularly in the summer, about two thirds of the Meuse water originates from waste water treatment plants. Unie van Waterschappen and Vewin have joined forces with the Ministry of Infrastructure and the Environment to improve waste water treatment. This is done by adding active carbon to the treatment process. So far, this looks promising (removing more than 90% of medical residues) and is a lot cheaper than existing techniques.

The organisations would never have succeeded in this on their own. A practical pilot project is currently ongoing. Effectiveness, feedback from treatment of other problematic substances, cost and funding are important for decisions on expanding treatment at waste water treatment plants.

This knowledge is applied in decisions on the hot spot approach. Treatment at specific major sources such as hospitals could be part of this. We can also learn from other countries that already apply additional treatment at their waste water treatment plants.

International research

The Dutch water sector is also active in international research projects, such as the Transnational Action Programme on Emerging Substances project. Emerging substances include, among others, pharmaceuticals, plant protection products, personal care products and industrial pollutants.

The project helped participants exchange experiences and develop knowledge on how to combat emerging substances in the water cycle. Both cooperation between different organisations – ranging from universities to water utilities – and knowledge sharing are important in relation to the project's topic, since emerging substances are a transnational problem which transcends national borders. International cooperation is essential to developing strategies and to solving the problem.

Another interesting project in which the Dutch water sector is collaborating is Solutions. This searches for new and improved tools, models and methods to support decisions in environmental and water policies. The project aims to provide solutions for emerging pollutants, among them pharmaceuticals, in European water resources in close dialogue with relevant organisations at the decision-making level. Solutions is formed by a multi and interdisciplinary consortium composed of 39 renowned scientific institutions and enterprises from Europe, Brazil, China and Australia.

The Chain Approach to Pharmaceutical Residues in Water in The Netherlands is part of the Delta Approach to water quality and freshwater. This programme, under the direction of the Ministry of Infrastructure and the Environment, seeks to accelerate the improvement in water quality.

Common goals

The aim of Norway's National User Forum for Water Services is to ensure a high quality supply at an acceptable price to the consumer

By Toril Hofshagen, Managing Director and Elin Riise, Legal Advisor, Norsk Vann

Water and waste water services in Norway are performed mainly by municipalities or municipally owned companies.

In 2012, the Norwegian parliament adopted a law that ensured the public ownership of water and waste water plants. The reasoning behind this law was that water and waste water services are natural monopoly services and public ownership is important for quality, safety and price efficiency in the long term.

Water services are financed by tariffs paid by customers. The level of the tariffs is decided annually by the municipal council and is based on the principle of cost recovery: 'the incomes shall not exceed the costs'.

Dialogue with customers

As monopoly services, it is important to have good dialogue between the municipalities and their water and waste water customers. In 2005, Norsk Vann (Norwegian Water) established The National User Forum for Water Services. The purpose was to develop a two-way communication at national level between representatives from different customer groups and representatives from the municipalities as water services providers in Norway.

This forum is also a way to inform on and discuss current issues of drinking water and waste water. The aim is to make it easier to create a constructive discussion and to cooperate whenever appropriate to promote the common goal; which is a good water service at an appropriate cost.

Members of the National User Forum for Water Services

The National User Forum for Water Services has participants from the following Norwegian associations and organisations:

The National User Forum for Water Services was started in 2005 to create national-level communication between different Norwegian water organisations.

- Norsk Vann (a membership organisation for the municipalities as water and waste water service providers).
- The Consumer Council.
- The National Federation of House Owners in Norway.
- The Co-operative Housing Federation.
- Food Drink Norway (organised under the Confederation of Norwegian Enterprise).
- The Federation of Norwegian Industries.
- Finance Norway (the organisation for the financial industry in Norway).
- A water service representative from a large municipality.
- A water service representative from a medium or small municipality.

The forum meets once or twice a year. In addition, representatives exchange useful information between the meetings. Norsk Vann has the leadership and the secretariat functions of the forum.

The meetings normally begin with information from the representatives from Norsk Vann, pinpointing current challenges in the water sector. Issues discussed include quality and safety, service fees (focusing on both quality and price), benchmarking, information to customers about services, terms for subscription and service declarations.

Members also discuss how to improve the national regulations for the water services.

If appropriate, the forum or some of the members of the forum, can contact the media, authorities and politicians, particularly if useful or important information for general dissemination is discussed.

Guidelines for better water services

The forum is very useful for creating a constructive discussion between different interest groups with a common goal – a decent water service at an appropriate cost. The work in the forum is not very time demanding.

Among important achievements, the forum participants have contributed with their competence for making studies, reports and recommendations on issues such as:

- Suggestions for a sectoral legislation on water services.
- Guidance for calculating the full cost in the water and waste water sectors.
- Service pipes: technical and legal issues.
- Investment needs in the water and waste water sectors.
- Guidelines for developing local regulations for water and waste water tariffs.
- Guidelines on the regulation of water and waste water services to the food industry.

Norwegian tariffs, which are decided each year, are based on the principle, 'the incomes shall not exceed the costs'.

Environmental benefits of EU integration

From huge problems with pollution, Poland is now facing the positive challenges of EU membership. With knowledge sharing, Poland is a cleaner country

By Dr Klara Ramm, water expert at IGWP – the Polish Waterworks Chamber of Commerce

Poland is one of the countries that suffered the most during the Second World War. Our country's course took a dramatic and unexpected turn in the post-1939 period. The country came under the influence of the Union of Soviet Socialist Republics (USSR) and suffered many decades of having its natural resources overexploited.

The liberation of Eastern and Central Europe from the USSR began in Poland and the first free elections for the Polish parliament took place in June 1989. From then on, the transformation of Poland from a former communist satellite state to a modern independent country moved quickly. In Athens in April 1994, Poland applied to join the European Union, becoming an EU Member State in May 2004. Its integration is a dynamic and continuously ongoing, and sometimes difficult, process.

20th century pollution

Environmental protection is one of the greatest challenges to EU integration. During the 20th century, Polish industry had an extremely negative impact on the environment, using a lot of energy, water and mineral resources, while polluting air, rivers and lakes. In addition, cities didn't have appropriate water and waste water infrastructure and a lot of untreated waste water was transported by the Oder and Vistula rivers to the Baltic Sea.

Polish experts were aware that they needed know-how, new procedures, new investments and new approaches to tackle this problem. EU integration allowed Poland to develop a huge environmental protection programme. Before 2004, the country used pre-accession funds like Phare, the Instrument for Structural Policies for Pre-

▸ From 2003-14, Poland constructed 376 waste water treatment plants; sewage investment was in excess of €14bn.

▸▸ With a number of Poland's waste water treatment plants not meeting the requirement of the EU's Waste Water Directive, urgent modernisation was needed.

Accession (ISPA) and the Special Accession Programme for Agriculture and Rural Development to do this. ISPA was created in 1999 to support investment in transport and environmental protection infrastructure.

Between 2004-06, Poland was the biggest beneficiary of EU grants. In its first three years of EU membership, the European Commission allocated €12.9bn of community funds, which were combined with €4bn of Polish public and private funds. Poland needed not just new infrastructure but also knowledge, expertise and support from more experienced Member States.

From 2007-13, Poland participated in the third stage of the Cohesion Fund and European Regional Development Fund. The water sector is benefiting from EU financial support. The most important challenges concern the implementation of the EU directives such as the Water Framework Directive (2000/60/EC), the Drinking Water Directive (98/83/EC) and the Urban Waste Water Treatment Directive (91/271/EEC) (UWWTD).

The implementation of all the accession treaty commitments continues to be a huge challenge for the country. However, it isn't only solved through implementing new solutions and technologies; we have to change mentalities as well as organisational and management procedures.

Thanks to EU integration, Poland received significant support in doing this from the European institutions and other Member States through funds, technology, knowledge and best practices.

Implementing the Urban Waste Water Treatment Directive

During the accession negotiations, the transitional periods for the implementation of the UWWTD were permitted. Poland was obliged to implement the directive before the end of December 2015.

The Polish government developed the National Programme for Urban Waste Water Treatment (NPUWWT) to manage the process of implementing the directive. The programme entered into force in 2003. It included a list of agglomerations above 2.000 pe (population equivalent), with their needs, planned investments on waste water collection systems and treatment plants.

The first version contained 1.378 agglomerations where 1.163 waste water treatment plants had to be built, extended or modernised. The programme also included plans to build 21.000km of sewage networks. The NPUWWT has periodically been revised to verify how municipalities manage their projects. It was already updated four times and the fifth update is currently under development.

Although many waste water treatment plants were built before 2000, they didn't meet the requirements of the UWWTD. Thanks to the pre-accession funds, the process of the modernisation of the waste water infrastructure began before Poland entered the European Union. Between 2003-14, with EU financial support, 376 new waste water treatment

Waste water management is still a Polish environmental policy priority. Private partnerships and cooperation from EU Member States have provided many answers to administrative, operational and technological difficulties. Planned investment in the coming years is expected to be in excess of €7bn.

plants were built and 1.206 were extended or modernised. Agglomerations gained more than 76.000km in sewage networks. The investment value exceeded €14bn.

Implementation problem

Unfortunately, the deadlines were not observed. The National Water Management Authority estimates that the requirements of the directive are met by 50% of urban areas. In addition, due to a misunderstanding between the Polish Ministry of the Environment and the European Commission, the national plan for the implementation of the UWWTD was based on article 5.4 instead of article 5.2, which would have allowed Poland a transition period.

This error was only identified in 2011. Once it was detected, Poland introduced amendments to the relevant regulations, agglomerations had to revise their plans and the NPUWWT was updated. As a result, the amount and the value of indispensable investments increased.

For this reason, waste water management should remain one of the priorities of environmental policy in Polish cities. Addressing this challenge would not be possible without the participation of private partnerships and international cooperation, which for Poland provides the administrative, operational and technological solutions as well as innovative methods of financing. The estimated value of planned investments exceeds €7bn. Because of increasing amounts of treated waste water, a new challenge has emerged. In 2015, urban waste water treatment plants produced 568 tonnes of dry matter sludge. At the end of the 19th century, sludge had been stored or used in agriculture; however, its growing volume and a recent prohibition of its use for landfill mobilised utilities to find innovative solutions to using it.

The access to available technologies used in the EU became crucial. Currently, Polish companies have free access to the best available techniques existing in Europe but can also exchange experiences with other countries.

Drinking water

An analysis of statistical data for European countries shows that Polish water resources are modest. In spite of quite heavy precipitation, almost 75% of rainfall is allowed to evaporate. Poland has similar problems to other EU Member States related to drinking water quality, especially in medium and small cities and villages.

Of course, water resources depend on the region and the type of water (surface water, groundwater). However, if there are shortages of drinking water, they are usually local and temporary, caused by the inefficiency or the lack of water plants and not by insufficient water resources. Industry, especially the energy sector, is in a more difficult situation

In the 1990s, the average amount of water used by each Warsaw citizen was 450 litres a day. Through water operators' education about sensible water use, more efficient appliances and higher prices, that figure is now below 100 litres.

since low water levels on rivers cause seasonal operational problems. Another problem concerns the drinking water quality.

The implementation of the Drinking Water Directive has motivated Polish municipalities to invest in drinking water technologies and network extension. Between 2000-15, the length of the supply network increased by 30%.

During that period, €3.5bn was spent on the water network, €4bn on treatment plants and €1.3bn on intakes. Most of the investments came from EU funds or grants.

Water operators have a major impact on water use by implementing solutions that reduce the amount of leaked water and educating consumers about proper water use. Furthermore, modern household appliances use less and less water. Naturally, reductions may also be caused by prices, which in Poland rose significantly.

Due to these factors, the use of water in some Polish cities has reduced to a quarter of what it was 20 years ago. For example, in the 1990s, Warsaw was estimated to use approximately 450 litres per citizen per day. Today, it's less than 100 litres.

But it is fair to say, only very few cities are investing in new technologies to achieve better control and effective management of water consumption. This is why the implementation of smart networks and systems is necessary.

Organisation of the water sector

Technical challenges are important for the water sector. Although they are difficult and costly, they have clear rules. Organisational issues are much more complicated. In 1990, local government and territorial reforms took place. It was a significant change from a centralised economy towards the local management of communal services.

All regional state enterprises responsible for water services were split between municipalities. Municipalities were autonomous in deciding how their local water services were managed: to outsource, privatise or manage in-house. Currently, most municipalities manage water utilities themselves. In addition, EU funds didn't mobilise governments to look after external (for example, private) sources of financing. Of course, it will change when EU funding ends.

EurEau membership

The Polish association of water utilities, Izba Gospodarcza Wodociągi Polskie (IGWP; Economic Chamber Polish Waterworks), has been a member of EurEau since 2004. For IGWP, EurEau is the most important source of knowledge about water issues and regulations. EurEau is not only a platform for the exchange of knowledge; it gives a unique opportunity to share experiences between experts working for the federation. It's a significant part of our EU integration.

Vulnerability to climate change

Is the Portuguese water sector prepared for periods of extreme weather? A number of projects have been developed but an integrated strategy is needed

By Rui Godinho, President of the General Assembly, APDA – Portuguese Association of Water Supply and Waste Water Services

According to the most recent reports, southern Europe and the Mediterranean Basin – including Portugal and Spain – are among the main areas that are vulnerable to climate change impacts with serious consequences for the urban water cycle. Significant decreases in available water supply have already been documented, making water management a priority in the affected areas.

A trend towards drier conditions began to be observed in Portugal over the last decades of the 20th century, with lower rainfall and more frequent and persistent extreme weather events, including floods and drought. This means that the share of available water resources is decreasing. And projections up to the end of the century, obtained using various global climate models, agree that the trend is likely to continue and intensify.

Dealing with drought

The EU's concern is expressed in the Blueprint to Safeguard European Water Resources of 2012. This blueprint evaluates water resource vulnerability to climate change. It views scarcity and droughts as crucial issues to consider when designing and implementing proper river basin management plans, which will deliver and ensure water supplies and security of water services in the future. Meanwhile, as a result of the Troika's (the European Commission, the European Central Bank and the International Monetary Fund) financial adjustment programme in the wake of the global financial and economic crisis, water management became a secondary priority in Portugal.

A lot of wrong decisions were taken in 2011 and 2012. One was the placement of the River Basin District Authorities – financially and administratively independent regional water management bodies since 2008 – under the direct supervision of the Central Portuguese Environmental Agency. This brought delays and other consequences in the implementation of the regional hydrological plans, namely the River Basin Management Plans.

This incomprehensible political decision, not supported by technical or scientific evidence, and contrary to the European Water Framework Directive and the 2005 Portuguese Water Law, put increased pressure on the availability and quality of the supply and other relevant management issues.

Therefore it is prudent, and urgent, to plan and implement adaptation strategies to climate change, thus minimising its adverse combined impacts, especially concerning water resources.

▼ Portugal is gradually seeing less rainfall and more extreme weather events, such as drought and flooding.

Studying climate change

Nowadays, Portuguese utilities, municipalities and research centres are undertaking important studies and projects on climate change, water resources and water and sanitation services.

AdaptaClima-EPAL: A Contribution to the Study of Climate Change and Urban Water Cycle Adaptation was the most in depth study carried out by the Portuguese water utilities. It took place between 2010-14 and was carried out by EPAL, the largest Portuguese water supply company.

The ClimAdaPT.Local project, which covers mainland Portugal as well as Azores and Madeira (pictured), identifies climate change issues at regional level.

It serves 2.9 million people in 35 municipalities, including Lisbon, and supplies an average daily amount of 600,000m^3 of water, and can produce a maximum of 1.1million m^3/day. This project was launched following a decision by the EPAL executive board, when it became evident that more work was needed to protect the main surface and groundwater sources and to increase the resilience of the EPAL water system.

AdaptaClima-EPAL is a good example of a well-prepared and well-developed project to be followed by other water supply operators.

The strategic climate adaptation options laid out in the *AdaptaClima* study focus mainly on the evaluation of the impacts of climatic changes on surface and underground drinking water sources. The study assessed how to continue supplying water services to 2.9 million people while taking rising sea levels and salt intrusion risks into account.

Global, regional and local socioeconomic and climate change scenarios were combined with regional climate and non-climate factors to accurately project likely scenarios for water resources at the end of this century.

Current and future vulnerabilities were assessed, taking into account the risks to climate events and the adaptive capacity to lead with the factors considered such as forecast demographic projections, land use and the effects on water quality, as well as estimations of climate change until the end of the century. This evaluation highlighted serious increases in qualitative and quantitative vulnerability in the EPAL main water sources. The next phase of the project will develop solutions on how to avoid or minimise them.

Adopting risk monitoring and uncertainty into decision processes and into the choice of the best mitigation and adaptation measures will be indispensable to guaranteeing the future water sector sustainability.

So, to ensure enough resilience of the water supply systems from the source to tap in any water utility – EPAL or any other operator – we must analyse carefully a set of multiple mitigation and adaptation measures, considering namely:

- Changes in the water supply pattern.
- Changes in the water demand pattern.
- Changes and reinforcement of internal processes and skills.
- Adopting innovation as a permanent 'way of life'.
- Implementing a new kind of institutional relationship with all agents and stakeholders.
- Ensuring water quality through high levels of safe water for all.
- Ensuring a strict protection of water abstractions and related sources.

Portugal's ClimAdaPT.Local project

ClimAdaPT.Local is a project that includes 26 municipalities covering the whole continental territory of Portugal and the islands of Madeira and Azores. The main goals are to identify the most frequent climate vulnerabilities at local and regional levels and prepare and implement the appropriate adaptation

strategies for each municipality and water utility infrastructure. The project disseminates strategies to deal with climate change through municipalities and other local and regional authorities, including water operators managed by these. The expected overall result is to build, in the future, a national network for climate change adaptation for all municipalities and regions.

The main concerns of the partners at the moment address the vulnerability related to frequent floods, the occurrence of droughts and their impact on urban infrastructures. The adaptation strategy of each participant was discussed in 2016.

BINGO project

At research level, the Bringing INnovation to onGOing water management (BINGO) project, chaired and conducted by LNEC, the Portuguese National Laboratory of Civil Engineering, is an advanced study, launched in 2015. It provides practical knowledge and tools to end users, water managers, decision -makers and policymakers affected by climate change to enable them to better cope with all climate projections, including droughts and floods.

This research project was selected and supported by the European Programme Horizon 2020, involving 20 European partners from six countries. One of the most relevant outcomes for the water sector is an integrated analysis of the impacts of climate change scenarios on the water cycle providing tools to be applied by different users at research and operational level.

Stakeholder engagement, preferably according to OECD proposals and recommendations, is also foreseen to be developed in the implementation of the above projects.

It is assumed that working with relevant stakeholders will provide synergies that will be useful in applying successful adaptation measures and therefore improve better practices in the different segments of the adaptation processes.

Some examples were given by Humberto Delgado Rosa, Director of the European Commission DG Climate Action, in a presentation to CNA, the Portuguese National Water Council, in Lisbon in 2013. He highlighted the combination of efforts and the sharing of information on how best to manage assets and carry out investments, as well as the sharing of information related to regulation, control and coordination of activities. He also pointed out the value of anticipating or managing potential crises and using mediation to influence public policies regarding the adoption of more integrated strategies to anticipate severe impacts of extreme events or gradual deterioration induced by the progressive increase of climate change. These examples, he said, "could be very positive in achieving good results".

Therefore, there is no doubt that it is absolutely necessary to consider climate change as an essential dimension to achieve a better future performance for water resources and in water services management.

All of these projects are in accordance with the National Strategy for Adaptation to Climate Change and take on a relevant meaning as demonstrable initiatives to be followed by other utilities both at national and international level.

Talking about legislation, in addition to the national strategy, in 2006, the Portuguese government approved the National Programme of Climate Change whose purpose was to define the adoption of a set of harmonised measures and additional policies to be assumed by different affected sectors.

However, despite all the projects described above, Portugal does not yet have a consolidated, integrated strategy to forecast properly the effects of climate change on water services and to adapt to them.

The EPAL experience, as an important utility, is a good example to be followed but it is only one relevant contribution that needs to be extended to the whole country.

The other mentioned projects also make excellent contributions to the climate change discussion in Portugal, particularly taking into account the tools they will provide (BINGO). ClimAdaPT.Local will ensure that the principle of subsidiarity is adopted in the implementation process, especially in municipalities.

So, passing to an integrated national policy, building a network of operative interactions and guaranteeing the participation of all partners and stakeholders is needed.

Finally, it is necessary to emphasise that a consistent institutional reform of the water sector and water resources management must be implemented at the same time, restoring the ARH and a National Water Authority to water resources management, reversing what was changed by the former Portuguese government and designing a stable and sustainable model of water and sanitation services.

Working on at least these two strands and taking into account the framework of the 2015 Paris Agreement, already adopted by the Portuguese government, Portugal will be equipped to manage the challenges of climate change and the consequent vulnerability we will be faced with in the future.

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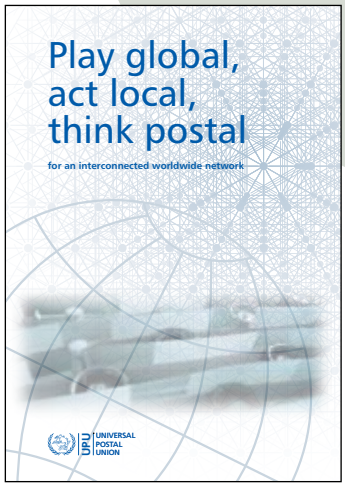


Requirements for sustainability

Cost recovery, further investment and asset management plans will ensure the long term development of Spanish water services

By Gari Villa-Landa Sokolov, Head of International Affairs, Spanish Association of Water Supply and Sanitation (AEAS) and Mariano Blanco Orozco, International Director of Customer Management, FCC Aqualia

Ever since the International Conference on Water and the Environment, held in Dublin in 1992, water has been considered an eco-social asset, satisfying economic, social and environmental functions. Currently, it is evident that integrated water resources management policies need to be implemented, including water demand policies.

Water tariffs

Water tariffs play an important role in water policy and governance. They provide an income to water operators to recover the costs of water services, promote efficient and sustainable water use from consumers and facilitate universal and equitable access to water and sanitation, provided they are clear and transparent.

Calculating a price that reflects the true value of water and contributes to the long term sustainable management of resources is critical, both for the effectiveness and integrity of water pricing systems.

In terms of regulatory principles, article 9 of the Water Framework Directive (WFD) establishes that:

- Member States shall take account of the principle of cost recovery of water services, including environmental and resource costs, having regard to the economic analysis conducted according to annex III of the WFD and in accordance with the Polluter-Pays Principle.
- Water pricing policies must provide adequate incentives for users to use water resources efficiently, contributing to the environmental objectives of the directive.
- An adequate contribution of the different water users (disaggregated, at least, into industry, households and agriculture) to the recovery of the costs of water services must be ensured.

The WFD links the Polluter-Pays Principle with cost recovery. In the WFD context, several water uses do not cause pollution *sensu stricto*, and as the WFD requires those who benefit from water services to cover the costs of these, the Polluter-Pays Principle should include the 'User-Pays'/ 'Beneficiary Pays' Principles as well.

Spanish regulation framework

In Spain, urban water supply and sanitation services are under municipal competency, as stated in Law 7/1985 Regulating the Basis of the Local Governance System, and these services can be managed directly or indirectly (having public direct management and delegated, both public and private, management). Regardless of the management model, tariffs must be approved by public administration. The most common way of approving the tariffs is via a joint action by the municipality and the Price Commission established by the regional government (the municipalities approve tariffs and the Price Commissions authorise price revisions) or through regional public bodies or regional governments.

The total domestic water bill usually includes all water supplied, taking into account service-related costs of collection (treatment and distribution of water) and sanitation (in which the costs of sewage and waste water treatment are considered, including regional fees for waste water treatment, for the management of waste water itself or financing waste water treatment plants) .

Cost recovery

The average price for domestic water in Spain is €1.78/m3 (€1.03/m3 for water supply and €0.75/m3 for sanitation). However, the price of urban water varies significantly between regional areas.

In fact, Spain has the most variable price in Europe, with differences of up to 500% between municipalities. Each municipality or urban water system has a specific cost-recovery system and, therefore, a different finance model in which the water tariff does not cover the same costs.

In Spain, the urban water sector is financed by the 3T model. This means:

- Taxes, imposed by local, regional and national authorities.
- Transfers, mainly allocated by the European Union.
- Tariffs, determined by the municipalities.

According to the Asociación Española de Abastecimientos de Agua y Saneamiento's (AEAS) *XIV National Study on Water Supply and Sanitation*, 84% of municipalities' tariffs cover all operating costs, including those associated with the operation of services and infrastructure maintenance and conservation. They do not cover investment in modernisation or improvements in infrastructure or equipment.

Where costs cannot be covered entirely by the tariffs, some entities receive subsidies, but according to AEAS's study, only 8% of service providers receive any subsidy to cover operating costs.

Another reason for obtaining grants is the need for investment in infrastructure and technology. As indicated in AEAS's study, 28% of respondents received subsidies from European funds and 39% from other funds. Regarding investment in new infrastructure or equipment for the supply of water, operators invest 12.5% of turnover. As for the investment in renovation, where the greatest share is also accounted for by the supply of water, operators spend 9.4% of turnover on renewal.

Although water tariffs are as diverse as existing services, in general, they have a common structure, being binomial and progressive. Tariffs are comprised of two components, a fixed one, and a variable one which depends on consumption and is progressive, following a block system of consumption with increasing prices (usually three or four blocks), with the aim of reducing the consumption of water and increasing the efficiency of water usage.

The WFD compels Member States to develop an economic analysis, including cost recovery of water services. According to the second planning cycle of River Basin Management Plans (RBMP), approved in 2016, the average rate of total cost recovery (including environmental costs) is around 65%,

The water purification plant at Venta Alta in Arrigorriaga, Bizkaia is one of Spain's largest water treatment plants, with a capacity of $7m^3$ a second.

which is insufficient. But there are significant differences in the degree of cost recovery among Spanish river basins. Several reasons can be identified for these differences:

- Investment and infrastructure maintenance costs of water services are usually subsidised, with only part of the total costs being charged to the end user through the tariff.
- There are difficulties in financing urban water services in small municipalities.
- RBMPs do not take the environmental and resource costs evenly or adequately into consideration.
- There is a political resistance to increase water tariffs.

According to the EEA Technical Report No.16/2013 *Assessment of Cost Recovery Through Water Pricing*, a water pricing system that meets the WFD requirements, as well as other social objectives, should consider the following features:

- The water tariff has fixed and variable parts and uses increasing block rates.
- Rates must be high enough to enable investment in efficient and environmentally sound improvements, innovation and the expansion of water services.
- Rates should be determined in a transparent and accountable way.

Water tariffs should be designed in order to achieve cost recovery, as well as incentive objectives.

Although currently the urban water services are satisfactory, they pose a number of challenges that should be addressed to ensure their sustainability, with the aim of improving the efficiency and universality of water services, securing the human right to water and meeting social demands of citizens.

Prices will need to increase gradually and progressively in the coming years to ensure a continued quality service and begin to correct the infrastructure deficit and the obsolescence affecting urban water services. They also need to comply with the EU's Urban Waste Water Directive (91/271/EEC) regarding waste water treatment in sensitive areas and small- and medium-sized agglomerations.

Asset renewal

After many years without adequate investment, the fallout of the economic and financial crisis and the dispersion of responsibilities and competencies, water infrastructure is ageing. We risk losing the current quality levels of water supply and sanitation services. It is also necessary to invest in new waste water treatment facilities that are capable of complying with EU legislation to protect and improve the environmental conditions of our water resources, such as the Urban Waste Water Treatment Directive.

It is, therefore, imperative to renew the great heritage of infrastructure and equipment that we have in Spain. But given the conditions of control and limitation of public debt due to the current economic and financial situation, it will be necessary to recover costs through water tariffs and to develop mechanisms of public-private partnerships to meet these objectives.

As mentioned earlier, tariffs paid by users do not cover the costs of urban water services. Current tariffs tend to cover the operating costs of the service but do not cover, in general, the amortisation of existing infrastructure or their renewal, nor the impact of new measures on improving the performance or quality of service and, hence, of water.

As indicated by the OECD in its report *Pricing Water Resources and Water and Sanitation Services*, cost recovery through tariffs is considered a significant driver of the financial sustainability of water operators because other financing instruments (taxes and transfers) are volatile and beyond the reach of the water community.

We tend to forget that the high level of development and population concentration require technological tools that need to be maintained, improved and adapted to increasing quality, safety and resilience, environmental protection and economic efficiency goals. That means investing in renovation, new equipment and contributing to their operation and routine maintenance. In that sense, we detect a tremendous gap between the value we give to water and the economic effort we are personally willing to make to ensure the sustainability of urban services.

Maintaining low water tariffs would lead to underfunded services, inadequate investment and ageing, inefficient infrastructures, which would deplete water resources, decrease the quality of water services and result in future users not being able to enjoy the same level of quality at a similar degree of affordability, as there would be a heavy burden of investment for future generations.

The users of water services must be charged the full cost of the service, thus allowing the costs to be recovered, and let water bills finance investments in water infrastructure.

But maintenance and the renewal of assets in water services needs to be developed in an effective and efficient way, to ensure the long-term sustainability of water utilities.

In this sense, a new systematic and structured approach is needed, which allows for the maintenance and renewal of assets at a manageable pace, while maintaining an adequate level of performance for those assets.

This approach is asset management, in which management of water utilities can assist in making better decisions on caring for the ageing assets, consisting of a set of procedures to manage assets through their life cycles, based on principles of life cycle costing. As the Asian Development Bank (ADB) indicates in its document *Water Utility Asset Management: a Guide for Development Practitioners*, poor asset management leads to: water losses; less than 24/7 water supply service and concerns over water quality; maintenance that mostly addresses breakdowns; and too high costs.

The Áramo Quiros waste water treatment plant at Oviedo in Spain has been built in a mountainous region and serves 300.000 people. Construction was completed in 2010.

In recent years, several guides have been developed regarding asset management, such as the previously mentioned ADB guide but also:

- *ISO 24516: Guidelines for Management of Assets of Water Supply and Wastewater Systems.*
- *International Infrastructure Management Manual* (IPWEA, 2011).
- *Implementing Asset Management: A Practical Guide* (AMWA *et al*, 2007).
- *Sustainable Infrastructure Management Program Learning Environment* (WRF and WERF, 2008).
- US Environmental Protection Agency's *Asset Management: A Best Practices Guide.*

Asset management has several benefits, such as prolonging asset life and aiding in rehabilitation/replacement decisions through efficient and focused operations and maintenance, helping to set rates based on sound operational and financial planning, focusing budgets on activities critical to sustained performance, meeting service expectations and regulatory requirements and improving responses to emergencies and the security and safety of assets.

Although asset management is still not a very extended practice in Spain, we do have some good practices in the sector, such as the Canal de Isabel II Gestión Renewal and Adaptation of Water Supply Networks Plan 2015-2019, the Consorcio de Aguas Bilbao Bizkaia Asset Management Plan in Udal Sareak, SA, FACSA's Renewal of Distribution Network in Concession Contracts Plan, Aljarafesa's Assets Renewal Strategy in a Community of Municipalities and Emasesa's Asset Renewal Strategy.

Conclusions

Our water services assets are ageing and a sustained investment effort is needed to maintain and renew the great heritage of infrastructure and equipment. We can't rely any longer on public administration subsidies (EU, national or regional) so significant progress needs to be made in order to advance in the cost recovery of water services, as established in the WFD. Service providers have to develop asset management plans to ensure the long term sustainability of water utilities and their cost should be defrayed via tariffs.

Transparency and awareness-raising regarding water tariffs and the need of covering costs of services by water tariffs are a challenge to be addressed immediately.

Certifiable sense

In Sweden, the circular economy is already a reality. The REVAQ certification system, which started in 2008, recycles nutrients back to agricultural land

By Anna Linusson, CEO and Anders Finnson, Senior Environmental Adviser, Svenskt Vatten

To ensure high quality digestate from the anaerobic digestion of sewage sludge in Sweden, REVAQ, a certification system, was established in 2008. REVAQ is operated by the Swedish Water & Wastewater Association, the Federation of Swedish Farmers, the Swedish Food Federation and the Swedish Food Retailers Federation, in cooperation with the Swedish Environmental Protection Agency.

Today, more than 50% of the population is connected to a waste water treatment plant (WWTP) that is certified through REVAQ and the number is growing. The work performed by certified WWTPs is focused on removing heavy metals and other contaminants before they reach the WWTPs, and ensuring the safe recycling of nutrients.

REVAQ-certified WWTPs

In 2008, the first 14 WWTPs were certified through REVAQ. Today, there are 42, and every year, more plants are joining. The plants certified through REVAQ ensure that:

- The quality of the incoming waste water is continuously improved.
- Information is available about the treatment methods used and the quality of the digestate.
- The quality of the digestate fulfils requirements.

Excellent phosphorous source

One of the main drivers behind the creation of REVAQ is to increase the recirculation of nutrients in our society (*Figure 1*). Special attention is given to phosphorous, a limited resource, but also to nitrogen, micronutrients and organic matter which are important components of fertilisers and which contribute to soil quality improvement.

Phosphorus is given special importance due to Europe's dependence on imported phosphate rocks. Today, mineral fertilisers containing 10.000 tonnes of phosphorus and manure containing 26.000 tonnes of phosphorus are used in the Swedish agricultural sector. In 2015, the REVAQ-certified digestate contained almost 3.000 tonnes of phosphorous, out of which 1.300 tonnes was used in the agricultural sector. If the entire Swedish population were to be connected to REVAQ-certified WWTPs and the acceptance for using WWTP digestate in agriculture further improved, more than 50% of mineral fertilisers could be replaced by digestate from WWTPs.

The future price of phosphorus and the volume of contaminants, such as cadmium, are expected to increase for mineral fertilisers due to reduced availability and quality phosphorous resources. The reasoning is that phosphorous rock is imported from outside the EU. It is a limited resource, polluted with cadmium, a hazardous substance.

There is no full-scale technology in place to remove cadmium from phosphorous rock. As supplies of phosphorous with low levels of cadmium run out, at the same time as the EU's new Fertilisers Regulation introduces maximum cadmium limits in mineral fertiliser, there will be two options:

1. Price increases as manufacturers turn to the limited reserves of phosphate rock with low levels of cadmium or producers of mineral fertilisers have to introduce technology to remove cadmium from the produced fertiliser.
2. Increase the recirculation of phosphorous in order to ensure future food production for the growing world population. If the proposed Fertilisers Regulation would open the market to the phosphorus contained in sewage sludge of good quality, regardless of its form (compost, digestate, struvite or ashes), we could certainly have a sustainable source of phosphorus for the farmers.

The urban water and nutrient cycles

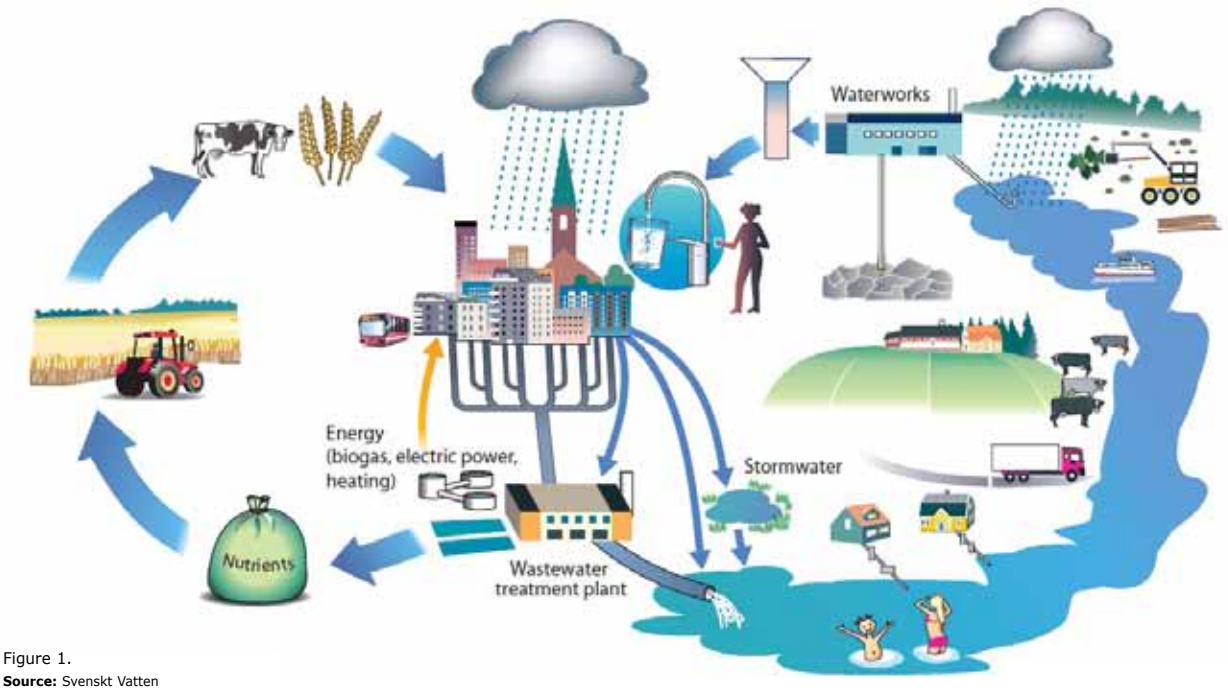


Figure 1.
Source: Svenskt Vatten

Cadmium: one of our main challenges

Finding and eliminating cadmium sources requires a lot of investigation but also information campaigns promoting better consumer behaviour; for example, on what can and cannot be flushed. Another example is the specific type of paints used by artists, which contain high levels of cadmium. A proposed ban on cadmium in hobby and artist paints failed this year, though information campaigns targeted artists who use these paints, making them aware of the problem and stating that they should no longer flush paint down the sink.

Removal of organic contaminants

The most efficient way to remove undesired organic substances from the sewage system is to encourage reduced usage of specific compounds at the source, e.g. industries and services, either by legislation or information, or both. In the long term, it is important to influence amendments to laws and regulations controlling what substances are allowed to be used by various industries and which eventually end up in WWTPs.

Certified WWTPs identify where undesired compounds are used, and in cooperation with local environment authorities, the identified industry actors take action so these compounds are removed from their process and from the sewage system.

The Swedish Chemicals Agency has a list of 2.500 substances whose use should be phased out by industry. The WWTPs also have the right to express their opinion when new companies apply to start up activities in their area so as to avoid the establishment of companies that will pollute sewage.

During 2015, most of these 2.500 substances were no longer used. The general impression from REVAQ's work is that cooperation with the industries causing the pollution in the first place usually goes a long way to solving the overall problem.

Conclusions

The Swedish REVAQ certification system was launched in 2008 to coordinate and strengthen the WWTPs' systematic work with control-at-source and the elimination of contaminant sources by laying down strict requirements on the reuse of nutrients in sludge on agricultural land.

REVAQ certification is the result of long term cooperation between stakeholders in agriculture, the food industry, retailers and the water sector. The REVAQ certification system has shown that it is possible to simultaneously build confidence, reduce contaminants and increase the recycling of nutrients and organic matter by implementing a transparent and goal-oriented cooperation between WWTPs and key stakeholders.

Toilet training

With the UK population on the rise, drainage systems are facing added pressure. Educating the public about 'toilet rules' – no wet wipes – is working

By Sarah Mukherjee, Director of Environment, Water UK

UK water consumers take it for granted that waste water will be disposed of appropriately. However, most people don't know what happens after they flush the toilet or pull the plug in their sinks.

Water operators have worked hard to reduce the likelihood of flooding and pollution from their sewer networks. While there is still much to do, we now have rivers abundant with life and bathing waters to be proud of. Clean beaches attract visitors and support communities, jobs and the economy.

This has all been possible because the UK water sector has invested £39bn (€45bn) over the last 25 years in improving the sewage system and more on maintaining the country's sewer network. Sixteen billion litres of waste water a day goes through 624.000km of sewers, 9.000 waste water treatment plants and about 15.000 combined sewer overflows (CSOs). The UK water sector plans to invest even more to further improve the sewer network.

Combined sewer systems

When the Victorians started to construct sewer systems to meet the needs of towns and cities, they built what we call 'combined sewers'. These transport sewage and surface water (mainly rainfall) to waste water treatment works for cleaning, before this water is returned to the natural environment.

These work well the majority of the time. But very heavy rainfall can rapidly increase the amount of water flowing through combined sewers. Sometimes, the amount of waste water collected exceeds the sewer capacity (something that may happen more often if we get the more intense rainfall that scientists predict). And sometimes sewers can back up because of blockages caused by people tipping fats and oils down the sink or flushing wipes and sanitary items that the sewers weren't designed to cope with.

The UK has seen a spate of major floods since the turn of the century. Very heavy rainfall creates havoc. Predicted climate change will mean more freak weather.

Combined sewer overflows

When sewers are overwhelmed, the excess water is channelled away from homes, businesses and land, avoiding flooding. This is currently done using combined sewer overflows (CSOs), which act as a relief valve. Overflow water is diluted by storm water within the sewer network at the time and further diluted by the flow in the streams and rivers they flow into, as these will also be swollen due to heavy rainfall. The water is screened, where necessary, to remove most of the plastics and other materials, which find their way into sewers and drains. If our sewer systems didn't have CSOs, more homes, businesses and land would flood.

When a few CSOs overflow, they can have a significant impact on the environment. Water operators are increasing investment in monitoring CSOs so they can better understand the effect they have on wildlife and find ways of dealing with the ones that have most impact on the environment.

CSOs are also regulated by the UK's environment regulators. But the heavy rain predicted by climate change scientists could mean that even these relief valves will not be able to cope.

Future challenges

Companies already face some large challenges and these will only increase. Water operators invest in the network so that the drainage system can meet these challenges in order to avoid flooding and pollution. These challenges include:

- Changing weather patterns due to climate change.
- New environmental standards to better protect and enhance our rivers and seas.
- Population and development growth and smaller household size. These will lead to more houses, roads and other developments being built. As a result, there will be fewer areas for water to soak away naturally and more water flowing straight into combined sewers.
- How best to inform customers about what the sewer network can carry – only toilet paper, pee and poo.
- Separating sewage from surface water in sewer pipes to reduce the risk of flooding.

By the 1850s, Thames water had become known as 'monster soup'. It was the Great Stink of 1858, which so upset the noses of British MPs, that led to the commissioning of Joseph Bazalgette's sewers.

And all this is set against customers' challenge to companies for better service at a lower cost.

Creative and innovative solutions

Upgrading the sewer network to accommodate these extra pressures is expensive. Water operators work hard, in partnership with regulators, local authorities and environmental and customer groups to get the right balance between reducing the risk of flooding and pollution and maintaining affordable bills.

We've moved on since Victorian times, developing creative and cost-effective ways of removing storm water from the sewer network to reduce the risk of flooding and pollution. For example, there are many of what we call 'sustainable drainage solutions' up and down the country, which soak rainwater away and slow it down, so it doesn't all get to the sewer at the same time. This can help reduce the number of CSO spills. These can include specially designed ponds, lakes, grassy areas and rainwater gardens. They can enhance local communities, provide havens for wildlife and, when they're installed in schools, are fun ways to teach children about the water cycle.

Working partnerships

Each of us is responsible for looking after the sewer network. Each of the 12 water operators in the UK have creative campaigns to inform customers about, for example, the importance of only flushing toilet paper, pee and poo down the loo and of not putting fats, oils and greases down sinks to prevent sewer blockages.

Operators also recognise that it's vital that they work in partnership with local authorities, regulators, customer groups, environmental charities, land owners and community partners.

With all this in mind, Water UK, the water industry trade association, has set up a programme board to review current practices and set out what research, engineering design changes, new regulatory controls and government policies we need to ensure that our drainage systems are fit for the future. This group of diverse partners includes environmental groups, engineers, regulators, government representatives, customer representatives, water companies and local authorities.

Together, we believe we can deliver affordable changes to our drainage systems, ready to meet challenges we face, now and in the future. We are working on research that will give companies the tools they need to plan the capacity of drainage systems and what we will need to do to in order to make them resilient. We have already had significant success with a clear message about wet wipes. It is early days, and a new way of working for us, but we are confident that it will deliver results to support our communities, the environment and the economy.

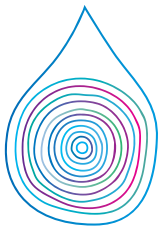
European water in numbers

Water is the most important shared resource. EurEau is fully committed to the continuous supply of clean water and the safe return of treated waste water into the water cycle. Our members actively protect the aquatic environment by providing and implementing solutions to water pollution and the impact of a changing climate. We promote public health and economic growth by ensuring the continuous supply of high quality water now and for future generations. We make a crucial contribution to supporting the EU economy.

- ~ 542.000 jobs in the water sector.
- ~ €82bn annual turnover.
- ~ €36bn invested annually to provide consumers with a safe, clean and secure infrastructure.
- ~ 51km³ of drinking water is produced each year, which is equal to the volume of Lake Garda.
- ~ There are 3 million km of sewers in Europe, which would get you to the moon and back four times.
- ~ 95% of people living in Europe are connected to drinking water services.
- ~ 86% of the European population are connected to waste water services.

Milestones in Europe's water policy

- ~ **1991 (91/271/EEC)**
  The Urban Waste Water Treatment Directive
  Regulates the discharge of municipal and some industrial waste water.
- ~ **1998 (98/83/EC)**
  The Drinking Water Directive
  Ensures the quality of drinking water at the tap.
- ~ **2000 (2000/60/EC)**
  The Water Framework Directive
  Lays down the principles and rules of water resource management.



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